

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

**Centre for Marine Science and Technology
Programme: UG Integrated Marine Science**

Vision of the University

- To provide quality education to reach the un-reached

Mission of the University

- To conduct research, teaching and outreach programmes to improve conditions of human living.
- To create an academic environment that honours women and men of all races, caste, creed, cultures, and an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity.
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development.
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

PREAMBLE

Under Graduate Integrated Marine Science deals with the study of marine animals specially the structural diversity, biology, embryology, habits and distribution of animals. As it covers a fascinating range of topics, the modern marine biologist needs to have insight into many disciplines. The learning outcomes-based curriculum framework for a B.Sc. degree in integrated marine science is designed to cater to the needs of students in view of the evolving nature of marine science as a subject. The framework is expected to assist in the maintenance of the standard of marine science degrees/programmes across the country by reviewing and revising a broad framework of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes. A comprehensive knowledge of structure-function relationship at the level of gene, genome, cell, tissue, organ, and systems, through development would further add to the knowledge base and the learning outcome in terms of editing of genes and genomes for industrial application and research purposes. Short dissertations could be designed around these problems to give them hands-on-training and equip them with skill sets of use in future, in the areas of applied aspects of marine science, including Aquaculture.

Programme Outcome

1. PO1 Disciplinary Knowledge

This programme offers knowledge on in the basic and advanced fields of the core zoology and applied disciplines particularly in marine science, for the fulfillment of professional requirements which enable them to apply solve the problems in marine science.

2. PO2 Communication Skills

Demonstrate communication skills, scientific writing and data recording abilities in all the fields of marine science. The communication skills of students may be enhanced by giving periodic assignments, writing of group project dissertation and presentation of group project results in viva-voce.

3. PO3 Critical Thinking

Capability for developing innovative and solution centered approach for handling any kind of problem and the paradigm of scientific temperament. The students get capability of critical thinking based on the contextual knowledge of living beings/organisms (marine organisms), non-living components and environmental basis of life, enabling them to critically analyse the day-to-day problems in aquaculture/mariculture.

4. PO4 Problem Solving

Understanding of the vital connections, within and among-the flora, fauna and the physical environment, enabling them to integrate and synthesize the acquired knowledge within their fields and beyond to identify, survey and analyze the problems in aquaculture/mariculture and solving them.

5. PO5 Analytical Reasoning

Knowledge about various core and advanced skills for theoretical and practical understanding of different descriptive and inferential statistical tools and techniques, practicals related to covering biodiversity, isolation, analysis and interpretation of marine based research and arriving valid conclusions in marine science.

6. PO6 Research Related Skills

One semester marine science research based group project involves ability to define problem, formulate the hypothesis, draw conclusions and report the results is included in the students' curriculum.

7. PO7 Co-operation / Team Work

Capable of working effectively in diverse teams in both classroom, laboratory and in industry and field-based situations. Team works among the students to establish marine based aquarium, live feed culture, sea-weed culture and ornamental fish breeding included in their curriculum create co-operation within student community.

8. PO8 Scientific Reasoning

Understanding the development of the applications of biological materials from marine environment in food, health, medicine and environment for sustainable development of the society.

9. PO9 Reflective Thinking

Understanding the development of the applications of biological materials from marine environment in food, health, medicine and environment for sustainable development of the society.

10. PO10 Information / Digital Library

Almost all the course in Marine Science teaching is based on knowledge dissemination involving ICT. For the project data analysis appropriate statistical analysis is recommended. Capable of using computers for Bioinformatics and computation and appropriate software for analysis of genomics and proteomics data, and employing modern bioinformatics search tools to locate, retrieve, and evaluate location and biological annotation genes of different species.

11. PO11 Self-directed Learning

Marine based project works, practicals and group works makes a self-directed approach among the student community.

12. PO12 Multicultural Competence

Marine based field visits, interaction with coastal people, sample collection to coastal areas, visit to national organization, and participation of international webinars create the multi-cultural competence among students.

13. PO13 Moral & Ethical Awareness / Reasoning

Capable of conducting their work with honesty and precision thus avoiding unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, and appreciating environmental and sustainability issues. Research ethics committee expects them to declare any type of conflict of interest that may affect the research. Any plan to withhold information from researchers should be properly explained with justification in the application for ethical approval.

14. PO14 Leadership Readiness / Qualities

Create start up/entrepreneurship based grouping of teams and inculcating of leadership qualities among students.

15. Life-long Learning

Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling. Establishment of marine research forum, invitation of alumni and exchange of knowledge among students creates life-long learning among students.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1:

Acquire knowledge on various groups of invertebrates and chordate related to its structure and functional characteristics and the sequential changes from cellular level of organization to organ grade of organization in the development of multicellular organisms.

PSO2:

Analyze the basic concepts of marine biodiversity, ecology, communities and its conservation also the history, classification, diversity and applications of microorganisms. Acquire knowledge about the fresh water, estuarine and marine fishes of India. Understand the different culture technologies for both inland and marine fishes. Acquire skill and knowledge on aquarium techniques for marine and fresh water ornamental fishes.

PSO3:

Assess the medicinal applications, embryogenesis, anatomy, physiology and tissue culture of cryptogams and phanerogams of plant community. Acquire knowledge on fundamentals of molecular techniques in biology and its applications

PSO4:

Acquire knowledge on the different functional aspects of higher animals. Understand the knowledge on cell organelles and their functions. Acquire knowledge on cellular components involved in immunity. Understand the basic phenomenon in genetics. Acquire knowledge on statistics, bioinformatics and their applications in biology.

PSO5:

Understand the basics of sericulture and its economic importance. Acquire knowledge on earthworm lifecycle, fertility, interaction with other organisms and the methodology of vermicompost and livefeed culture for mariculture.

PSO6:

Obtain knowledge on food processing and acquire knowledge on community health.

Eligibility for admission: A pass in +2 in Biology group (Physics, Chemistry, Biology/ Physics, Chemistry, Botany, Zoology/ Physics, Chemistry, Biology, Micro-Biology/ Physics, Chemistry, Biology, Bio-Chemistry) or Biology with vocational group (Botany, Zoology with Agriculture, Microbiology) or an equivalent programme of study recognized by the Government of Tamil Nadu.

UG Marine Science (Integrated)

I and II Semester

(Choice based credit system)

with effect from the academic year 2022-2023 onwards

Semester	Part I, II, III, IV & V	Subject status	Subject title	Hours/Week	Credits	Marks			Passing minimum
						Internal	External	Total	
I									
	I	Language	Tamil	4	4	25	75	100	50
	II	Language	Communicative English	4	4	25	75	100	50
	II	Language	Professional English – I (Add on course: compulsory)		4	25	75	100	50
	III	Core 1 - Theory	Animal Diversity – I Invertebrata	4	4	25	75	100	50
	III	Core 2 - Theory	Animal Diversity – II Chordata	4	4	25	75	100	50
	III	Major Practical - I	Practical - I (Core 1 & 2)	4	2	50	50	100	50
	III	Allied - Theory	Allied Chemistry - I	3	3	25	75	100	50
	III	Allied - Practical	Allied practical – I	4	2	50	50	100	50
	IV	Common paper	Environmental studies	2	2	25	75	100	50
					25				

Semester	Part I, II, III, IV & V	Subject status	Subject title	Hours/Week	Credits	Marks			Passing minimum
						Internal	External	Total	
II	I	Language	Tamil	4	4	25	75	100	50
	II	Language	Communicative English	4	4	25	75	100	50
	II	Language	Professional English – II (Add on course: compulsory)		4	25	75	100	50
	III	Core 3 - Theory	Developmental Biology	4	4	25	75	100	50
	III	Core 4 - Theory	Marine Ecology	4	4	25	75	100	50
	III	Major Practical - II	Practical -II (core 3 & 4)	4	2	50	50	100	50
	III	Allied - Theory	Allied Chemistry - II	3	3	25	75	100	50
	III	Allied - Practical	Allied practical – II	4	2	50	50	100	50
	IV	Common paper	Gender Equality and Social Development /Social Harmony	2	2	25	75	100	50
					25				

INTERNAL ASSESSMENT (Theory Courses - 25 marks) :

Each course has three internal assessments, each worth 20 marks. The average of the two best results from each of the three tests would be considered. For each course, the student should submit one 5-mark assignment & seminar.

EXTERNAL ASSESSMENT (Theory Courses - 75 marks):

Question Paper Pattern at end of each semester - University Examination Pattern

Sub. Code:

Title of the course

Semester:

Max. Marks : 75

Time : 3 hrs

Section–A (10 X 1 mark =10 marks)

Answer all the questions in one or two sentences

Section – B (5 X 5 marks = 25 marks)

Answer all the questions (minimum 200 words) by selecting either ‘a’ or ‘b’

Section – C (5 X 8 marks = 40 marks)

Answer all the questions (minimum 500 words) by selecting either ‘a’ or ‘b’

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester – I / Core-1
ANIMAL DIVERSITY - I – INVERTEBRATA**

ANIMAL DIVERSITY - I – INVERTEBRATA

Semester	I				
Course Type	Core Paper - 1				
Title of the Course	ANIMAL DIVERSITY - I – INVERTEBRATA				
Course Code	EMRC11				
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	ANIMAL DIVERSITY - I – INVERTEBRATA	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on molecular cell biology					
CODE:	ANIMAL DIVERSITY - I – INVERTEBRATA	L	T	P	C
		4	2	-	4
Course Objectives	<p>1. To elucidate the importance of taxonomy, to know the methods of nomenclature, to realize the differences between Protozoa and Metazoa</p> <p>2. To study the structure, functional organization, adaptations and the economic importance of lower and higher Invertebrates.</p> <p>3. Create awareness and concern towards importance of animal diversity for human survival and its socioeconomic significance.</p> <p>4. Nurture the skills of conducting scientific inquiry and experimentation in the field of animal diversity to acquire knowledge of fundamental concepts and theories of animal diversity.</p>				
Module-I:	Taxonomy, Kingdom: Protista & Phylum: Porifera			12hours	
<p>Taxonomy: Introduction to Principles of Taxonomy – Binominal Nomenclature. Kingdom-Protista: General Characters and classification up to classes: Mastigophora, Rhizophora, Ciliophora, Sporozoa and Mycetozoa with examples; Type study: <i>Paramecium</i>: morphology – nutrition – Osmoregulation – Excretion – Reproduction (binary fission and conjugation). General Topic: Life cycles of (a) Spirogyra (b) Euglina (c) malarial parasite.</p> <p>Porifera: General Characters and classification up to classes: Calcariae, Hexatinellidae, Demospongiae and Homoscleromorpha with examples; Type study: Scypha (Syeonsponge) – External morphology – Body wall – Reproduction. General topic: Canal system in sponges.</p>					
Module-II:	Phylum: Cnidaria, Ctenophora & Platyhelminthes			12hours	
<p>Cnidaria: General characters and classification up to classes: Hydrozoa, Scyphozoa and Anthozoa with examples; Type study:- Hydra – External Characters (structure of the colony) – life history. General Topics: Corals, Coral reefs and their significance.</p> <p>Ctenophora: Tentaculata and Nuda with examples.</p> <p>Platyhelminthes: General characters and classification up to classes: Turbellaria, Trematoda and</p>					

Cestoda with examples; Type study: <i>Liver fluke</i> - External morphology and life cycle of <i>Fasciola hepatica</i> . General topic: Parasitic adaptations of Platyhelminthes.		
Module-III:	Phylum: Nematoda & Annelida	12hours
<p>Nematoda: General characters and classification up to classes: Rotifera, Gastrotricha, Kinorhyncha, Nematomorpha and Nematoda with examples. Type study: <i>Ascaris lumbricoides</i> (Round worm): External morphology, life cycle, pathogeny. General Topic: Parasitic adaptations and control measures of Aschelminthes.</p> <p>Annelida: General characters and classification up to classes: Polychaeta, Oligochaeta, Hirudinea, Archiannelida, Echiuroidea, Sipunculoidea, Priapulida and Myzostomaria with examples. Type study: Nereis- External characters. General topics: Metamerism in Annelida and Feeding in Polychaetes.</p>		
Module-IV:	Phylum: Arthropoda	12hours
<p>Arthropoda: General characters and classification up to classes: Meristomata, Arachnida, Crustacea, Myriopoda and Insecta with examples. Type study: <i>Panurgus</i>: External characters- Appendages—compound eye -Reproductive system and Life cycle. General topic: Larval forms of crustacean, Mouth parts of insects.</p>		
Module-V:	Phylum: Mollusca & Echinodermata	12 hours
<p>Mollusca: General characters and classification up to classes: Aplacopora, Monoplacopora, Polyplacoda, Gastropoda, Scaphopoda, Pelicipoda, Cephalopoda with examples. Type study: <i>Sepia</i>: External characters – shell – mantle cavity – Anatomy, Digestive system and Reproductive system. General topic: Economic importance of Molluscs.</p> <p>Echinodermata: General characters and classification up to classes: Asterozoa, Ophiurozoa, Echinozoa, and Pelmatozoa. Type study: Star fish: External characters – Water vascular system. General topic: Larval forms of Echinoderms and their phylogenetic significance.</p>		
ReferenceBooks	<ol style="list-style-type: none"> 1. Verma P, S., Jordon E, L., 2018, Invertebrate Zoology, 14th Edition. S Chand Publishing 2. Kotpal R, L., 2019, Modern Text Book of Zoology: Invertebrates, 12th Edition. Rastogi Publications 3. Pechenik J, A., 2015, Biology of the Invertebrates, 7th Edition. Tata McGraw-Hill 4. Schierwater B., DeSalle R., 2021, Invertebrate Zoology: A Tree of Life Approach, 1st Edition. CRC Press 5. Barrington E, J, W., 2012, Invertebrate Structure and Functions. II Edition, EWP Publishers 6. Ruppert E, E., Fox R, S., Barnes R, D., 2003, Invertebrate Zoology: A Functional Evolutionary Approach. 7th Edition, Cengage Learning, India 	
Online tools and Web Resources	<ul style="list-style-type: none"> • https://swayam.gov.in/courses/animal-diversity • https://swayam.gov.in/courses/zoology • https://epgp.inflibnet.ac.in/ahl.php?csrnr • http://vle.du.ac.in/course/view.php?id 	

Suggested Activities:

- Assignments , Quiz, Flash cards, Field work and survey, Animals in nature /preserved specimens/models, Chart preparations, Discussions

Course Outcome

No	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO1	Acquire in-depth understanding of Principles of taxonomy and structural organization of Animal groups. Learn and apply taxonomic knowledge to identify and name organisms	K1, K2, K3
CO2	Acquire knowledge and appreciate the diversity of Invertebrates.	K1, K2, K4
CO3	Learn evolutionary relationships and phylogeny of non-chordates through functional and structural similarities. Compare and contrast the characteristic features of various phyla	K1, K2, K4, K5
CO4	Understand the economic importance of invertebrates and their significance in the ecosystem. Acquireskills of conducting scientific inquiry and experimentation in the field of animal diversity	K2, K3, K4, K5, K6
CO5	Create a Platform for shared learning through practical classes, class presentations and field projects. Learn to preserve, identify and classify organisms.	K3, K4, K5, K6

K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	M	L	L	L	M	L	L	L	M	L	L	L	L	L
CO2	H	M	M	L	L	M	L	H	H	L	M	L	L	L	L
CO3	H	H	M	L	M	M	H	H	H	M	M	H	M	M	M
CO4	H	M	M	H	H	H	H	H	H	L	M	H	M	H	H
CO5	H	M	H	H	H	H	H	M	M	M	M	H	H	H	H

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	L	L	L	L	L
CO2	H	M	M	M	M	M
CO3	H	M	M	M	M	M
CO4	M	M	M	M	H	M
CO5	M	H	H	H	M	H

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester – I / Core-2

ANIMAL DIVERSITY – II: CHORDATA

ANIMAL DIVERSITY–II CHORDATA

Semester		I Semester			
Course Type		Core 2			
Title of the Course		ANIMAL DIVERSITY–II CHORDATA			
Course Code					
Teaching Hours		60 Hours/ Semester : 4 Hours/ week			
	ANIMAL DIVERSITY–II CHORDATA	Credits: 4	Max. Marks: 100 (Internal: 25, External 75)		
Course Prerequisites: Students must have a basic knowledge on animal diversity– chordata					
CODE:	MARINE ECOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	1. To exemplify the intermediary position of Prochordates between invertebrates and vertebrates 2. To study the structure, functional organization, adaptations and the economic importance of lower and higher chordates with special reference to marine organisms.				
Module 1	INTRODUCTION TO CHORDATA	12 hours			
Introduction to Chordata: General characters (Diagnostic characters and additional characters) and Classification up to classes with examples. Prochordates: Hemichordata, Urochordata, Cephalochordata with examples. General characters and classification up to orders with examples. Type study: Ascidian - External features-Digestive and Excretory system External features and biological significance of Balanoglossus Agnatha: Ostracodermi, Cyclostomata. Petromyzon- External morphology; Ammocoetes Larva. General topic: Origin of Vertebrates.					
Module 2	PISCES	12 hours			
Pisces: Gnathostomata, Placodermi, Chondrichthyes, Osteichthyes with examples. General characters and classification up to sub-classes with examples Type study: Scoliodon (shark) -External characters- Placoid scales-Digestive system-Respiratory system-Receptor Organs- Urinogenital system. General topics: (i) Economic importance of fishes. (ii) Reproductive organs in fishes (iii) Fish breeding					
Module 3	AMPHIBIA, REPTILIA	12 hours			
Amphibia: Labyrinthodontia, Lepospondyli, Phyllospondyli, Apoda, Urodela, Anura with examples. General characters and classification up to orders with examples. External features and biological significance of the following examples: Type study: <i>Rana hexadactylata</i> (Green frog)					

<p>General topic: Parental care in Amphibians Reptilia: Anapsida, Parapsida, Diapsida, Synapsida with examples General characters and classification up to orders with examples Type study: Turtle General Topics: (i) Identification of poisonous and non-poisonous snakes of South India (ii) Poison apparatus- Biting mechanism- venom- First aid for snake bite-Antivenom.</p>		
Module 4	Birds	12 hours
<p>Birds:- Archaeornithes, Neornithes with examples General characters and classification up to subclasses with examples. Type study: <i>Columba livia</i> (Pigeon)-External characters-Flight muscles - Digestive system-Respiratory system-Urinogenital system General topics: (i) Migration of Birds (ii) Flight adaptations in Birds (iii) Beaks and feet in Birds.</p>		
Module 5	Mammalia	12 hours
<p>Mammalia: Protheria, Metatheria, Eutheria with examples General characters and classification up to subclasses with examples. Type study: Rat –External morphology – Digestive system – Respiratory system- Heart-Structure of Brain- Reproductive system. General topics: (i) Aquatic mammals (ii) Placentation in mammals (iii) Stomach in mammals</p>		
References	<ol style="list-style-type: none"> Alexander, R.M. The Chordates Cambridge University Press. Bhamrah, H.S. <i>et al.</i> A text book of chordates.Anmol publication Limited, 4374/4B Ansari Road,Daryaganj, New Delhi 110002. Ekambaranatha Ayyar,M. and T.N.Ananthakrishnan. A Manual of Zoology Vol.II(chordate).S.Viswanathan (Printers and Publishers)Pvt.Ltd.,Chennai. Jordan E.L. and P.S Verma.Chordata Zoology (11th Edition).S.Chand and Company Limited,7361 Ram Nager,Qutab Road,New Delhi-110 055. Kardong, K. Vertebrates:Comparative Anatomy, Function, Evolution. Tata Mc Graw Hill publishing Company Limited,444/1.Sri Ekambara Naicker Industrial estate, Alapakkam, Porur, Chennai-600 116. Kotpal.R.L.Modem Text Book of Zoology-vertebrates.Rastogi Publications, Gangotri,Shivaji Road,Meerut-250 002. Kulshrestha,S.K.Comparative Anatomy of Vertebrates,Anmol Publishers a.Private limited,4374/14B,Ansari Road,Daryaganj.New Delhi-110 002. Mahanta Rita and I,K.Bhattacharyya.Vertebrate Zoology,Kalyani publishers,B-1/1299,Rajinder Nagar,Ludhiana-141008. Nigam,H.C.Biology of Chrodates.Vishal Publishing Company,Books Market,Old Railway Road,Jalandhar-144008. Pough,R.H., C.M.Janis and J.B. Heiser. Vertebrate life.Pearson Education (Singapore) Pvt.Limited;Indian Branch-482 FIE Patpaganj,Delhi-110092. Prasad, S.N.and Kashyap Vasantika,P.Text Book of Vertebrate Zoology,New Age International publishers,4835/24 Ansari Road,Daryaganj,New Delhi-110002. Young,J.L.Life of Vertebrates.Oxford at the clarendon press,London. 	

Course Outcome

No	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO1	Acquire in-depth understanding of Principles of taxonomy and structural organization of Chordata groups, Prochordates and Agnatha	K1, K2, K3
CO2	Acquire knowledge on pisces and General characters and classification.	K1, K2, K4
CO3	Learn evolutionary relationships of amphibia and reptilia through functional and structural similarities.	K1, K2, K4, K5
CO4	Acquire knowledge on birds and General characters and classification.	K2, K3, K4, K5, K6
CO5	Students will get deeper Understanding on organisation and functional aspects of mammalia.	K3, K4, K5, K6

K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	M	L	L	L	M	L	L	L	M	L	L	L	L	L
CO2	H	M	M	L	L	M	L	H	H	L	M	L	L	L	L
CO3	H	H	M	L	M	M	H	H	H	M	M	H	M	M	M
CO4	H	M	M	H	H	H	H	H	H	L	M	H	M	H	H
CO5	H	M	H	H	H	H	H	M	M	M	M	H	H	H	H

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	L	L	L	L	L
CO2	H	M	M	M	M	M
CO3	H	M	M	M	M	M
CO4	M	M	M	M	H	M
CO5	M	H	H	H	M	H

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester – I / Core-1,2
MAJOR PRACTICAL I –ANIMAL DIVERSITY - I – INVERTEBRATA, ANIMAL
DIVERSITY – II**

ANIMAL DIVERSITY - 1 – INVERTEBRATA, ANIMAL DIVERSITY – II

Semester	I				
Course Type	MAJOR PRACTICAL				
Title of the Course	ANIMAL DIVERSITY - I – INVERTEBRATA, ANIMAL DIVERSITY – II				
Course Code					
Teaching Hours	4 Hours/ Week				
	ANIMAL DIVERSITY - I – INVERTEBRATA, ANIMAL DIVERSITY – II	Credits: 2	Max. Marks: 100		
Course Prerequisites: The students should know the basics of animal kingdom and classification.					
CODE:	ANIMAL DIVERSITY - I – INVERTEBRATA, ANIMAL DIVERSITY – II	L	T	P	C
			-	2	2
Course Objectives	<ol style="list-style-type: none"> 1. To dissect and mount– shark placoid scales, fish/frog arterial system, brain, reproductive system . 2. To identify museum specimens with various phyla. 3. To identify various kinds of wetland birds. 4. To undertake field visits for better understanding about the subject. 5. To visit zoo and aquarium for better understanding about the subject 				

Course Outcomes (COs):

After the Completion of the Course, the student will be able to

	Course Outcomes	Cognitive Level
CO1	Learn to preserve, identify and classify organisms (Understand/Apply/ Analyze) Understand the anatomy of Invertebrates (Understand)	K1,K2
CO2	Create models and charts (Create) Undertake field visits and projects related to taxonomy (Create)	K1, K2,K3
CO3	Analyze and dissect shark placoid scales, fish/frog arterial system, brain, reproductive system .	K3,, K5
CO4	Understand the knowledge on museum specimens with various phyla. Acquire knowledge on wetland bird and its types.	K2, K3
CO5	Acquire knowledge marine biodiversity by undergone field visit. Obtain knowledge by visiting zoo and Aquarium.	K2, K4, K5

K1- Remember; K2- Understand; K3- Apply; K4- Analyze; K5- Evaluate; K6- Create

Syllabus

Animal diversity–II chordata

1. Dissection and mounting – shark placoid scales, fish/frog arterial system, brain, reproductive system (demonstration only)
2. Museum specimens – slides/models/charts, Amphioxys, Balanoglossus, Asidians, Pelromyzon, Hippocampus, Rachophorus, Ambystoma, Chameleon, Cobra, Kingfisher, Bat.
3. Identification of wet land birds
4. Field visit – biodiversity study of different places in peninsular coast, gulf of mannar biodiversity
5. Visit to Zoo and Aquarium

Animal diversity - I - invertebrata

1. Dissection and mounting – cockroach/Peneaus/Pila/Silk worm – nervous system, digestive system, trachea, salivary apparatus.
2. Museum specimens / slides/ models/ charts – Paramacium, plasmodium, Euglena, Obelia colony, Ascaricus male & female, Earthworm, honey bee, Naupilus, Mysis, Zoea, corals, sponges, sepia, loligo, octopus, sea cucumber, starfish, polychaetes.

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester – I /Allied

Allied Paper – I

Allied Chemistry - I

Allied Practicals - I
Quantitative Analysis

**MSU/ 2022-23 / CMST-Integrated UG Marine Science/ Semester – II / Core - 3
DEVELOPMENTAL BIOLOGY**

DEVELOPMENTAL BIOLOGY

Semester	I				
Course Type	Core 3				
Title of the Course	DEVELOPMENTAL BIOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	DEVELOPMENTAL BIOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External 75)		
Course Prerequisites: The student should possess basic knowledge on male and female gametes, fertilization and embryo development. They may have the cellular events taking place in fertilized egg like cleavage, blastulation and gastrulation. May have knowledge on types of reproduction including sexual and asexual reproduction.					
CODE:	DEVELOPMENTAL BIOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	1. To understand the sequential changes from cellular grade of organization to organ grade of organization in the development of multicellular organisms.				
Module 1	BASIC CONCEPTS OF DEVELOPMENT	12 hours			
History and basic concepts of Development -Definition and Scope of Gametogenesis – Spermatogenesis – Oogenesis – Vitellogenesis - Structure of Sperm and Egg. Fertilization: Pre and Post fertilization events – significance; Parthenogenesis.					
Module 2	STAGES OF DEVELOPMENT	12 hours			
Stages of development – Zygote – Blastula, Gastrula, Neurula - Cell fate commitment – Potency – Concept of embryonic stem cells – Lineages of 3 germ layers – fate map – Germ cell speciation and migration – Eg. Chick / Frog / Zebrafish.					
Module 3	MORPHOGENESIS AND ORGANOGENESIS IN ANIMALS	12 hours			
Early development – Cleavage- Gastrulation – Axis specification – Dorsoventral and exterior posterior, Body plan patterning					
UNIT 4	LATE DEVELOPMENT	12 hours			
Late development - Organogenesis – Eg. Rat. Development of eye, ear, heart and brain. Metamorphic events in frog and its hormonal regulation.					
Module 5	IMPLANTATION OF EMBRYO & ASSISTED REPRODUCTIVE TECHNOLOGIES	12 hours			
Implantation of embryo in humans, placenta in humans and its function, manipulation of reproduction in humans – infertility (Male and Female), IUI , IVF, Artificial insemination , test tube babies, Amniocentesis. Birth control, contraceptive devices- surgical and hormonal methods.					

**References
Books**

1. Arora, M.P. Embryology. Himalayan Publishing House, Ramdoot, Dr. Bhalero Marg (Kelewadi) Girgaon, Mumbai – 400004.
2. Arumugam, N. Developmental Biology. Saras Publications, 114/35G, A.R.P camp Road, Nagercoil.
3. Balinsky, B.J. Introduction to Embryology, W.B. Saunders, Philadelphia, USA.
4. Berry, A.K. An Introduction to Embryology, EMKAY Publications, Post Box No. 9410, B-19 East Krishna Nagar, Swami Payanand Marg, Delhi – 110 051.
5. Beryl, N.J. Developmental Biology, Tata McGraw Hill Publishing Company Limited, 444/1 Sri Ekambara Naicker Industrial Estate, Alapakkam, Porur, Chennai -600 116.
6. Developmental Biology: R.M. Twyman. Bios scientific publishers, Ltd. New Delhi (2001).
7. Diwan, A.P. Mammalian Embryology, Anmol Publications Private Limited, 4374/4B Ansari Road, Daryaganj, New Delhi-110 002.
8. Diwan, A.P. Avian Embryology, Anmol Publications Private Limited, 4374/4B Ansari Road, Daryaganj, New Delhi-110 002.
9. Gilbert, Developmental Biology, ANE Books India, Avantika Niwas, 19, Doraiswamy Road, T. Nager, Chennai-600 017.
10. Goel, S.C. Principles of Animal Developmental Biology, Himalaya Publishing House, Ramdoot, Dr. Bhalerao Marg (Kelewadi) Girgaon, Mumbai – 400 004.
11. Jain, P.C. Elements of Developmental Biology (Chordate Embryology). Vishal Publishing Company, Books Market, Old Railway Road, Jalandhar – 144 008.
12. Jangir, O.P. Developmental Biology – A Manual. Agrobios (India), Behind Nasrani Cinema, Chopasani Road, Jodhpur – 342 002.
13. Nelson, E. Comparative Embryology of Vertebrates. Tata McGraw Hill Publishing Company Limited, No. 444/1 Sri Ekambara Naicker Industrial Estate, Alapakkam, Porur, Chennai – 600 116.
14. Ramesh Mathur and Meenakshi Metha. Embryology. Anmol Publications Private Limited, 4374/4B, Ansari Road, Daryaganj, New Delhi – 110 002.
15. Rao, K.V. Developmental Biology. A Modern Synthesis. Oxford & IBH Publishing Company Private Limited, S-155 Panchshila Park, New Delhi 110017.
16. Sastry, K.V. and Vineeta Shukul, Developmental Biology Rastogi Publications Gangotri, Shivaji Road, Meerut-250 002.
17. Slack, Essential Developmental biology. ANE Books India. Avantika Niwas, 19, Doraiswamy Road, T. Nager, Chennai-600 017.
18. Subramomam, T. Developmental Biology. Narosa Publishing House Private Limited, 35 – 36 Grams Road, Thousand Lights, Chennai – 600 006.
19. Verma, P.S. and V.K. Agarwal. Chordate Embryology (10^h Edition). S. Chand & Company Ltd. 7361 Ram Nagar, Qutab Road, New Delhi – 110055.

Course Outcomes

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

Course Outcomes		Cognitive Level
CO1	Know the basic concepts of developmental biology such as Gametogenesis, Spermatogenesis, Oogenesis, Vitellogenesis.	K1, K2
CO2	Understand about the Stages of development such as Zygote, Blastula, Gastrula, Neurula and Lineages of 3 germ layers	K2, K3
CO3	Know the sequential development of Cleavage- Gastrulation – Axis specification, Dorsoventral and exterior posterior, Body plan patterning	K2, K3
CO4	Know about other types of developments such as late development and Organogenesis.	K2, K3
CO5	Acquire knowledge on placenta in humans and its function, manipulation of reproduction in humans.	K2, K3

K1 –Remember, K2 –Understand, K3 –Application, K4 –Analysis, K5 – Evaluate, K6 – Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	M	L	M	L	L	L	M	M	L	H	L	M	L	M
CO2	L	L	H	L	H	M	L	L	M	L	L	L	L	L	M
CO3	L	M	L	M	L	M	L	M	M	L	M	H	M	L	L
CO4	L	M	H	L	H	L	L	L	H	L	H	L	L	L	L
CO5	H	L	L	H	L	M	L	H	L	L	L	L	L	L	M

H – High, M – Medium, L - Low

Mapping of CO with PSO

	PO1	PO2	PPO3	PO4	PO5	PO6
CO1	M	L	L	L	M	L
CO2	L	H	L	L	L	M
CO3	M	L	M	M	L	L
CO4	L	H	L	L	M	M
CO5	M	H	L	L	L	L

H – High, M – Medium, L - Low

MSU/ 2022-23 / CMST-Integrated UG Marine Science/ Semester – II / Core - 4

MARINE ECOLOGY

Semester		II Semester			
Course Type		Core Compulsory Paper - 4			
Title of the Course		MARINE ECOLOGY			
Course Code					
Teaching Hours		60 Hours/ Semester : 4 Hours/ week			
	MARINE ECOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External 75)		
Course Prerequisites: Students must have a basic knowledge on marine habitat					
CODE:	MARINE ECOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	<ul style="list-style-type: none"> To introduce the organisms, habitat and ecosystem that makeup marine realm – to understand the marine biodiversity, ecology, communities and marine conservation. Students will be given field experience and conduct biodiversity studies of different marine ecosystem and conservation projects. 				
Module 1	Marine Ecosystem			12 hours	
Marine environment ecological factors- light, temperature, salinity, pressure. Classification of marine environment – pelagic environment- planktonic and nektonic adaptations. Benthic environment – internal, interstitial and deep sea adaptation.					
Module 2	Diversity and symbiosis			12 hours	
Marine Biodiversity – Photosynthetic communities – Seaweed, Seagrass, mangroves, phytoplanktons, Chemosynthetic ocean communities – marine herbivores, marine detritivores. Animal association in marine environment – endocism, inquilinism, phoresis, epizoism, mutualism, commensalism, symbiosis, parasitism – Marine zoogeography with reference to Indian, Artic and Antarctic oceans.					
Module 3	Food chain and web			12 hours	
Marine ecosystem concepts, principal components – marine food chains – trophic structure - food web- ecological pyramids – energy flow – evolution and management system – Competition and succession – Intra and interspecific competition.					
Module 4	Population Ecology			12 hours	
Population ecology – Group attributes – population growth – density variations, concept of carrying capacity – Dispersal, prey-predator relationship – density dependent and independent factors.					
Module 5	Marine habitats			12 hours	
Ecology of coastal marine communities – Estuaries and salt marsh communities – Mangrove, coral reef, sea grass, soft-sediment – Rocky sediment – intertidal and subtidal – Threats to marine ecosystem – Pollution, overexploitation, habitat destruction – Conservation – Laws, CITES, In situ/ex situ conservation.					
References	<ol style="list-style-type: none"> Arora, M.P., 2009, Ecology, Himalaya Publishing House, Ramdoot. Clarke, G.L., 1965, Elements of Ecology, John Wiley & Sons Inc. New 				

	<p>York.</p> <p>3. Junega Kavita, 2004, Ecology, Anmol Publications Private Limited, New Delhi.</p> <p>4. Kotpal, R.L and N.P. Bali, 2018, Concepts of Ecology, Vishal Publishing Company, Jalandhar.</p> <p>5. Madhab C. Dash, 1993, Fundamentals of Ecology, Tata McGraw Hill Publishing Company Limited, Chennai.</p> <p>6. Odum, E.P., 1971, Fundamentals of Ecology, International Student Edition, W.B. Saunders Company, Philadelphia, USA.</p> <p>7. Purohit, S.S., Agarwal, A.K., 2014, Ecology and Environmental Biology, Student Edition, Agrobios, India.</p> <p>8. Purohit, S.S., 2017, A Text book of Environmental Science, Student Edition, Agrobios, India.</p> <p>9. Singh, H.R. and Neeraj Kumar, 2014, Ecology and Environmental Science, Vishal Publishing Company, Jalandhar.</p> <p>10. Singh, S.P., 2021, Animal Ecology, 6th Edition, Rastogi Publications, Meerut.</p> <p>11. Verma, P.S. and Agawal, 1986, Environmental Biology, S. Chand & Co Ltd.</p>
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Course Outcomes

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

Course Outcomes		Cognitive Level
CO1	Understand the marine environment, the factors affecting marine environment, and the classification of marine environment	K1, K2
CO2	Understand the biodiversity in the marine environment and their interactions, different types of associations within the marine animals and the zoogeography of the major oceans of the world	K2, K3
CO3	Understand the marine ecosystem, the components of marine ecosystem, energy flow, food chain, food web etc	K2, K3
CO4	Understand the population ecology, the concepts and factors affecting population ecology	K2, K3
CO5	Understand the different marine communities such as coastal, estuary, salt marshes, mangrove, coral reef, rocky sediments, their threats and conservation.	K2, K3

K1 –Remember, K2 –Understand, K3 –Application, K4 –Analysis, K5 – Evaluate, K6 – Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	M	H	M	H	M	L	M	M	H	H	H	M	L	M
CO2	H	M	H	M	H	M	L	M	M	H	H	H	M	L	M
CO3	H	M	H	M	H	M	L	M	M	H	M	H	M	L	L
CO4	H	M	H	M	H	M	L	H	H	H	H	H	M	L	L
CO5	H	M	H	H	H	M	L	H	H	H	H	H	M	L	M

H – High, M – Medium, L - Low

Mapping of CO with PSO

	PO1	PO2	PPO3	PO4	PO5	PO6
CO1	M	H	L	L	L	L
CO2	M	H	L	L	L	L
CO3	M	H	L	L	L	L
CO4	M	H	L	L	L	L
CO5	M	H	L	L	L	L

H – High, M – Medium, L - Low

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester – I / Core-3,4
MAJOR PRACTICAL 2 – Developmental Biology, Marine Ecology**

DEVELOPMENTAL BIOLOGY, MARINE ECOLOGY

Semester	I Semester				
Course Type	Practical				
Title of the Course	DEVELOPMENTAL BIOLOGY, MARINE ECOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	MARINE ECOLOGY	Credits: 2	Max. Marks: 100 (Internal: 50; External: 50)		
Course Prerequisites: The students should have a basic idea on marine organisms, environment etc					
CODE:	DEVELOPMENTAL MARINE ECOLOGY	L	T	P	C
		-	-	2	2
Course Objectives	<ul style="list-style-type: none"> • To get a skill about the collection and identification of specimens in different marine communities • To get an idea and methods for the collection and mounting of marine phytoplanktons and zooplanktons • To determine the ecological factors affecting the marine environment • To find the different association between the marine animals • To get skills about the mounting and observation of live specimen • To get an idea and methods for the Isolation of fish embryo 				

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

Course Outcomes		Cognitive Level
CO1	Understand and get the skill to collect and identify the organisms from different zones of marine environment Determine various chemical and physical ecological factors affecting the marine environment	K2, K3, K4
CO2	Different animal association with in marine environment. Students will acquire knowledge about collection and mounting of Phyto & Zoo plankton specimen	K2, K3, K4, K5
CO3	Students will acquire knowledge about mounting and observation of Live sperm and egg of a vertebrate	K2, K4
CO4	Students will get an idea and methods for the Isolation of fish embryo	K1, K2,K3
CO5	Students will also be exposed to make Models & Charts: Secchi disc, grab sampler, water sampler, plankton net.	

K1– Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 – Create

Syllabus

Developmental biology

1. Mounting and observation of Live sperm and egg of a vertebrate
2. Isolation of zebrafish embryo
3. Zebrafish staging
4. Organogenesis in zebrafish
5. Staging of zebrafish for somite and motor neuron development.
6. Museum specimens / slides/ models/ charts – sperm, ovum, chick embryo, 24, 48, 72, 96 hours.
7. Placenta in mammals – Discoidal, cotyledonary, zonary placenta, diffuse placenta.

Marine Ecology

1. Identification of intertidal species and distribution pattern in intertidal zone – specimen preservation & submission
2. Plankton collection and mounting – Phyto & Zoo plankton
3. Determination of temperature, salinity and dissolved oxygen
4. Museum specimen slides, models and charts – Secchi disc, grab sampler, water sampler, plankton net.
5. Mutualism (hermit crab & sea anemone), Commensalism (Echeneis & Shark), Parasitism (Sacculina & Crab), predation – cyclomorphosis (Daphnia)
6. Marine ecosystem, food chain and food web(chart)
7. Study tour (compulsory) – mangroves & coral reef ecosystem – observation and study of organism in their natural habitat

*students should write an illustrated study tour report and same to be submitted for evaluation at the time of practical examination (5 marks)

MSU/ 2022-23 / CMST-Integrated UG Marine Science/ Semester – II / Allied

Allied Paper – II

Allied Chemistry

Allied Practical - II

Organic Analysis Qualitative

MSU/ 2022-23 / CMST-Integrated UG Marine Science/ Semester – II / Common paper

**GENDER EQUALITY & SOCIAL DEVELOPMENT / SOCIAL HARMONY
PART – IV (SEMESTER - II)**

GENDER EQUALITY & SOCIAL DEVELOPMENT

SOCIAL HARMONY

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Centre for Marine Science and Technology

UG Marine Science (Integrated)

(Choice based credit system)

III and IV Semester

(With effect from the academic year 2022-2023 onwards)

Semester	Part I, II, III, IV & V	Sub .No.	Subject Status	Subject Title	Course/ paper	Hrs./ week	L Hrs/ week	T Hrs/ week	P Hrs/ week	C Credits
III	I	17	Language	Tamil /Other Languages		4	4	-	-	4
	II	18	Language	English		4	4	-	-	4
	III	19	Core -5	Molecular Cell Biology		4	4	-	-	4
	III	20	Major Practical - III	Practical: Molecular Cell Biology		4	-	-	4	2
	III	21	Allied - III	Allied Botany 1		3	3	-	-	3
	III	22	Allied – Practical III	Practical: Allied Botany 1		4	-	-	4	2
	IV	23	Non Major Elective - I	Aquarium Technology and Management (Or) Post harvest technology		2	2	-	-	3
		24	Mandatory paper	Yoga		2	2	-	-	2
				Subtotal		27	19	-	8	24
IV	I	25	Language	Tamil /Other Languages		4	4	-	-	4
	II	26	Language	English		4	4	-	-	4
	III	27	Core 6	Microbiology and Immunology		4	4	-	-	4
	III	28	Major Practical - IV	Practical : Microbiology and Immunology		4	-	-	4	2
	III	29	Allied - IV	Allied Botany 2		3	3	-	-	3
	III	30	Allied Practical- IV	Practical: Allied Botany 2		4	-	-	4	2
		31	Non major	Vermitechnology (Or)		2	2	-	-	3

			Elective - II	Sedimentology						
		32	Mandatory Paper	Computers for Digital Era		2	2	-	-	2
	IV	33	Extension activity	NCC,NSS,YRC, YWF		-	-	-	-	1
				Subtotal		27	19	-	8	24

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –III / Core/Ppr-5
MOLECULAR CELL BIOLOGY**

Semester	III				
Course Type	Core Paper - 5				
Title of the Course	MOLECULAR CELL BIOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	MOLECULAR CELL BIOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on molecular cell biology					
CODE:	MOLECULAR CELL BIOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	To enable the students to acquire knowledge on organisational arrangements of cellular organelles of prokaryotes and eukaryotes, their structural setup and their biological functions				
UNIT-I:	CELL TYPES			10 hours	
Cell types – Prokaryotic and Eukaryotic, Microscopy – detailed study of compound microscope, phase contrast and electron microscope. Cytological techniques : Fixation and staining – types of stains.					
Module-II:	ULTRASTRUCTURE OF CELL ORGANELLS			10 hours	
Ultrastructure and functions of the following cell organelles: Plasma membrane, mitochondria, golgi apparatus, endoplasmic reticulum, ribosomes, lysosomes and centriole.					
Module- III:	NUCLEAR COMPONENTS			12 hours	
Nuclear components: Ultrastructure and functions of nucleus, nuclear membrane, nucleolus, Chromosomes and their types. Cancer cells and Carcinogenesis: Definition, types, causes, properties and treatment, oncogenes and cell signaling.					
Module- IV:	DNA			14 hours	
DNA: DNA as genetic material, Base pairs, constancy of DNA structure and Replication, Hybridization, Cell division – mitosis & mitotic apparatus, Meiosis & Synaptonemal complex. DNA as a tool in taxonomy. Mitochondrial DNA and DNA barcoding of Marine animals.					
Module- V:	RNA			14 hours	
Different types of RNA, transcription, functional unit of gene, promotergene, coding sequences, processing of ribosomal RNA, inhibitors of transcription various steps in protein synthesis. Genetic code – Codons , anticodons and control of gene expression.					

ReferenceBooks	1. Cell Biology (ELBS CAMLOT Press), Ambrose, E.J & Dorothy, M.E 2. Cell & Molecular Biology, (W.B. Saunders & co. Philadelphia): De Robertis & De Robertis 3. Cell Biology (W.B.Saunders & Co, Philadelphia): Dr. Robertis, E.D.P, Nowinski, W.N & Saez, F.A 4. Cell& Molecular Biology (Academic press, New York): Dupraw, E.J 5. Essentials of Cell Biology (Allyn & Bacon Inc, Boston). Giese. A.C 6. Cell Physiology (WB.Saunders & co, Philadelphia): Dyson, R.D 7. Elements of Cytology (Feeman Book co, Kamia Nager, New Delhi): Norman. S.Cohn 8. The Cell (Prentice Hall Inc., Engle Wook Cliffs, New Jersey), Swanson, C.P & Webster, B
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Course Outcome

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Students will understand Cell types and Inculcate knowledge on working principles of microscopes, Cytological techniques, staining and identification of cell types	K1,K2,K3
CO 2	Students will get deeper Understanding on organisation and functional aspects of cellular organelles.	K1,K2,K3
CO 3	Students will be able to understand the ultra structure and functions of Nuclear components, differentiation of chromosomes, cyclic events of Cancer cells and Carcinogenesis, cell signaling.	K1,K2,K3
CO 4	Students will acquire knowledge about organisation of DNA, types of DNA, DNA as a tool in taxonomy, DNA barcoding and types of cell division	K1,K2,K3,K4
CO 5	Students will also be exposed to role in gene regulation and steps in protein synthesis, types of RNA.	K1,K2,K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	H	H	M	H	M	H	H	M	M	L	H	L	M	L	L
CO 2	H	H	M	M	L	L	M	L	L	H	L	L	L	L	M
CO 3	H	M	H	H	M	L	M	L	L	H	L	L	L	L	L
CO 4	M	H	H	M	H	L	H	L	L	H	L	M	L	L	M
CO 5	M	M	L	M	M	H	M	L	L	H	M	L	M	L	L

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	M	M	H	L	L
CO 2	H	H	L	H	L	L
CO 3	H	M	L	H	L	L
CO 4	H	L	M	H	L	L
CO 5	H	M	L	H	L	L

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –III / Major Practical-3
MAJOR PRACTICAL 3 (Core 5: Molecular Cell Biology)**

Semester	III				
Course Type	MAJOR PRACTICAL III				
Title of the Course	MOLECULAR CELL BIOLOGY				
Course Code					
Teaching Hours	3 Hours/ Week				
	MOLECULAR CELL BIOLOGY	Credits: 4	Max. Marks: 100		
Course Prerequisites: The student should have basic practical knowledge on molecular cell biology					
CODE:	MOLECULAR CELL BIOLOGY	L	T	P	C
			-	2	2
Course Objectives	To visualize and analyse the morphology and anatomy of cell types, cell division and physiological activities.				

Course Outcome

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Students will understand plants and animal Cell, Cytological techniques, staining and identification of cell types	K1,K2,K3
CO 2	Students will get deeper understanding on cellular organelles.	K1,K2,K3
CO 3	Students will be able to understand the ultra structure and functions of Nuclear components, differentiation of chromosomes.	K1,K2,K3
CO 4	Students will acquire knowledge about DNA/RNA quantification, PCR amplification and Gel electrophoresis	K1,K2,K3,K4
CO 5	Students will also be exposed to make Models & Charts: DNA, RNA and cell organelles.	K1,K2,K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Syllabus

1. Mitosis in Onion root tip cells /garlic root cells.
2. Meiosis in grasshopper testis
3. Giant chromosomes in Chironomous larva.
4. Preparation of a) Squamous epithelium, b) Human blood smear and, c) Frog blood smear.
5. DNA/RNA quantification from marine samples.
6. PCR amplification and Gel electrophoresis (Demonstration)
7. Models & Charts: DNA, RNA, Ribosomes, Nucleus, Mitochondria, Golgi apparatus, Endoplasmic reticulum and Protein synthesis.

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –III / Allied/Ppr-3

ALLIED BOTANY 1 (Allied/Ppr-3)

Semester	III				
Course Type	Allied Paper – 3				
Title of the Course	ALLIED BOTANY 1				
Course Code					
Teaching Hours	45 Hours/ Semester : 4 Hours/ week				
	ALLIED BOTANY 1	Credits: 3	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on habit and habitat of plants					
CODE:	ALLIED BOTANY 1	L	T	P	C
		3	-	-	3
Course Objectives	To understand the relationship between plants and people .This study gives a full knowledge about the habit and habitat of plants and the possible usage to human.				
Module-I:	GENERAL CHARACTERISTICS OF ALGAE			9 hours	
General Characteristics of Algae – Distribution, Structure and Life History of Volvox. General Characteristics of Fungi – Distribution, Structure and Life History of polyporus – Economic Importance of Algae, Fungi and their products.					
Module-II:	GENERAL CHARACTERISTICS OF LICHENS			8 hours	
General Characteristics of Lichens; Structure and Reproduction of Usnea. General Characteristics of Bryophytes; Structure and Reproduction of Funaria.					
Module- III:	GENERAL CHARACTERS OF PTERIDOYHYTES			9 hours	
General Characters of Pteridoyhytes – Structure and Reproduction of Lycopodium; General Characters of Gymnosperms – Structure and Reproduction of Pinus; Economic Importance of Pteridophytes and Gymnosperms					
Module- IV:	PLANT NOMENCLATURE			10 hours	
Plant Nomenclature – Bentham and Hooker’s System of Classification, Merits and Demerits of Bentham Hooker’s system; Critical study of the following Families and their Economic importance – Rutaceae, Asclepiadaceae, Euphorbiaceae and Poaceae.					
Module- V:	ETHNOBOTANY			9 hours	
Ethnobotany: study of herbal medicines, medicinal plants, Economically important medicinal plants e.g. Aloe vera, Piper nigrum, Phyllanthusniruri, Coleus amboinicus, Catharanthusroseus, Gymnemasylvestre, medicinal Aquatic plants and culture of micro and macroalgae in general.					

ReferenceBooks	<p>1. A Text Book of Algae. R. M. Johri, Snehlata and KavitaTyagi. Dominant Publishers and Distributors Pvt. Ltd. ISBN: 978 – 93 – 80642 – 71 - 0, 2013.</p> <p>2. A Text Book of Fungi. R. M. Johri, Snehlata and KavitaTyagi. Dominant Publishers and Distributors Pvt. Ltd. ISBN: 978 – 93 – 80642 – 00-0, 2011.</p> <p>3. Botany. V. Verma, Ane books Pvt Ltd, ISBN: 8190832204, 2010.</p> <p>4. Recent Progress in Medicinal Plants. V.K. Singh, J.N.Govil, ShamimaHashmi and Gurdip Sing. StudiumPress LLC, USA, ISBN: 1- 930813-12-0, vol: 7, 2003.</p> <p>5. Medicinal Plants. Moshrafuddin Ahmed. MJP Publishers, ISBN: 978 – 81 – 8094 – 073 – 6, 2015</p>
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Course Outcome

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

Category	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	<p>Remember the classification, distribution, reproduction and salient features of Algae and fungi.</p> <p>Gain knowledge on the structural organization of Algae and Fungi.</p> <p>Comprehend current applications of Algae: Live feed culture, production and commercialization; Comprehend the applications to identify and differentiate algae, mushroom, and toad stools.</p> <p>Analyse the salient features of Algae and Fungi.</p> <p>Evaluate the benefits of Algae and Fungi to mankind.</p>	K1,K2,K3, K4, K5
CO2	<p>Remember the classification Describe characteristics of Bryophytes, Lichens, their phylogeny, habit, distribution, classification and their economic importance.</p> <p>Gain knowledge on the features of each class of Bryophytes and Lichens.</p> <p>Comprehend the benefit of Lichen in forming forests by lichenification.</p> <p>Evaluate the benefits of Bryophytes and Lichen to mankind.</p>	K1,K2,K3
CO3	<p>Remember the general characters, classes and features of Pteridophytes and Gymnosperms.</p> <p>Gain knowledge on the morphology and reproduction of different forms of Pteridophytes and Gymnosperms.</p> <p>Comprehend the evolutionary significance of Pteridophytes and Gymnosperms.</p> <p>Evaluate the benefits of Pteridophytes and Gymnosperms to mankind.</p>	K1,K2,K3
CO4	<p>Remember the natural system of classification of Bentham and Hooker and critical studies on Rutaceae, Asclepiadaceae, Euphorbiaceae and Poaceae.</p> <p>Gain knowledge on naming of plants, identification of the studied four</p>	K1,K2,K3,K4

	families and the natural system of classification. Comprehend the benefit of learning natural system of classification to identify angiosperms. Evaluate the benefits of the four families to mankind.	
CO5	Remember the morphological, anatomical, physico-chemical characteristics of medicinal plants <i>Aloe vera</i> , <i>Piper nigrum</i> , <i>Phyllanthus niruri</i> , <i>Coleus amboinicus</i> , <i>Catharanthus roseus</i> , <i>Gymnema sylvestre</i> and their uses. Gain knowledge to understand the importance of above medicinal plants Acquire skills on preparing herbal medicines herbal preparations Evaluate the use of the above medicinal plants to prepare medicines.	K1,K2,K3, K5

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	L	M	M	L	H	L	L	L	L	M	L	L	L	L
CO2	H	L	L	M	L	L	L	L	L	L	L	L	L	L	L
CO3	H	L	L	M	L	L	L	L	L	L	L	L	L	L	L
CO4	H	L	M	M	M	H	L	L	L	L	L	L	L	L	L
CO5	M	L	L	M	L	L	L	L	L	L	M	L	L	L	L
CO6	L	H	M	L	M	L	H	M	M	L	H	H	L	M	L

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	H	H	L	H	H
CO2	L	L	M	L	M	M
CO3	L	L	H	L	M	H
CO4	L	L	H	L	M	H
CO5	L	L	H	L	M	H

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –III / Allied Practical -3
ALLIED BOTANY 1 (Allied Practial -3)**

Semester	III Semester				
Course Type	Allied Practial -3				
Title of the Course	ALLIED BOTANY 1				
Course Code					
Teaching Hours	3 Hours/ Week				
	ALLIED BOTANY 1	Credits: 2	Max. Marks: 100		
Course Prerequisites: The student should have basic practical knowledge on plant internal structure					
CODE:	ALLIED BOTANY 1	L	T	P	C
			-	2	
Course Objectives	To visualize and analyse the plant anatomy and micro algae.				

Course Outcome

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

Category	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Remember the internal structure of plant parts, flower, stem and root	K1,K2, K4
CO2	Gain knowledge on identification of micro, macro algae, sea weed, Mangroves, and the products of algae.	K1,K2,K3, K4
CO3	Acquire skills on collection of samples and culture of microalgae.	K1,K2,K3, K6
CO4	Comprehend the benefit of medicinal plants and knowledge on their anatomy.	K1,K2,K3,K4
CO5	Evaluate the use of the techniques on culture of macro algae.	K1,K2,K3, K5

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Syllabus

1. Dissection of medicinal plant parts – Flower, Stem and root
2. Microalgae collection, identification and micro slide preparation of atleast 10 microalgae.
3. Microalgal culture of any one species (Demonstration)
4. Macro algal culture – one species (Demonstration)
5. Identification of coastal medicinal plants – atleast 5
6. Identification of mangrove medicinal plants – atleast 5
7. Identification of Seaweeds: Red seaweeds – any 5 Brown seaweeds – any 5
Green seaweeds - any 5
8. Identification of any 5 traditional medicinal plants
9. Types of root system
10. Spotter: Algae & algal products – spirulina, agar agar, alginates, carageenan

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –III / Non Major
Elective-I
AQUARIUM TECHNOLOGIES AND MANAGEMENT (Non Major Elective-I)**

Semester	III				
Course Type	Non Major Elective-I				
Title of the Course	AQUARIUM TECHNOLOGIES AND MANAGEMENT				
Course Code					
Teaching Hours	30 Hours/ Semester : 2 Hours/ week				
	AQUARIUM TECHNOLOGIES AND MANAGEMENT	Credits: 3	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on Aquarium Technologies and Management					
CODE:	AQUARIUM TECHNOLOGIES AND MANAGEMENT	L	T	P	C
		2	-	-	3
Course Objectives	<ol style="list-style-type: none"> To study the Aquarium techniques in marine and fresh water ornamental fishes culture and breeding. Management and maintenance of marine and freshwater ornamental fish culture 				
Module-I:	AQUARIUM AQUACULTURE PRODUCTION SYSTEMS	6 hours			
An overview of aquarium aquaculture production systems: Present status, constraints and future perspectives of aquarium aquaculture production systems in India and the world. The global trade in ornamental fish, Present and future market trends of Indian ornamental fish sector.					
Module-II:	MARINE ORNAMENTAL FISH AQUARIUM	6 hours			
Marine ornamental fish Aquarium: Resources of marine ornamental fishes. Merits of marine ornamental fish aquarium, Challenges of marine ornamental fish keeping, marine aquarium. Important aquarium fishes for beginners: Criteria for selection of ornamental fishes, stocking of fish in aquarium, Food and feeding management, water quality management, Health management, Guidance for maintenance.					
Module- III:	FRESHWATER ORNAMENTAL FISH AQUARIUM	6 hours			
Freshwater ornamental fish Aquarium: Ornamental fish culture as hobby. Setting up of freshwater aquaria. Selection of suitable species, species combination. Commercial breeding and culture of ornamental fishes. Methods of production of live and artificial feeds. Common diseases of ornamental fishes and their control. Transport of live ornamental fishes and Aquascaping.					
Module- IV:	ORNAMENTAL FISH REPRODUCTIVE BIOLOGY	6 hours			
Ornamental fish endocrinology and reproductive Biology: Modes of reproduction. Secondary sexual characters and maturation process. Different endocrine glands. Ecological and hormonal influence on maturation and spawning; Breeding behaviour; Pheromones in ornamental fishes.					
Module- V:	AQUARIUM MANAGEMENT	6 hours			
Aquarium management: Aquarium keeping: Design and construction of tanks, heating, lighting, aeration and filtration arrangements, and decoration used common aquarium plants and their propagation, prophylaxis, quarantine. Design and construction of water filtration devices; Use of biological filters. Sump Filters for Freshwater and Saltwater Aquariums.					

ReferenceBooks	<ol style="list-style-type: none"> 1. Sunderaraj. V and Satheesh. J.M., 2005, Tropical marine aquarium Yegam Publication, Chennai. 2. Jhingran, V.G., 1991, Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi. 3. Bal, D.V. and Rao, V.K., 1990, Marine Fisheries of India, Tata Magraw Hill, New Delhi. 4. Iversen, E.S., 1996. Living Marine Resources, John Wiley & Sons, Inc., New York. 5. Khan, I., 1999, Marine Fishery Resources, Rajat Publications, New Delhi. 6. Munro, S.I., 1982, The Marine and Fresh Water Fishes of Ceylon. Soni Reprints Agency, New Delhi. 7. Jameson JD and Santhanam R 1996. Manual of ornamental fishes and farming technologies, Fisheries College and research institute, Tuticorn 8. Stephen Spotte 1993. Marine aquarium keeping. John wiley and sons, USA
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Course Outcomes (CO)

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Acquire knowledge on aquarium aquaculture techniques.	K1,K2, K3
CO 2	Understanding the Challenges of marine ornamental fish keeping and marine aquarium.	K1,K2, K3,K5,K6
CO 3	Impart knowledge on Freshwater and marine ornamental fish culture.	K1,K2, K3,K5
CO 4	Analyze estimate the minerals level in aquarium system	K1,K2, K3 K4
CO 5	Impart the knowledge on Aquarium keeping and Design and construction of water filtration devices	K1,K2, K3,K5,K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	H	H	H	H	M	H	H	H	M	H	H	M	M	M	H
CO 2	H	H	H	H	M	H	H	M	M	H	H	H	L	H	M
CO 3	H	M	H	H	H	H	H	H	M	H	M	L	M	H	H
CO 4	M	M	M	M	H	H	M	H	M	H	M	M	L	L	M
CO 5	H	H	H	M	M	H	H	M	M	H	M	M	M	H	H

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	L	L	L	M	M	M
CO 2	L	H	L	H	L	H
CO 3	M	H	L	H	L	L
CO 4	M	H	M	H	L	L
CO 5	M	M	M	H	L	L

Or

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –III / Non Major Elective-I

POST HARVEST TECHNOLOGY (Non Major Elective-I)

Semester	III				
Course Type	Non Major Elective-I				
Title of the Course	POST HARVEST TECHNOLOGY				
Course Code					
Teaching Hours	30 Hours/ Semester : 2 Hours/ week				
	POST HARVEST TECHNOLOGY	Credits: 3	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on post harvest technology					
CODE:	POST HARVEST TECHNOLOGY	L	T	P	C
		2	-	-	3
Course Objectives	<p>1. To study the marine and fresh water fish Pre-processed handling, processing, packaging and transportation.</p> <p>2. The human resources development in postharvest technology sector is also promising as it is a major provider of employment next only to agriculture and the much – needed inexpensive wholesome protein food to the masses.</p>				
Module-I:	IMPORTANCE OF PRESERVATION AND PROCESSING	8 hours			
Cultured organisms, criteria for assessing the freshness of cultured organisms – handling of fresh materials, phenomena of rigor mortis, quality assurance, HACCP –Concepts – Plans – Hazard Analysis – Identification – Assessment.					
Module-II:	FISH SPOILAGE	4 hours			
Types of fish spoilage, causative factors – autolytic spoilage, microbial spoilage, oxidative changes.					
Module- III:	DRYING AND CURING	4 hours			
Dehydration – conventional and modern methods of drying (Solar driers), relative merits and demerits. Salt curing, pickling and smoking – merits and demerits.					
Module- IV:	FREEZING AND CANNING	6 hours			
Cold storage – various types of freezers, individually quick freezing (IQF), cold storage design and equipments, freeze – drying, canning – history of canning containers, canning procedures.					
Module- V:	FISHERY BY-PRODUCTS	8 hours			
Fishery by – products of commerce – processing of miscellaneous products, fish meal, oil, fish protein concentrate, fish wafers, ensilage, chitosan etc., development of diversified products. Antibiotic residue analysis – Muddy smell - marketing – export – domestic – economics. Marketing role of MPEDA.					
ReferenceBooks	1. Burges, G.H.O., C.L. Cutting, J.A. Lovern and J.J. Waterman, 1965. Fish Handling and Processing Her Majesty’s Stationery Office, Edinburg, 390				

	<p>pp.</p> <ol style="list-style-type: none"> 2. Pillay, T.V.R., 1972. Coastal Aquaculture in the Indo – Pacific Region. Fishing News (Books), London. 3. Kreuzer, R., 1974. Fishery Products. FAO Fishing News (Books), England, 462 pp. 4. Govindan, T.K., 1985. Fish Processing Technology. Oxford and IBH publishing Company Private Ltd, 252 pp. 5. Gopakumar, K. 1997. Tropical Fishery Products. Oxford & IBH Publications, 190 pp. 6. Chandran, K.K., 2000. Post Harvest Technology of Fish and Fish Products. Daya Publishing House, New Delhi, 440 pp. 7. Balachandran, K.K., 2001. Post harvest Technology of fish and fish products. Daya Publishing House, New Delhi, 440 pp. 8. Malhotra, S.P. V.R.P. Sinha, 2007. Indian fisheries and Aquaculture in a globalizing economy. Narendra Publishing House, New Delhi, 385 pp. 9. Dietrich Knorr, 2005. Food Biotechnology, Marcel Dekker Publishing, New York. 10. Vickie, A. Vaclavir, Elizabeth W. Christian, 2009. Essentials of food Science – Second edition Springer – Food Science text series, New York.
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Course Outcomes (CO)

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Acquire knowledge on importance of preservation and processing.	K1, K2, K3
CO 2	Understanding the challenges in types of fish spoilage.	K1, K2, K3, K5, K6
CO 3	Impart knowledge on drying and curing techniques.	K1, K2, K3, K5
CO 4	Gain knowledge on freezing and canning methods.	K1, K2, K3, K4
CO 5	Students will also be exposed to fishery By-products economic and marketing.	K1, K2, K3, K5, K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	H	M	H	L	M	M	L	L	H	H	H	L	L	L	M
CO 2	H	L	H	L	L	H	M	L	H	H	H	L	L	L	L
CO 3	H	L	M	M	M	M	L	M	M	H	M	L	L	L	M
CO 4	M	L	M	L	H	H	M	L	M	H	M	L	L	L	M
CO 5	H	L	H	M	L	H	H	L	M	H	M	M	M	M	L

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	L	L	L	M	L	M
CO 2	L	H	L	L	L	H
CO 3	M	H	L	L	L	M
CO 4	M	H	L	L	L	M
CO 5	M	M	L	L	L	M

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –IV / Core/Ppr-6
MICROBIOLOGY AND IMMUNOLOGY**

Semester	IV				
Course Type	Core Paper - 6				
Title of the Course	MICROBIOLOGY AND IMMUNOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	MICROBIOLOGY AND IMMUNOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should possess basic knowledge on general aspects about microorganisms and its application. Simultaneously they get knowledge on immunology and functions of immune system in our body.					
CODE:	MICROBIOLOGY AND IMMUNOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	<ol style="list-style-type: none"> 1. The course is intended to make an awareness of the students about the classification, diversity, organization, application and pathogenicity of the microorganisms existing the ecosystem. 2. The course will help the students to learn about the various microbial culture techniques and its handling. 3. The course will give an idea that how microbes are used in various industries for generation of various products related to day to day life. 4. The course will give an insight to the cellular components involved in the immunity. 5. The course will give an awareness of the mechanism, types and concepts regarding immune response. 				
Module-I:	INTRODUCTORY MICROBIOLOGY			12 hours	
Biogenesis - contributions of Louis Pasteur - Leuwanhoeck, Lazaro, Spallanzani, John Tyndall, Joseph Lister, Robert Koch. Microscopy-simple & compound light microscopy-Dark field-phase contrast- fluorescence and electron microscopy-Sterilization methods. Anatomy of Prokaryotes, Eukaryotes - Characters and basic classification of Kingdom Monera and Fungi. scope of microbiology. Systematic position of Virus – classification - structure of bacteriophage, viroids and prions, ultra structure of <i>E. Coli</i> , general structure of fungi					
Module-II:	BACTERIAL CULTURE			12 hours	
Sterilisation- types of culture medium – culture of bacteria –bacterial growth and growth curve – factors influencing bacterial growth, maintenance & characteristics of colonies, staining of bacteria. Microbial identification - morphological, physiological, and biochemical properties. Biofermenters and its role in mass culture.					
Module- III:	APPLIED MICROBIOLOGY			12 hours	

Control of microbes, preservation of milk –microbes in food spoilage. Culture of yeast of economic importance. Microbial nitrogen fixation - stages – types and methods of fermentation & products. Basic concepts of probiotics. Bacterial (Cholera, Typhoid), viral (Rabies, HIV) & fungal (Candidiasis, Dandruff) diseases in man. Role of soil microbes in Nitrogen fixation - Symbiotic nitrogen fixation: Rhizobium mechanism. Non-symbiotic nitrogen fixation (biofertilizer): Azotobacter. Food Microbiology - food spoilage and food preservation. Industrial Microbiology: production of antibiotics with reference to penicillin, industrial production of ethanol.

Module- IV:	IMMUNITY	12 hours
Lymphoid organs & cells of immune system, structure, composition and functions of cells and organs involved in immune system - types of immunity – immune response – immunoglobulin – structure, types. Properties, epitopes, paratopes, haptens & adjuvants, antigen-antibody reactions - <i>in vitro</i> methods (Precipitation test, Agglutination Test). Clinical applications of antigen antibody reaction: Eg: VDRL , HIV test (ELISA), T-cell and B-cell activation - monoclonal antibodies.		

Module- V:	IMMUNIZATION	12 hours
Basic concepts of major histocompatibility complex - basic properties and functions of cytokines, interferons and complement proteins. Hypersensitivity - types of hyper sensitivity, concepts of autoimmunity and immunodeficiency – vaccines & immunisation.		

ReferenceBooks	<ol style="list-style-type: none"> 1. Pelczar Jr., M.J., Chan, E.C.S. and Kreig N.R., 2001, Microbiology, McGraw Hill Inc. New York. 2. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R., 1999, General Microbiology, Macmillan Education Ltd. London 3. Ananthanarayanan, R and Jayaram Panicker, C.K., 1999, A Text Book of Microbiology, Orient Longman. 4. Adams. M.R., and Moss, M.D., 1995, Food Microbiology, New Age International Ltd. 5. Sharma, P.D., 1995, Microbiology, Rastogi & Company, Meerut Chakravarthy, A.K., 1996, Immunology, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi. 6. Roitt, I.M., 2000, Essential Immunology, Blackwell Scientific Publishers. Kuby, J., 1999, Immunology, W.H. Freeman and Company, New York. 7. Dubey RC & Maheshwari DK, A Textbook of Microbiology, S. Chand Publishers, New Delhi. 8. Mani A, Selvaraj A.M , Narayanan L.M , Arumugam A, Microbiology, Saras Publication, Nagercoil. 9. Pelczar MJ, Chan EC, Pelczar MF. Elements of microbiology. McGraw-Hill International Book Company. 10. Ryan KJ, Ray CG, editors. Sherris medical microbiology. McGraw-Hill Education. 11. Willey JM, Sherwood L, Woolverton CJ. Prescott's microbiology. Singapore: McGraw-Hill. 12. Abul Abbas Andrew H. Lichtman Basic Immunology, Saunders. Delves PJ, Martin SJ, Burton DR, Roitt IM. Essential immunology. John Wiley & Sons. 13. Ramesh SR, Immunology, Mcgraw Higher Ed.
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Course Outcome

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Understand the basic classification of kingdom monera and fungi	K1, K2,K4
CO 2	Know about types of culture medium and microbial identification.	K1, K2,K4
CO 3	Acquire knowledge on microbial control, diseases and probiotics	K3, K4, K5
CO 4	Know the types of Lymphoid organs, immunity and their properties	K1,K2,K3
CO 5	Understand the concepts of autoimmunity and immunodeficiency	K1,K2,K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	M	M	M	M	M	L	H	L	L	L	M	L	L	M	M
CO 2	L	M	L	M	M	L	H	M	L	L	M	L	L	M	M
CO 3	L	M	L	M	L	M	L	L	L	L	L	L	M	L	L
CO 4	L	M	M	L	M	L	M	L	M	L	H	L	M	H	L
CO 5	M	L	H	L	M	H	L	M	L	M	L	M	L	L	L

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	M	M	L	M	H	M
CO 2	H	M	L	M	M	L
CO 3	L	M	H	M	H	H
CO 4	M	L	H	M	L	M
CO 5	L	L	L	L	L	L

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –III / Major Practical-4
MAJOR PRACTICAL 4 (Core 6: Microbiology and Immunology)**

MICROBIOLOGY AND IMMUNOLOGY

Semester	III				
Course Type	MAJOR PRACTICAL III				
Title of the Course	MICROBIOLOGY AND IMMUNOLOGY				
Course Code					
Teaching Hours	3 Hours/ Week				
	MICROBIOLOGY AND IMMUNOLOGY	Credits: 4	Max. Marks: 100		
Course Prerequisites: The student should have basic practical knowledge on microbiology and immunology					
CODE:	MICROBIOLOGY AND IMMUNOLOGY	L	T	P	C
			-	2	2
Course Objectives	To visualize and analyse the morphology and anatomy of cell types, cell division and physiological activities.				

Course Outcome

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Students will understand preparation of liquid and solid media, Plating techniques, staining and identification of cell types	K1,K2,K3
CO 2	Students will get deeper understanding on Microscopic examination of micro organism.	K1,K2,K3
CO 3	Students will be able to understand the Isolation of microorganism from soil.	K1,K2,K3
CO 4	Students will acquire knowledge about Identification of human blood groups and RBC count	K1,K2,K3,K4
CO 5	Students will also be exposed to Counting of microorganisms.	K1,K2,K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Syllabus

Microbiology and Immunology

1. Preparation of liquid and solid media for growth of microorganism
2. Plating techniques - Spread, Streak and Pour Plate
3. Storage of microorganism: slant and stab culture
4. Isolation of microorganism from soil

5. Growth curve – Measurement of growth by turbidometry method
6. Microscopic examination of bacteria and yeast
7. Counting of microorganisms using Hemocytometer
8. Identification of human blood groups – A, B, AB, O and Rh factor.
9. Total leucocyte count on the given blood sample.
10. Total RBC count on the given blood sample.
11. Identify different cells of the blood sample.
12. Differential count of the given blood sample

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –IV/ Allied /PPR-4
ALLIED BOTANY 2 (Allied Paper – 4)**

Semester	IV				
Course Type	Allied Paper - 4				
Title of the Course	ALLIED BOTANY 2				
Course Code					
Teaching Hours	45 Hours/ Semester : 4 Hours/ week				
	ALLIED BOTANY 2	Credits: 3	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on General Characteristics of Algae, Lichens, Pteridophytes, Plant Nomenclature and Ethnobotany					
CODE:	ALLIED BOTANY 2	L	T	P	C
		3	-	-	3
Course Objectives	To understand the overall views about the development of embryo in plants, structure, functions and metabolism in plants and also to know about the physio – chemical functioning and technological applications of plants.				
Module-I:	STRUCTURE AND DEVELOPMENT OF MICROSPORANGIUM			9 hours	
Structure and development of microsporangium; Structure, types and development of megasporangium; Development of male and female gametophyte; Double fertilization; Endosperm – types; structure of dicot embryo.					
Module-II:	TISSUES – SIMPLE TISSUES, COMPLEX TISSUES			9 hours	
Tissues – simple tissues, complex tissues; primary structure of dicot and monocot dicot and monocot Root; normal secondary thickening in dicot Stem.					
Module- III:	GENERAL CHARACTERS OF PLANTSS			10 hours	
Absorption of water – diffusion, osmosis, imbibitions; mechanism of absorption of water Ascent of sap – Cohesion Theory; Transpiration – types, structure of stomata, mechanism of stomatal transpiration (Starch – Sugar Hypothesis); Photosynthesis – structure of chloroplast, importance of photosynthesis, mechanism of photosynthesis – Light and dark reaction (Calvin cycle).					
Module- IV:	ALGAL BIOTECHNOLOGY			9 hours	
Algal Biotechnology: Nostoc – morphology, use as biofertilizer and mass cultivation; Fungal Biotechnology: structure and multiplication, Budding and fission of yeast, mass culture and uses.					
Module- V:	TISSUE CULTURE			8 hours	
Tissue Culture – Scope and importance – totipotency, nutrient medium (M.S medium) - Callus culture, meristem culture and their applications.					

Reference Books	<ol style="list-style-type: none"> 1. Botany. V.Verma, Ane books Pvt Ltd, ISBN: 8190832204, 2010. 2. Falcon Biology. Frederick Pitter, AraspuUpadhyay, Samualhans, Birendra Mohan, Mishra, Ram Kumar and Verma. Choice international Publishers, ISBN: 81- 87659 – 84 – X, Vol: 1 3. Falcon Biology. Frederick Pitter, AraspuUpadhyay, Samualhans, Birendra Mohan, Mishra, Ram Kumar and Verma, Choice international Publishers, ISBN: 81- 87659 – 85 – 8, Vol: 2 4. Microalgae Biotechnology and Microbiology. E.W. Becker, Cambridge University Press, ISBN: 0521350204, 1994. 5. Biotechnology. KeshavTrehan. New Age International Publishers, ISBN: 81 – 224 – 0129 – 5, 1990. 6. Plant Tissue culture. Roberta H. Smith, Academic Press, ISBN: 978 – 0- 12- 415920 4, 20`13.
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Course Outcome

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

Category	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	<p>Remember the structure and development of micro and megasporangium, male and female gametophyte, double fertilization, types of endosperm and structure of dicot embryo</p> <p>Gain knowledge on micro and megasporangium, double fertilization, triple fusion and types of endosperms and embryo structure.</p> <p>Comprehend the benefits of micro and megasporangium, endosperm and embryo</p> <p>Analyze the salient features of micro and megasporogenesis, embryogenesis</p> <p>Evaluate the benefits of micro and megasporogenesis, and embryogenesis.</p>	K1,K2,K4
CO2	<p>Remember the basic knowledge on types of tissues in plants.</p> <p>Gain knowledge on organization of tissues in primary and secondary anatomy of dicot and monocot stem and roots.</p> <p>Comprehend the importance of tissues in growth and development of plants</p> <p>Analyze the benefits of secondary growth in plants for making wood</p> <p>Evaluate the use of primary and secondary growth in plant tissues in mankind.</p>	K1,K2,K4
CO3	<p>Remember the physiological principles of absorption of water by diffusion, osmosis, imbibitions, mechanism of absorption, transpiration, mechanism of transpiration, photosynthesis and its importance</p> <p>Gain knowledge on absorption all the above physiological process in plants.</p> <p>Comprehend the importance of photosynthesis in plants.</p> <p>Analyze the hypotheses in water absorption to understand the</p>	K1,K2 ,K4, K5

	mechanism, analyze the mechanism of photosynthesis – light and dark reaction. Evaluate the process of photosynthesis and its use to mankind.	
CO4	Remember the morphology of Nostoc and Budding, fission of yeast. Gain knowledge on mass cultivation of Nostoc – a biofertilizer, and mass culture of yeast. Comprehend the importance of Algal biotechnology and Fungal biotechnology. Analyse the morphology of Nostoc and structure, multiplication of yeast. Acquire knowledge on production of Nostocfertilizer andYeast using these algal and fungal biotechnology.	K1,K2,K3, K6
CO5	Remember the techniques of tissue culture, and the nutrient media used. Gain knowledge on totipotency, tissue culture medium preparation, callus culture and meristem culture. Comprehend the importance and application of the tissue culture techniques. Acquire knowledge on production of tissue cultured plants using callus culture, meristem culture like processes applicable to the society.	K1,K2,K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	H	L	M	M	M	H	L	L	L	L	M	L	L	L	L
CO2	H	L	M	M	M	M	L	L	L	L	L	L	L	L	L
CO3	H	M	L	H	M	H	L	M	M	L	L	L	L	L	L
CO4	M	H	H	M	M	M	M	M	M	L	M	L	M	L	M
CO5	M	H	M	L	H	H	M	M	M	L	M	M	L	L	L
CO6	M	M	M	M	L	H	M	M	M	L	M	M	L	M	M

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	M	L	M	L	L	M
CO2	M	L	H	L	L	M
CO3	L	M	H	L	L	M
CO4	L	H	H	L	M	M
CO5	L	M	H	L	L	M

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –IV/ Allied Practical -4

ALLIED BOTANY II (Allied Practical -4)

Semester	IV Semester				
Course Type	Allied Practial -4				
Title of the Course	ALLIED BOTANY 1I				
Course Code					
Teaching Hours	3 Hours/ Week				
	ALLIED BOTANY 1I	Credits: 2	Max. Marks: 100		
Course Prerequisites: The student should have basic practical knowledge on plant internal structure					
CODE:	ALLIED BOTANY 1	L	T	P	C
			-	2	
Course Objectives	To visualize and analyse the plant floral parts and Micro preparations.				

Course Outcome

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

Category	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Remember the anatomy of plant parts, flower, stem and root.	K1,K2,K4
CO2	Gain knowledge to identify and to record the medicinal values and morphology of economically important plants.	K1,K2,K3
CO3	Acquire skills on collection and identification of embryological parts of plants, Microalgae, BGA, Fungi, Bryophytes, Pteridophytes and, Gymnosperms.	K1,K2 ,K3, K5
CO4	Comprehend the importance and application of demonstration experiment a. Ganong's light screenb.Bell jar experiment andc.Suction due to Transpiration.	K1,K2,K3, K4
CO5	Acquire knowledge on production of tissue culture applicable to society.	K1,K2, K3, K6,

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Syllabus

1. Technical description of Plant parts with reference to the families prescribed in the syllabus.
2. Dissection of floral parts of plants belong to the families prescribed in the syllabus.
3. Make suitable Micro preparations of
 - a. Dicot stem b. Monocot stem c. Dicot root d. Monocot root e. Lycopodium stem f. Pinus needle

4. To identify and to record the medicinal values and morphology of the useful parts of the plants prescribed in the syllabus.
5. To identify the slides showing
 - a. Mature anther b. Ovule c. Dicot embryo d. Volvox e. Nostoc f. Yeast g. Lycopodium cone L.S and h. Funaria capsule L.S.
6. To identify the following specimens
 - a. Polyporus b. Funaria c. Lycopodium and d. Pinus –male and female cone.
7. Demonstration experiment
 - a. Ganong's light screen b. Bell jar experiment and c. Suction due to Transpiration
8. Photograph – Callus culture, Meristem culture
9. To maintain a record note book for external and internal evaluation.

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –IV/ Non-Major
Elective -II**

VERMITECHNOLOGY (Non-Major Elective –II)

Semester	IV				
Course Type	Non Major Elective-II				
Title of the Course	VERMITECHNOLOGY				
Course Code					
Teaching Hours	30 Hours/ Semester : 2 Hours/ week				
	VERMITECHNOLOGY	Credits: 3	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on vermitechology					
CODE:	VERMITECHNOLOGY	L	T	P	C
		2	-	-	3
Course Objectives	To reach a thorough knowledge on the physiology and lifecycle of earth worm and also to understand the use of earth worm for the human welfare and to prepare a commercial culture system.				
Module-I:	EARTHWORM TAXONOMY			6 hours	
Earthworm taxonomy- Morphological and anatomical- classification of earthworms- Food habits- Digestive system- excretion- reproduction and life cycle- earthworm as farmer's friend.					
Module-II:	TYPES OF EARTH WORMS			6 hours	
Types of earth worms- exotic and native species- South Indian and North Indian species used in vermi composting- collection and preservation of earthworms for vermicomposting- culture techniques of earthworms.					
Module- III:	VERMICOMPOST PRODUCTION			6 hours	
Vermicompost production- Requirements- different methods of vermicomposting- Heap method- Pot method and Tray method- Changes during vermicomposting.					
Module- IV:	USES OF EARTHWORMS			6 hours	
Role of earthworms in soil fertility - Use of vermicompost for crop production- use of earthworms in land improvement and land reclamation- Economics of vermicompost and vermiwash production Earthworms as animal feed- Medicinal value of earthworm meal- Role of earthworms in solid waste, sewage and faecal waste management and vermifilters Earthworms as bioreactors.					
Module- V:	INTERACTION OF EARTHWORMS WITH OTHER ORGANISMS			6 hours	
Interaction of earthworms with other organisms- Influence of chemical; inputs on earthworm activities- Large scale manufacture of vermicompost, Packaging of vermicompost and its marketing- Financial supporting- government and NGO's for vermiculture work.					

ReferenceBooks	<ol style="list-style-type: none"> 1. Invertebrate Zoology – Ekambaranatha Ayyar 2. Earthworm in Agriculture – S.C. Talishakar and Dosani, Agrobios publications, Near Nasarani cinema, Jodhpur- 342002 3. Vermicompost for sustainable Agriculture – P.K. Gupta Agobios 2nd edition. 4. Organic farming for sustainable Agriculture – A.K. Dahama, Agrobios. 5. A hand book of organic farming – A.K. Sharma, Agrobios publication. 6. Earthworm ecology – Clive A Edwards, St.Lucie press – CRC press Washington DC. 7. Biology of Earthworm – Edward and Lofti – Chapman and Hall publication. 8. Vermicology – Sultan A Ismail – Orient Longman press. 9. Vermi Culture Biotechnology – U.S. Bhawalker BERI, PUNE.
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Course Outcomes (CO)

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Acquire knowledge on the Morphological and anatomical-classification of earthworms.	K1,K2,K3
CO 2	Understanding the types of earth worms- exotic and native species, collection and preservation techniques	K1,K2,K3
CO 3	Impart knowledge on Vermicompost production, different methods of vermicomposting	K1,K2,K3, K5
CO 4	Analyze the quality production of vermicompost for crop production, land improvement and land reclamation	K1,K2,K3, K4
CO 5	Trace the employability and marketing methods using vermicompost and Financial supporting of government and NGO's for vermiculture work..	K1,K2,K3, K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	H	H	L	H	H	H	H	H	L	H	M	L	M	H	H
CO 2	H	M	H	M	M	M	M	M	M	M	H	H	M	H	M
CO 3	H	M	H	H	H	H	H	M	L	H	M	L	M	H	H
CO 4	H	H	M	M	M	M	H	L	M	M	M	M	M	L	H
CO 5	H	M	M	L	M	H	H	L	L	H	M	H	M	H	H

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	M	L	M	H	L
CO 2	M	H	L	M	H	L
CO 3	L	M	L	M	H	L
CO 4	L	M	L	L	H	L
CO 5	L	M	L	M	H	L

(Or)

SEDIMENTOLOGY

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –IV/ Non-Major
Elective -II**

SEDIMENTOLOGY (Non-Major Elective –II)

Semester	IV				
Course Type	Non Major Elective-II				
Title of the Course	SEDIMENTOLOGY				
Course Code					
Teaching Hours	30 Hours/ Semester : 2 Hours/ week				
	SEDIMENTOLOGY	Credits: 3	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on sedimentology					
CODE:	SEDIMENTOLOGY	L	T	P	C
		2	-	-	3
Course Objectives	To reach a thorough knowledge on the physiology and morphological parameters of sedimentation and also to understand the Diagenesis.				
Module-I:	SEDIMENTATION			6 hours	
Distribution and genesis of terrigenous, biogenous, chemogenous, volcanogenic, authigenic and extra terrestrial (cosmogenous) sediments in the world ocean – Rate of sedimentation in the oceans.					
Module-II:	CONCEPTS OF SEDIMENTARY FACIES			6 hours	
Concepts of sedimentary facies, facies construction and interpretation, factors controlling the nature and distribution of facies – Provenance – Heavy minerals, rock particles and clay minerals – Mineral stability – Goldich stability series, sediment maturity, heavy mineral zones - X ray diffraction technique and its use in mineral and sediment study.					
Module- III:	SEDIMENTARY DEPOSITIONAL ENVIRONMENTS			6 hours	
Sedimentary depositional environments – Aeolian, lacustrine, glacial desert, fluvial, coastal shallow marine and deep sea – Sedimentary and faunal markers of paleoenvironmental conditions					
Module- IV:	SEDIMENTARY ROCKS			6 hours	
Sedimentary rocks – Classification, properties, origin and importance – Sandstone, limestone, mudstones and evaporites – Sedimentary structures formed by unidirectional water flows, water waves, airflows, liquefaction and current drag, diapirism and differential loading, desiccation and shrinkage structure – Diagenesis: general considerations, terrigenous clastic sediments, carbonate sediments, evaporates and hydrocarbons, Diagenesis of silica, iron and Manganese .					
Module- V:	PALEOCURRENT ANALYSIS			6 hours	
Sand, silt, clay and their estimation and interpretation methods, Heavy mineral counting and determination of number percentage - Study of stratigraphic correlation - Study of paleocurrent analysis - Facies identification of sediments.					

ReferenceBooks	<ol style="list-style-type: none"> 1. Sedimentation in the world ocean, 1972 – Lisitzin, A.P., Soc. Of E.C. Paleontologists. 2. Sedimentology, 1982 – Leeder, M.R., George Allen & Unwin. 3. Sedimentary rocks (3rd edn.), 1984 – Pettijohn, E.J., C.B.S. Publ. And Distrib. 4. Stratigraphy and sedimentation, 1963 – Krumbein, W.C. and Sloss, L.L., W.H.Freeman & Co. 5. Sedimentary environments and facies (2nd edn), 1986 – Reading, H.G. Blackwell Sci Publ. 6. Depositional sedimentary environments, 1986- Reineck, H.E. and Singh, I.B., Springer Verlag. 7. Origin of sedimentary rocks, 1972 – Blatt, H., Middleton, G. and Englewood, M.R., Cliff, New Jersey. 8. Principles of sedimentology, 1978 – Friedman, G.M. and Sanders, J. E., John Wiley & Sons. 9. Procedures in sedimentary petrology, 1971 – Carver, R.F., Wiley Interscience. 10. Sedimentary structures: their character and physical basis (Vol.1 & 2), 1982 – Allen, J.R.I., Elsevier. 21 11. Physical processes of sedimentation: An introduction, 1970 Allen, J.R., George Allen & Unwin. 12. Ancient sedimentary environments: A brief survey, 1970 – Selley, R.C., Chapman & Hall. 13. Atlas and glossary of primary sedimentary structures, 1964 – Pettijohn, F.J. and Potter, P.E. Springer Verlag. 14. Sand and sandstone, 1972 – Pettijohn, F.J., Potter, P.E. and Siever, R., Springer Verlag
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Course Outcomes (CO)

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Acquire knowledge on the Morphological and genesis of sedimentation .	K1,K2,K3
CO 2	Understanding the types Concepts of sedimentary facies, different technique and its use in mineral and sediment study	K1,K2,K3
CO 3	Impart knowledge on Sedimentary depositional environments and faunal markers of paleoenvironmental conditions	K1,K2,K3, K5
CO 4	Analyze the Sedimentary rocks and Diagenesis	K1,K2,K3, K4
CO 5	Obtain knowledge on paleocurrent analysis and estimation and interpretation methods	K1,K2,K3, K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	L	L	L	L	L	H	L	L	L	L	M	L	M	L	L
CO 2	L	M	H	M	M	L	M	M	M	M	L	L	L	L	M
CO 3	L	M	L	L	L	L	L	M	L	L	M	L	L	L	L
CO 4	L	L	M	M	M	M	L	L	M	M	M	M	M	L	L
CO 5	M	M	M	L	M	H	L	L	L	H	M	H	M	L	L

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	L	M	L	M	L	L
CO 2	M	H	L	L	H	L
CO 3	L	M	M	M	L	L
CO 4	L	M	L	L	H	L
CO 5	L	M	L	M	H	L

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI
Centre for Marine Science and Technology
UG Marine Science (Integrated)

(Choice based credit system)

V and VI Semester

(With effect from the academic year 2022-2023 onwards)

Sem	Part I/II/III/IV	Subject Status	Subject Title	Course /Paper	Hours/Week	L Hrs /week	T Hrs /Week	P Hrs /Week	Credits
V	III	Core 7	Animal Physiology		4	4			4
	III	Core 8	Biotechnology		4	4			4
	III	Elective	(A)Fish and Fisheries of India or (B) Coral Reef and Mangroves - Ecology and Management		4	4			4
	III	Elective	(A)Culture and Capture Fisheries or (B)Fish Biology		4	4			4
	III	Practical	Practical: Animal Physiology & Animal Biotechnology		4			4	2
	III	Practical	Practical: Lab in Electives		4			4	2
	IV	Skill based Common	Personality Development/Effective Communication		2	2			2
			Sub Total		26	18		8	22
VI	III	Core 9	Recent developments in live feed production		4	4			4
	III	Core 10	Fundamentals of Genetics		4	4			4
	III	Core 11	Biostatistics, Computer Applications & Bioinformatics		4	4			4
	III	Practicals	Lab in recent developments in live feed production, Fundamentals of Genetics, Biostatistics, Computer Applications & Bioinformatics		6			6	2

	III	Elective	Ornamental fishes and trading (Or) Food and Food Processing Technology		4	4			4
	III	Mini Project			8			8	8
			Sub Total		30	16		14	26

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V / Core/Ppr-7
ANIMAL PHYSIOLOGY**

ANIMAL PHYSIOLOGY

Semester	V				
Course Type	Core Paper - 7				
Title of the Course	ANIMAL PHYSIOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	ANIMAL PHYSIOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on animal physiology					
CODE:	ANIMAL PHYSIOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	1. To familiarize students with the principles and basic facts of Animal Physiology. 2. To give students an insight about the molecular and cellular basis of physiological functions in animals. 3. To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis. 4. To make awareness to the students about how the structure-function relationships synchronise along with the molecular signals.				
Module-I:	NUTRITION & RESPIRATION			12 hours	
Nutrition & Respiration: Nutrition: Digestion and absorption of carbohydrates, proteins and lipids. Minerals & Vitamins – their deficiency. Hormonal control of digestion. Respiratory pigments- structure of haemoglobin, transportation of gases - Bohr effect - Modification of respiratory organs in aquatic animals.					
Module-II:	CIRCULATION & EXCRETION			12 hours	
Circulation & Excretion: Major differences between closed and open circulation system Blood-composition and functions. Types of Hearts – Cardio- vascular system– Heart Circulation in fish– Working of the teleostean heart. Excretory organs in fish, Structure of the kidney, Mechanisms of excretion/ function, excretory products, Excretion in Shellfishes eg. Crustaceans.					
Module- III:	MUSCLE & OSMO-REGULATION			12 hours	
Muscle & Nerve Physiology: Types of muscles - Structure of various muscles, muscle contraction & properties. Osmo-regulation – Definitions, Regulators and conformers, Osmoregulatory problem in freshwater & marine fishes, hag fishes, elasmobranchs, Shellfishes, Osmoregulation in migratory fishes and Preparation for life in a changed environment .					
Module- IV:	REPRODUCTIVE PHYSIOLOGI & SENSE ORGANS			14 hours	

Importance of reproductive physiological studies; Types of reproduction. Male and Female reproductive system, Maturation and spawning, Modes of reproduction, Seasonal regulation of reproduction/ environmental influence on the reproductive cycle, Hormonal control of reproduction, Hormones involved in reproduction and their sources transaction of external signal, Sense Organs: Introduction, Chemoreception, Acoustico-Lateralis System, Electro-reception, Photoreception/vision, Other senses (touch, pain, and special senses) Pineal gland. .		
Module- V:	ENDOCRINE GLANDS	12 hours
Endocrine glands - Major endocrine glands, Neuro-endocrine regulation of the pituitary gland, Adrenal cortical tissue, Chromaffin tissue, ultimo-branchial gland, Islets of langerhans, Gastro-Intestinal hormones, Pheromones, Shellfishes - Hormones of Crustaceans, Other Invertebrate Hormones - feed-back mechanism, outlines of mechanism of hormonal activity.		
ReferenceBooks	<ol style="list-style-type: none"> 1. Verma P.S., Tyagi, B.S. & Agarwal V.K., 2010, Animal Physiology, S. Chand & Co. Ltd., New Delhi. 2. Agarwal, R.A., Srivatsava, A.K. & Kaushal Kumar, 1978, Animal Physiology and Biochemistry, S. Chand & Co. Ltd. New Delhi. 3. Sambasivaiah, Kamalakara Rao and Augustine Chellappa, 1990, A Textbook of Animal Physiology and Ecology, S. Chand & Co. Ltd., New Delhi. 4. Parameswaran, Anantakrishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd. 5. William S. Hoar, 1976, General and Comparative Physiology, Prentice Hall of India Pvt. Ltd., New Delhi. 6. Wood, D.W., 1983. Principles of Animal Physiology, 3rd Ed. 7. Prosser C.L., 1985, Comparative Animal Physiology, Satish Book Enterprise, Agra. 8. Arumugam N & Mariakuttikan A Animal Physiology Saras Publications, Nagercoil. 9. Bhagavan NV, Medical biochemistry, fourth edition Academic Press. 10. Guyton AC, Hall JE, Text Book of Medical Physiology, Elsevier 11. Jain AK Textbook of Physiology. Avichal Publishing Company. 12. Lehninger AL, Michael Cox, Nelson DL, Biochemistry. Macmillan. 13. Tyagi BS, Agarwal VK & Verma PS Animal Physiology S. Chand Publishers, New Delhi. 	

Course Outcomes (CO)

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Acquire knowledge on physiological role of major and minor nutrient, structure and physiology of respiratory systems	K1, K2, K3
CO 2	Impart knowledge on structure and physiology of circulatory system and Analyse the physiology of excretion in animals.	K1, K2, K3
CO 3	Students will be able to understand the types and structure of muscles, and Nerve Physiology, nerve disorders, chemical coordination.	K1, K2, K3

CO 4	Obtain knowledge on types and constructions of Sense Organs and structure and physiology of receptors	K1, K2, K3
CO 5	Gain the knowledge on endocrine glands and hormones action	K1, K2, K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	H	H	H	H	M	M	H	H	M	H	L	L	L	L	M
CO 2	H	H	H	L	M	L	M	H	M	H	L	L	L	L	L
CO 3	H	M	M	L	H	L	M	M	M	H	M	L	M	L	L
CO 4	M	H	M	L	H	M	M	H	L	H	L	L	L	L	M
CO 5	M	L	M	L	L	H	M	L	M	H	M	L	M	L	M

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	L	L	L	H	L	L
CO 2	M	H	L	M	L	L
CO 3	L	L	L	L	L	L
CO 4	H	L	H	H	L	L
CO 5	H	L	L	H	L	L

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V / Core/Ppr-8
BIOTECHNOLOGY**

BIOTECHNOLOGY

Semester	V Semester				
Course Type	Core Paper - 8				
Title of the Course	BIOTECHNOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	BIOTECHNOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on genetic material of prokaryotes					
CODE:	BIOTECHNOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	<p>To familiarize the students with the basic concepts in recombinant DNA technology.</p> <p>To acquaint the students to versatile tools and techniques employed in genetic engineering and to appraise them about applications of recombinant DNA technology.</p> <p>To give a firm foundation in the fundamentals of modern Molecular techniques.</p> <p>Give a nut shell idea of various protocols followed in Biotechnology in relation to animal science.</p> <p>To give an idea of animal tissue culture, to introduce the various genetic and transformation techniques in animals and its applications in various fields.</p>				
Module 1	RECOMBINANT DNA TECHNOLOGY			12 hours	
Scope of Biotechnology, Molecular tools and applications -restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Recombination, screening of recombinant DNA, application of recombinant DNA technology, commercial production of insulin, Human Genome Project.					
Module 2	MOLECULAR TECHNIQUES			12 hours	
Methods of isolating DNA, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR. Electrophoresis – types and principle. Blotting – types & applications. DNA finger printing and its applications –RAPD – FISH- RFLP. DNA probes & diagnosis – super bugs (Oil pollution).					
Module 3	ANIMAL TISSUE CULTURE			12 hours	
Design and layout of ATC laboratory. Requirements for Animal cell culture. Types of media, ingredients of media and sterilization. Foetal Bovine Serum, Metabolic profiling of Animal cell culture. Basic Techniques of Mammalian Cell Culture: Disaggregation of animal tissue. Primary culture and secondary culture. Evolution of cell line and continuous cell line, characterization of cell lines. Monolayer, suspension culture. primary culture, steps involved in mammalian cell culture- He					

la&WI38 cell lines – maintenance of cell lines – techniques and application of organ culture, animal cloning – Dolly. Characterization of cultured cell, measurement of viability, cyto-toxicity and growth parameters. Stem cell cultures, embryonic stem cell and their applications, cell culture based vaccines, apoptosis.		
Module 4	APPLICATIONS OF BIOTECHNOLOGY	12 hours
Genetically modified animals, Transgenic Animals (Fish, Mice, Sheep & Cow) & its significance single cell protein from microbes, biofuels, Waste management - solid waste management – liquid waste management , biogas production, biopesticides –Mushroom Culture.		
Module 5	ENZYME TECHNOLOGY	12 hours
Microbial production & application of enzymes – ribozymes- artificial enzymes - immobilization of enzymes methods and its application. Biosensors - cryobiology – methods of cryo-preservation.		
ReferenceBooks	<ol style="list-style-type: none"> 1. Brown, T.A., 1995, Gene cloning, London: Chapman & Hall. 2. Dubey, R.C., 2014, A Text Book of Biotechnology, 5th revised Edition, S. Chand & Co Ltd, New Delhi 3. Kumaresan, V., Biotechnology, Saras Publication, Nagercoil 4. Primrose, S.B., Twyman, R., 2013, Principles of Gene Manipulation and Genomics, John Wiley & Sons. 5. Ranga, M.M., 2007, Animal Biotechnology, 3rd Edition, Agrobios India. 6. Robertis D., 1987, Cell and Molecular Biology, 8th Edition, Lea & Febiger, U.S. 7. Sasidhara, R., 2006, Animal Biotechnology, MJP Publishers. 8. Satyanarayana, U., 2008. Biotechnology, Books and Allied (P) Ltd. 9. Sudha Gangal, 2010, Principles and Practice of Animal Tissue culture, 2nd Edition, University Press (India) Pvt. Ltd. Hyderabad. 10. Verma, P.S., & Agarwal, V.K., 2009, Genetics, 9th Edition, S. Chand Publishers, New Delhi 	

Course Outcomes (CO)

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

	Course Outcomes	Knowledge level according to (Blooms taxonomy)
CO1	Understand the basic tools in biotechnology, steps in rDNA technology and screening of recombinants	K1, K2, K3
CO2	Understand the molecular techniques in biotechnology	K1, K2, K3
CO3	Students will learn the requirements for the basic cell cultures, check and screen cell for cell viability and cytotoxicity and cell death parameters, understand basic biology of stem cells, properties, and applications	K1, K2, K3, K4, K5
CO4	Understand the applications of rDNA technology in transgenic animal and in animal biotechnology	K4, K5, K6

CO5	Understand the application of biotechnology in enzyme technology	K4, K5, K6
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K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 – Create

Mapping of CO with PO

	PO 1	PO 2	PPO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	M	H	M	H	M	M	M	L	M	M	M	M	L	M
CO2	H	M	H	M	H	M	M	M	L	M	M	M	M	L	M
CO3	H	M	H	M	H	M	M	L	L	M	M	M	M	L	M
CO4	H	M	H	M	H	M	M	M	H	M	M	M	M	L	M
CO5	H	M	H	M	H	M	M	M	H	M	M	M	M	L	H

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	H	H	M	L	L
CO2	L	H	H	M	L	L
CO3	L	H	H	M	L	M
CO4	L	H	H	M	L	L
CO5	L	H	H	M	L	L

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V / Major Practical-7,8
ANIMAL PHYSIOLOGY, BIOTECHNOLOGY
MAJOR PRACTICAL (Core 7, 8: Animal Physiology, Biotechnology)**

Semester	V				
Course Type	MAJOR PRACTICAL				
Title of the Course	ANIMAL PHYSIOLOGY, BIOTECHNOLOGY				
Course Code					
Teaching Hours	3 Hours/ Week				
	ANIMAL PHYSIOLOGY	Credits: 4	Max. Marks: 100		
Course Prerequisites: The student should have basic practical knowledge on animal physiology The student should have basic practical knowledge on biochemistry					
CODE:	ANIMAL PHYSIOLOGY, BIOTECHNOLOGY	L	T	P	C
			-	2	2
Course Objectives	<ol style="list-style-type: none"> To analyse the idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis. To familiarise students with Qualitative test for carbohydrate, protein and lipid To inculcate/impart skills to perform various tests/assays and experiments. To provide an practical skill for the isolation of DNA from various sources To provide students with a deep insight of the various molecular techniques like PCR, electrophoresis 				

Course Outcomes (CO)

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Acquire knowledge on physiological role of Oxygen consumption	K1, K2, K3
CO 2	Impart knowledge on Effect of temperature on operculum movement of fresh water fish. Students will be able to understand Analyse the physiology of excretion in animals.	K1, K2, K3
CO 3	Obtain knowledge on Nerve Physiology and physiology of receptors. Students will also be exposed to make Models & Charts.	K1, K2, K3
CO 4	Improved skills to perform various tests/assays and experiments. Design and analyze the experiments related with the isolation of DNA from different sources	K1, K2, K3
CO 5	Use the techniques, skills, and modern tools necessary for imbalances in various life processes, design a research project, collect and analyze data, and interpret results. Obtain knowledge on enzyme technology	K1, K2, K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Syllabus

Animal physiology

1. Rate of Oxygen consumption in a fish
2. Effect of temperature on operculum movement of fresh water fish - Calculation of Q_{10}
3. Detection of Nitrogenous waste products of fish, birds & mammals - ammonia, uric acid and urea.
4. Effect of salinity on oxygen consumption by the fish
5. Qualitative test for carbohydrate (glucose), protein and lipid
6. Recording of heartbeat, muscle twitch, and reflexes in frog
7. Models, charts and photos:
 - a) Simple muscle twitch
 - b) Sphygmomanometer
 - c) Haemoglobinometer
 - d) Haemocytometer
 - e) Reflex arc model

Biotechnology

1. Isolation of genomic DNA.
2. Isolation of plasmid
3. Isolation of DNA by AGE
4. Immobilization of enzymes
5. PCR-Demonstration
6. Restriction digestion - Demonstration
Models /charts /photos: pBR 322, pUC8, Ti plasmid, lambda Phage, M13 Phage, SV40, CaMV, Restriction enzyme, recombinant DNA, Gene cloning, electroporation, microinjection, lipofection, Southern blotting, stem cells, Dolly, Trans genesis, animal cloning, organ culture.

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V Elective:(A)

FISH AND FISHERIES OF INDIA

FISH AND FISHERIES OF INDIA

Semester	V				
Course Type	ELECTIVE -				
Title of the Course	FISH AND FISHERIES OF INDIA				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	FISH AND FISHERIES OF INDIA	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on fish and fisheries of india					
CODE:	FISH AND FISHERIES OF INDIA	L	T	P	C
		4	-	-	4
Course Objectives	To study the fishery resources of riverine,lakes, reservoirs, estuaries and marine in India and also to understand the craft and gears employed for catching fishes.				
Module -I:	RIVERINE FISHERIES OF INDIA			10 hours	
Riverine Fisheries of India: Important characteristics of Stream. Ecology of riverine environment, form of river system, Different River System and their Fishes: The Ganga River System, the Brahmaputra River System, the East Coast River System, the West Coast River System , Indus river system.					
Module -II:	FISHERIES OF LAKES & RESERVOIRS			10 hours	
Fisheries of Lakes & Reservoirs: Origin, distribution, classification and ecology of lakes, fish and fisheries of major lakes and reservoirs of India, conservation and recent developments in reservoir management. Dams and their effect on fish migration:Importance of dams, ecological changes, effect on migratory fish- deleterious effect, fish ways.					
Module - III:	ESTUARINE FISHERY RESOURCES OF INDIA			14 hours	
Estuarine fishery resources of India: Definition origin and Classification; Geomorphological, physical and ecological classification. The Hooghly –Maltah estuary, The Mahanadi estuary, The Godavari estuary, The Krishna estuary, The Cauvery estuary, The Adayar estuary, The Vellar estuary, Chilka Lake, Pulicat lake and Kerala back waters.					
Module - IV:	MARINE FISHERIES OF INDIA			14 hours	
Marine Fisheries of India: Marine fish production in India, available fishing potential, sampling technique adopted for estimating marine fish landings, coastal fisheries of India. Commercially important pelagic-demersalcatches: Finfishes, Crustaceans, Prawns / shrimps, lobsters, crabs; molluscs, pearl fishery, chank fishery, clam fishery, oyster fishery, mussel fishery, sea cucumbers and sea weed resources of India.					
Module - V:	CRAFT AND GEARS: TRADITIONAL, MOTORIZED AND MECHANIZED MAJOR GEARS			12 hours	
Craft and Gears: Traditional, motorized and mechanized major gears: Fishing Crafts: Different types of fishing crafts in India- inland and marine– traditional, motorized and mechanized. country crafts, trawlers, gill netters, purse seiners, long liners, trollers, deep sea					

vessels. Fishing Gears: Factors affecting the design of fishing gears and fish catching methods. Traditional Fishing Gears: Design and operation of- gill nets, long lines, hooks, traps, stake net, dol net, Chinese dip nets, cast nets.

ReferenceBooks	<ol style="list-style-type: none"> 1. Jhingran, V.G., 1991, Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi. 2. Bal, D.V. and Rao, V.K., 1990, Marine Fisheries of India, Tata Magraw Hill, New Delhi. 3. Dixitulu, J.V.H. (Ed.), 1994. Hand Book on Fisheries. Global Fishing Chimes Pvt. Ltd., Visakhapatnam. 4. Iversen, E.S., 1996. Living Marine Resources, John Wiley & Sons, Inc., New York. 5. Khan, I., 1999, Marine Fishery Resources, Rajat Publications, New Delhi. 6. FAO. 1999, Aquaculture Production Statistics, 1988-'97. 7. Jayaram, K.C., 1999, The Freshwater Fishes of the Indian Region, Narendra Publication, New Delhi. 8. Munro, S.I., 1982, The Marine and Fresh Water Fishes of Ceylon. Soni Reprints Agency, New Delhi. 9. Silas, E.G., 1992, Fresh Water Prawns, Kerala Agricultural Univ., Kochi.
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Course Outcome

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

	Course Outcome	Knowledge Level according to (blooms taxonomy)
CO1	Understand the fishery resources, types of fishes, river system and river environment.	K1, K2, K4
CO2	Acquire knowledge on Lakes & Reservoirs of India and the fishery resources.	K1, K2, K5
CO3	Know the Estuarine fishery resources of India	K1, K2, K5
CO4	Develop knowledge on marine fishes of India and its production potentials, type of fishes, important landing Centres and estimation of fish catching.	K1, K2, K4
CO5	Obtain knowledge on craft and gears which are used for catching fishes, locating the fishery resources by using GPS, remote sensing, radio and fish resources in EEZ	K1, K2, K3, K5, K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	M	M	L	L	M	M	L	H	M	H	M	H	L	L	L
CO2	M	M	M	L	M	M	L	H	M	H	M	H	M	L	L
CO3	M	M	M	L	M	M	L	H	M	H	M	H	M	L	L
CO4	M	M	M	L	M	M	L	H	M	H	M	H	M	L	L
CO5	M	M	M	L	M	M	L	H	M	H	M	H	M	L	L
CO6	M	M	M	L	M	M	M	H	M	H	M	H	M	L	L

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	M	L	M	L	M
CO2	L	M	L	M	L	M
CO3	L	M	L	M	L	M
CO4	H	M	L	H	L	M
CO5	L	M	L	H	L	M
CO6	M	L	L	M	L	M

OR

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V Elective: (A) CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT

CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT

Semester	V				
Course Type	ELECTIVE -				
Title of the Course	CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on coral reef and mangroves - ecology and management					
CODE:	CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT	L	T	P	C
		4	-	-	4
Course Objectives	To study the coral reef and mangroves - ecology and management to understand the Conservation and management of coral reef & mangroves.				
Module -I:	CORAL REEFS			10 hours	
Coral reefs – Types, structure and distribution in world oceans. Zonation and limiting factors. Factors influencing the growth, productivity, reproduction, larval dispersal and settlement of corals. Major species of corals in India. Protected coral reefs.					
Module -II:	ECOLOGY OF CORAL REEFS			10 hours	
Ecology of coral reefs: Major reef communities, species interactions, food chains and food webs, symbiotic relationships. Crypto-fauna, Ecology of reef fishes. Natural processes and succession in coral reefs, Interactions with adjacent ecosystems. Degradation and destruction of coral reefs: impact of climate change and anthropogenic interventions including destructive fishing practices.					
Module - III:	CORAL REEF CONSERVATION			14 hours	
Coral reef conservation measures. Activities of various organizations in coral reef conservation and management. Ecosystem services of coral reefs.					
Module - IV:	MANGROVE ECOSYSTEMS			14 hours	
Mangrove ecosystems. Distribution of mangroves – global, regional and local levels. Major species of mangroves. Mangrove diversity, zonation and adaptations. Faunal and floral communities in mangrove ecosystem, food chains and food webs. Ecosystem services of mangroves.					
Module - V:	CONSERVATION AND MANAGEMENT			12 hours	
Conservation and management: principles of ecological restoration –habitat enhancement, afforestation; Mangrove conservation activities around the world; Use of Remote Sensing and GIS techniques for mapping mangrove distribution; Joint Mangrove Management (JMM) programme.					
ReferenceBooks	<ol style="list-style-type: none"> 1. Bakus, G.J., 1994. Coral reef ecosystems. Oxford and IBH publishing Company, New Delhi: 232 p. 2. Colin D. Woodroffe (auth.), Howard J. Teas (eds.). 1993, Biology and ecology of mangroves. Springer Netherlands 189 pp. 				

	<ol style="list-style-type: none"> 3. Mark D. Spalding, Edmund P. Green, Corinna Ravilious. 2001. World Atlas of Coral Reefs. University of California Press 430 pp 4. McClanahan T. R., C. R. C. Sheppard, D. O. Obura. 2000. Coral Reefs of the Indian Ocean: Their Ecology and Conservation. Oxford University Press, USA 550 pp. 5. Naskar, K. 2004. Manual of Indian Mangroves. Daya Publishers, New Delhi. 220 p. 6. Peter, S. (Ed.) 2006. Coral reef fishes: Dynamics and diversity in a complex ecosystem, Academic Press, London. 7. Yuri I. Sorokin (auth.). 1993. Coral Reef Ecology. Springer-Verlag Berlin Heidelberg 475 pp.
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Course Outcome

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

	Course Outcome	Knowledge Level according to (blooms taxonomy)
CO1	Understand the Coral reefs – Types, structure and distribution in world oceans.	K1, K2, K4
CO2	Acquire knowledge on Major reef communities, species interactions, food chains and food webs, symbiotic relationships and impact of climate change and anthropogenic interventions	K1, K2, K5
CO3	Know the Coral reef conservation measures	K1, K2, K5
CO4	Develop knowledge on distribution of mangroves, mangrove diversity and Faunal and floral communities in mangrove ecosystem	K1, K2, K4
CO5	Obtained knowledge on Conservation and management of Coral reefs and mangroves	K1, K2, K3, K5, K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	M	M	L	L	M	L	L	L	M	H	M	H	L	L	L
CO2	L	M	L	L	M	L	L	L	M	H	M	L	M	L	L
CO3	M	L	M	L	L	M	L	H	L	L	L	H	M	L	L
CO4	L	M	L	L	M	M	L	H	M	H	M	L	M	L	L
CO5	M	M	M	L	L	L	L	H	M	H	M	H	M	L	L
CO6	M	M	M	L	M	M	M	H	M	H	M	H	M	L	L

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	M	L	M	L	M
CO2	M	M	L	M	L	L
CO3	L	L	M	M	L	M
CO4	H	M	L	H	M	L
CO5	L	M	L	H	L	M
CO6	M	L	L	M	L	M

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V/ Elective: 5 (B)

Culture and Capture Fisheries

Culture and Capture Fisheries

Semester	V				
Course Type	Elective – 5 (B)				
Title of the Course	CULTURE AND CAPTURE FISHERIES				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	CULTURE AND CAPTURE FISHERIES	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on culture and capture fisheries					
CODE:	CULTURE AND CAPTURE FISHERIES	L	T	P	C
		4	-	-	4
Course Objectives	To study the aquaculture, their scope, types, inland fisheries.				
Module -I:	AQUACULTURE IN GENERAL	12 hours			
Aquaculture in General: Introduction – scope of aquaculture –aquaculture in India and world – salient feature of cultivable species of fin fishes & shell fishes, there suitability for culture. Site selection of aquaculture, preparation of ponds – lay out – construction & maintenance of nursery – rearing & culture ponds – control of predatory organisms & weeds in aquaculture ponds.					
Module -II:	KINDS OF AQUACULTURE	12 hours			
Kinds of aquaculture: Eextensive – semi intensive and intensive, monoculture – mono sex culture – composite culture – integrated forming – sewage fed fisheries – paddy cum fish culture – pen & cage culture – race way culture. Culture of different organisms – finfish culture – Indian major Carps – shell fish culture – culture of freshwater & marine prawns – lobsters – edible & pearl oysters – crab culture –frog culture.					
Module - III:	HATCHERY TECHNOLOGY	12 hours			
Hatchery Technology: Broodstock maintenance – hyphophysation – hatching methods. Seed and brood fish transport production of monosex & sterile fish –transgenic fish. Nutritional requirements in hatcheries – culture of fish feed organism – phytoplankton (diatom) – zooplankton (rotifers, cladocerains) – brine shrimp – tubifex.					
Module - IV:	INLAND CAPTURE FISHERIES	12 hours			
Inland capture fisheries – importance of capture fisheries of India and the world. Present yield and estimates of potential – international fishery commissions the fishery resources of india – reservoir fisheries – riverine fisheries of major & minor carps – cat fishes & other groups - cold water fishery resources – fisheries of trout – marshy & other cold water species – crafts & gears					
Module - V:	MARINE CAPTURE FISHERIES	12 hours			
Marine capture fisheries; marine fishery resources in India – problems of inshore fishing – fishery resources of continental shelf – pelagic fishery resources of India. Fisheries of oil sardine and anchovies – other clupeoids – mackerals – carangids – cephalopods, mid water & demarshal fishes; fisheries of elasmobranchs –flat fishes – prawns – lobsters. Biological aspects of fishery					

management.

Reference Books	<ol style="list-style-type: none"> 1. Jhingran V.G., 1991, Fish and Fisheries of India. Hindustan Publication Corpn. (India) New Delhi. 2. Srivastava C.B.L., 2013, Fishery Science and Indian Fisheries, KitabMahal, New Delhi. 3. Khanna S.S. and H.R. Singh, 2014, A Text book of Fish Biology & Fisheries, 3rd Edition, Narendra Publication House, New Delhi. 4. Chakroff, M., 2015, Fresh Water Pond Culture and Management, Scientific Publishers, Jodhpur. 5. Chakrabarthy, N.M., 2009, Biology Culture & Production of Indian Major Carps: A Review, Narendra Publications House, New Delhi. 6. Chond, S.L., Hypophysation of Indian Major Carps, Satish book Enterprise, Agra. 7. Latha Shenoy, 1987, Manual on Fishing Technology, CIFE. 8. Biswas K.P.A., 1996, Text book of Fish, Fisheries and Technology, 2nd Edition, Narendra Publication House, New Delhi. <p>John C. Sainsbury, 1996, Commercial Fishing methods, An Introduction to Vessels and gear fishing news (Books) Ltd. Surey, England.</p>
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Course Outcomes (CO)

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

No.	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO 1	Acquire knowledge on basic aquaculture methods like Site selection of aquaculture, preparation of ponds – lay out – construction & maintenance of nursery – rearing & culture ponds	K1, K2, K3
CO 2	Impart knowledge on different types of aquaculture methods and culture of different organisms.	K1, K2, K3
CO 3	Students will be able to understand the types of hatchery technology and nutritional requirements in hatcheries	K1, K2, K3
CO 4	Obtain knowledge on importance of capture fisheries of India and the world, reservoir fisheries – riverine fisheries	K1, K2, K3
CO 5	Gain the knowledge on marine fishery resources in India and fishery resources	K1, K2, K3

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO 1	H	H	H	H	M	M	H	H	M	H	L	M	L	L	M
CO 2	H	H	H	M	M	L	M	H	M	H	L	L	L	L	L
CO 3	H	M	M	L	H	L	M	M	M	H	M	L	M	L	L
CO 4	M	H	M	M	H	M	M	H	L	H	L	L	L	L	M
CO 5	M	L	M	L	L	H	M	L	M	H	M	L	M	L	M

Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	L	L	L	H	L	L
CO 2	M	H	M	M	M	L
CO 3	L	M	L	L	L	M
CO 4	H	L	H	H	L	L
CO 5	H	L	L	H	L	L

OR

MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V/ Elective: 5 (B)

FISH BIOLOGY

FISH BIOLOGY

Semester	VI				
Course Type	Elective – 5				
Title of the Course	FISH BIOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	FISH BIOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on fish biology					
CODE:	FISH BIOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	To study the evolution of fishes, morphology and anatomy fishes, food habits of fishes and behavior of fishes.				
Module -I:	EVOLUTION OF FISHES			10 hours	
Evolution of fishes - fish phylogeny- ostracoderms placoderms hagfishes, Chondrichthyes osteichthyes- evolutionary trends. outline classification. Ecology – reef fishes- pelagic fishes- adaptations. Zoogeography – Marine fishes – Continental shelves, tropical, subtropical, temperate, arctic , Antarctic and polar regions. Procedure for fish sampling.					
Module -II:	EXTERNAL FORM AND STRUCTURE			10 hours	
External form and structure - Fish integument – Locomotion – Alimentary system and nutrition - Accessory respiratory organs - sensory mechanisms - Acoustico-lateral line system - Osmotic/ionic regulation and acid base balance - Buoyancy regulation - Air bladder and its functions – Weberian ossicles. Circulatory and nervous systems.					
Module - III:	FOOD AND FEEDING HABITS			14 hours	
Food and feeding habits – methods – merits and demerits of methods – food habits of commercially important marine fin fishes. Length-weight relationship – estimation – gastro-somatic index. Growth- factors affecting growth – hard parts – estimation.					
Module - IV:	SPAWNING AND MATURATION			14 hours	
Reproduction – spawning and maturation – gonado-somatic index- length at minimum maturity – relative condition factor – sex ratio and metamorphosis – Sexual cycle and fecundity - egg/larval development, Parental care. Spawning season of commercially important marine fin fishes					
Module - V:	BEHAVIOR– MIGRAION			12 hours	
Behavior– migratory, shoaling, feeding behavior, communication modalities - community structure - Fish migration - Deep sea adaptations – climate change and its impact on marine fishes.					
ReferenceBooks	<ol style="list-style-type: none"> 1. Marshall & Williams. Textbook of Zoology. Vol.I. Parker and Hasswell. Textbook of zoology, Vertebrates. Vol.II. 2. Day, F. The fishes of India. S.S. Khanna. An introduction to fishes. 3. K.G. Lagler. Ichthyology. Gene Helfman, Bruce B.Collette, Douglas E. Facey, and Brian W. Bowen. The Diversity of Fishes: Biology, Evolution, 				

	<p>and Ecology. ISBN: 978-1-4051-2494-2 736 pages, May 2009, Wiley-Blackwell.</p> <p>4. Cailliet, G., M. Love, A. Ebeling 1986. Bond's Biology of Fishes 3rd edition by Michael Barton ISBN: 0120798751 Fishes – An Introduction to Ichthyology (5 th edition).</p> <p>5. Ayyappan, S. 2011. Handbook of Fisheries and Aquaculture. Indian Council of Agricultural Research, New Delhi.</p> <p>6. Badapanda, K.C. 2013. Basics of Fisheries Science.Vol III Fishing Craft & Gear Technology.Narendra Publishing House. ISBN 9789380428741</p> <p>7. Bardach, J.E., Rythor, J.H. and MeLarney, W.O. 1972. Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms. New York, WileyInterscience, 868 p.</p> <p>8. Beveridge, M.C.M. 2004. Cage Aquaculture 3rd edn. Blackwell Publishing, Oxford.</p> <p>9. Jhingran,V.G. 1991. Fish and Fisheries of India, Hindustan Pub. Corp. (India), ISBN 9788170750178., 727 p.</p> <p>10. Kumar, H.D. 2003. Sustainability and Management of Aquaculture and Fisheries. Daya Publishing House, Delhi. Kurian C.V. and Sebastian, V.O. 1976. Prawn and Prawn Fisheries of India. Hindustan Pub. Corp., Delhi.</p> <p>11. Mischke, C.C. (Ed.) 2012, Aquaculture Pond Fertilization: Impacts of Nutrient Input on Production.Wiley-Blackwell, Oxford.</p> <p>12. Modayil, M.J. and Jayaprakash,A.A. 2003. Status of Exploited Marine Fishery Resources of India, CMFRI, Kochi.</p>
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Course Outcome

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

	Course Outcome	Knowledge Level according to (blooms taxonomy)
CO1	Understand the evolution of fishes, zoogeography, and the procedure for fish sampling .	K1, K2, K4
CO2	Acquire knowledge on Fish integument, Locomotion, Alimentary system, Accessory respiratory organs - sensory mechanisms and lateral line system.	K1, K2,K5
CO3	Obtain knowledge on food habits of commercially important marine fin fishes	K1, K2, K5
CO4	Understand the reproductive biology of marine and fresh water fishes and Spawning season of commercially important marine fin fishes	K1, K2, K4
CO5	Obtain knowledge on fish behavior, Fish migration, Deep sea adaptations and climate change and its impact on marine fishes	K1, K2,K3,K5, k6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	M	M	L	L	M	M	L	L	M	H	L	H	L	L	L
CO2	M	M	L	L	M	L	L	H	M	L	M	L	M	L	L
CO3	L	L	M	L	L	M	L	L	L	H	L	L	M	L	L
CO4	M	M	L	L	M	M	L	H	M	H	M	H	M	L	L
CO5	M	M	M	L	M	M	L	H	M	L	M	L	M	L	L
CO6	M	M	M	L	M	L	M	H	M	H	M	H	M	L	L

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	M	L	M	M	M
CO2	L	M	L	M	L	M
CO3	L	L	L	M	M	L
CO4	H	M	L	H	L	M
CO5	L	M	L	H	L	M
CO6	M	L	L	M	L	M

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V / Elective Practical -
FISH AND FISHERIES OF INDIA, CULTURE AND CAPTURE FISHERIES**

FISH AND FISHERIES OF INDIA, CULTURE AND CAPTURE FISHERIES

Semester	V				
Course Type	ELECTIVE PRACTICAL				
Title of the Course	FISH AND FISHERIES OF INDIA, CULTURE AND CAPTURE FISHERIES				
Course Code					
Teaching Hours	3 Hours/ Week				
	FISH AND FISHERIES OF INDIA, CULTURE AND CAPTURE FISHERIES	Credits: 2	Max. Marks: 100		
Course Prerequisites:					
<ol style="list-style-type: none"> The student should have basic practical knowledge on fish and fisheries of India The students would acquire knowledge to identify important cultivable fin and shellfish species, their culture practices, hatchery production of seeds, difficulties like common diseases which are met in the culture practice, etc. 					
CODE:	FISH AND FISHERIES OF INDIA, CULTURE AND CAPTURE FISHERIES	L	T	P	C
			-	2	2
Course Objectives	<p>To identify and locate the fishery resources of riverine, lakes, reservoirs, estuaries and marine in India and also to understand the landing centers.</p> <p>To identify and study about commonly available cultivable finfishes and crustaceans.</p> <p>To know the different characters of penaeid and non penaeid shrimp, along with identification of male and female sex organs in penaeid shrimp</p> <p>To study the important phyto plankton and zoo plankton, which are mainly used as live feed organisms in shrimp hatcheries</p> <p>To identify common diseases encountered in cultivable fin and shell fishes</p> <p>To visit to fish landing centers and identify and record the fish specimens, also to visit shrimp farms and hatcheries and make a report about the visit.</p>				

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO1	Identify and locate the major rivers, reservoirs, dams and estuaries of India. Know the major landing centres of India. Identify and name the major fresh, brackish and marine water fishes of India	K2,K3,K5
CO2	Identify the major fresh, brackish and marine water fish landing centres of India. Acquire hand on experiences on operating cast net and making of different nets, knots, fishing traps	K1,K2
CO3	Identify commonly available cultivable finfishes and crustaceans. To know the differences between the characteristics of penaeid and non	K1,K2,K3,K5

	penaeid shrimp, and also they can able to identify the male and female sex organs in penaeid shrimp. To identify the important phyto and zoo plankton, which are mainly used as live feed organisms in shrimp hatcheries	
CO4	Acquire knowledge to identify common diseases seen in cultivable fin fishes and shell fishes	K1,K2,K3,K4
CO5	To identify and record the fish specimens from fish landing centres and also they can able to understand about shrimp farming and hatchery system after their field visit	K1,K2,K3,K4,K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Syllabus:

Fish and fisheries of india

1. Map: a) Major rivers in India b) Major brackish water resources in India c) Major lakes in India d) Major lagoons in India e) Major dams in India
2. Collect the photos and identify at least 50 fishes from different fishery resources
3. Map the Major Landing centers in India
4. Map the inland fishery regions of India
5. Study visit to landing Centers in Kanyakumari District and record the fish landing for oneweek time
6. Collect the photos of major crafts and gears in India
7. Operate a Cast net and identify and quantify the fishes
8. Learn to make different types of nylon net, knots and fishing traps used in fishing

Culture and capture fisheries

1. Identification and study of important cultivable and edible fishes (any ten)
2. Identification and study of important cultivable and edible crustaceans (any five)
3. Identification of penaeid and non penaeid shrimp and their characteristics
4. Identification of male and female sex organs of penaeid shrimp
5. Identification and study of important zooplankton and phytoplankton (any five in each)
6. Identification and study of fish and prawn diseases – using specimens/pictures
7. Visit to fish landing centres and shrimp farms & shrimp hatcheries

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –V / Elective Practical -
CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT, FISH
BIOLOGY**

**CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT, FISH
BIOLOGY**

Semester	V				
Course Type	ELECTIVE PRACTICAL				
Title of the Course	CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT, FISH BIOLOGY				
Course Code					
Teaching Hours	3 Hours/ Week				
	CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT, FISH BIOLOGY	Credits: 2	Max. Marks: 100		
Course Prerequisites:					
<ol style="list-style-type: none"> 1. The student should have basic practical knowledge on methods employed in field collection and preservation of biological samples 2. The students would acquire knowledge to identify cultivable and edible fin fish species, sex differentiation, etc. 					
CODE:	CORAL REEF AND MANGROVES - ECOLOGY AND MANAGEMENT, FISH BIOLOGY	L	T	P	C
			-	2	2
Course Objectives	To documented record of the field and laboratory works. To know the preservation of biological samples To study the important different phyla and classes of corals and mangrove To identify associated faunal and floral communities and their seasonal variations.				

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO1	Identify and locate the major rivers, reservoirs, dams and estuaries of India. Know the major landing centres of India. Identify and name the major fresh, brackish and marine water fishes of India	K2,K3,K5
CO2	Identify the major fresh, brackish and marine water fish landing centres of India. Acquire hand on experiences on operating cast net and making of different nets, knots, fishing traps	K1,K2
CO3	Identify commonly available cultivable finfishes and crustaceans. To know the differences between the characteristics of penaeid and non penaeid shrimp, and also they can able to identify the male and female sex organs in penaeid shrimp. To identify the important phyto and zoo	K1,K2,K3,K5

	plankton, which are mainly used as live feed organisms in shrimp hatcheries	
CO4	Acquire knowledge to identify common diseases seen in cultivable fin fishes and shell fishes	K1,K2,K3,K4
CO5	To identify and record the fish specimens from fish landing centres and also they can able to understand about shrimp farming and hatchery system after their field visit	K1,K2,K3,K4,K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 - Create

Syllabus:

Coral reef and mangroves - ecology and management

1. Identification of representative examples coming under different phyla and classes dealt with in theory.
2. Materials and methods employed in field collection and preservation of biological samples.
3. Case studies of selected coral reef, inter-tidal and mangrove ecosystems.
4. Inventory of associated faunal and floral communities and their seasonal variations.
5. Documented record of the field and laboratory works.

Fish biology

1. Fresh water and marine edible fish identification.
2. Sex identification of fresh water and marine fish.
3. Spotters:
Air bladder, Accessory respiratory organs, sensory mechanisms, lateral line sense organ, Circulatory and nervous systems.
4. Determination of gastro-somatic index.
5. Calculation of gonado-somatic index

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –VI/ Core 9/Ppr-...
RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION**

RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION

Semester	VI				
Course Type	Core 9				
Title of the Course	RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on recent developments in live feed production					
CODE:	RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION	L	T	P	C
		4	-	-	4
Course Objectives	To inculcate the recent technologies to the learners on isolation, culture, harvest and feeding of live feeds to the young ones of cultivable fishes and feeding management.				
Module -I:	INTRODUCTION TO LIVE FEED			12 hours	
Introduction to live feed: Definition, advantages, Nutritional Value, Types of live feed, live feed selection and larval feeding.					
Module -II:	PHYTOPLANKTON			12 hours	
Phytoplankton: Isolation, Stock culture, Outdoor mass culture, Culture media Preparation, Culture methods, Harvest and Feeding, Processing and Preservation, Cryopreservation of microalgae, Enrichment, Important phytoplankton in aquaculture. Isolation, Stock maintenances and Culture of Chaetoceros Sp., Nannochloropsis, Tetraselmis sp., Skeletonema sp., Thalassiosira sp.,					
Module - III:	ZOOPLANKTON			12 hours	
Zooplankton: Isolation, Stock Maintenance, Outdoor mass Culture, Different culture Systems, larval feeding, Preservation of Zooplankton, culture and feeding of Rotifer, Cyclopes, Moina, Daphnia, Paramecium and Artemia nauplii					
Module - IV:	ALTERNATIVE LIVE FEEDS			12 hours	
Alternative live feeds: Culture methods of Infusoria, Chironomids, white worms, earthworms, mosquito larvae. Periphyton culture - Importance of periphyton in aquaculture, Species composition, Methods for the development and maintenance of Periphyton; Nutritional qualities of alternative live feeds.					
Module - V:	CULTURE SYSTEMS			12 hours	
Culture Systems: Different types of culture system of phyto and zooplankton, Culture tanks and vessels, Aeration System, Harvesting methods, Estimation of live feed in LRT, Photobioreactors, Purification of stock culture from contamination, System controlled automated plankton culture System and feeding, live feeds in bio flock culture system.					

ReferenceBooks	<ol style="list-style-type: none"> 1. Hand book on Ingredients for Aquaculture Feeds, Joachim W. Hertrampf and Felicitas Piedad – Pascual, Kluwen Academy publisher, ISBN: 978-81-8128-919-3, 2008. 2. Live Feeds in Marine Aquaculture, JosianneSlottrup and Lesley AnicEvoy, ISBN: 0632054956, 2003. 3. Live Food in Aquaculture, Atsushi Hagiwara, Springer Science & Business media. 4. Manual on the production and use of Live food for Aquaculture, Patrick Lavens and Patrick Sorgeloos, Laboratory of Aquaculture and Artemia Reference center, University of Ghent, ISBN: 92-5-103934-8, 1996. 5. Live Feed culture, Trainers training Centre, Central Marine Fisheries Research Institute, Indian Marine Fisheries Research Institute, 1998. 6. Algae, Laura Barsanti, Paolo Gualtieri, CRC Press Taylor & Francis Group LLC, ISBN10: 0-8493-1467-4, 2006. 7. 7.Introduction to Marine Plankton, Abhijit Mitra, KakoliBanerjee, AvijitGangopadhyay, Daya publishing house, ISBN: 978-81-7035-32
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Course Outcome

On the successful completion of the course, students will

No.	Course outcome	Knowledge level according to (Blooms taxonomy)
CO 1	Understand the definition, advantages, Nutritional Value, Types of live feed, live feed selection and larval feeding.	K1, K2
CO 2	Acquire knowledge on isolation and culture of phytoplankton, media preparation, different culture methods, harvest and feeding of phytoplankton to larvae	K1, k2, k3, K5
CO 3	Acquire knowledge on isolation, culture methods, feeding and harvest of Zooplankton.	K1, K2, k5
CO 4	Develop knowledge on isolation, culture, feeding, harvest and preservation of alternative live feed other than Phyto and Zooplankton.	K2, K3, K5
CO 5	Obtain a thorough understanding about the different culture system and management.	K1, K2, K4, K5

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	L	M	L	L	L	L	M	L	H	M	L	L	L	L
CO2	H	L	M	M	M	L	M	H	H	M	M	L	L	M	L
CO3	H	L	M	M	M	L	M	H	H	M	M	L	L	M	L
CO4	H	L	M	M	M	L	M	H	H	M	M	L	L	M	L
CO5	H	L	M	M	M	L	M	H	H	M	M	L	L	M	L
CO6	H	L	M	M	H	L	M	H	H	M	H	L	M	M	L

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	M	L	L	M	H	M
CO2	M	L	L	M	H	M
CO3	M	L	L	M	H	M
CO4	M	L	L	L	H	M
CO5	M	L	L	L	H	M
CO6	M	L	L	L	H	L

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –VI/ Core 10
FUNDAMENTALS OF GENETICS**

FUNDAMENTALS OF GENETICS

Semester	VI Semester				
Course Type	Core Paper -				
Title of the Course	FUNDAMENTALS OF GENETICS				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	FUNDAMENTALS OF GENETICS	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on genetics & Mendelian Laws					
CODE:	FUNDAMENTALS OF GENETICS	L	T	P	C
		4	-	-	4
Course Objectives	To understand the basic phenomenon in genetics and to attain a thorough knowledge on genetic variations and related problems in animals and humans. Genetics allows for the understanding of the structure and function of genes and chromosomes as well as the harmful effects of mutations which can cause various genetic disorders				
Module 1	HISTORY & MENDELIAN INHERITANCE			12 hours	
Historical background, Principles of Mendelian inheritance, Mendelian inheritance patterns and Mendelian laws of heredity. Modification of Mendelism – complete and incomplete dominance and codominance, complementary, supplementary, lethal genes in man. Interaction of genes; Multiple alleles - A, B, O blood groups, Rh factors in man – Erythroblastosis foetalis; Multiple genes (polygenic inheritance) – skin colour in man; Sex linked inheritance - Hemophilia, Colour blindness, hypertrichosis; Sex influenced and Sex limited traits, lethal genes, and multiple alleles, polygenic inheritance, complementation test; Extra chromosomal inheritance: Maternal inheritance (mitochondria and chloroplast)- inheritance in paramecium – maternal predetermination in coiling of shells;					
Module 2	LINKAGE & POPULATION GENETICS			12 hours	
Linkage: complete and incomplete linkage, linkage analysis and genetic maps, Linkage and recombination of gene, Mechanism of crossing over, Genetic analysis: calculating recombination frequencies, Linkage maps, types of molecular markers, mapping with molecular markers, Gene mapping by three point test cross, Tetrad analysis, Sex determination and Dosage compensation in Mammals and Drosophila, Quantitative Genetics: Gene pool concept – Hardy – Weinberg Equilibrium – genes –frequencies in the population- factor affecting gene frequency – selection - mutation – drift & meiotic drive – migration. Animal breeding – Inbreeding and out breeding – heterosis.					
Module 3	MUTATION			12 hours	

Mutations: concept and types, Mechanism of spontaneous mutations, Physical and chemical mutagenesis, Selection and enrichment of mutants, Molecular mechanism of induced and spontaneous mutations, importance of mutation; detection of mutation and directed mutagenesis, types of mutations: insertion, deletion, duplication, translocation, transposition, frame-shift, mis-sense, non-sense, regulatory region mutations. Consequences of mutations. Replica plating experiment, Luria and Delbruck test, Numerical alterations of chromosomes: Ploidy and their genetic implications. Non disjunction in man – detection of mutation by CLB method.		
Module 4	HUMAN GENETICS	12 hours
Human genetics – twins, human chromosomes, karyotypes, ideogram, simple Mendelian traits in man. Inborn errors of metabolism – phenylketonuria, alkaptionuria, albinism, sickle cell anaemia, chromosomal abnormalities – autosomal & sex chromosomes – syndromes in man (Klinefelter’s syndrome, Turner’s syndrome & Down’s syndrome) Improvement of human race – Eugenics, Pedigree analysis, Medical genetics – Genetic prognosis – Genetic counseling – family history – Preventive measures – Medico – legal aspects – Effect of drug on human heredity.		
Module 5	BACTERIAL & VIRAL GENETICS	12 hours
<i>E.coli</i> – Transformation of genetic material in bacteria & bacteriophages, conjugation, transduction, sex duction – genetic applications of bacteria – Identification of genetic material – structure, lifecycle of bacteriophages – T4 Phage – recombinations of viruses, genetic applications of viruses.		
Reference Books	<ol style="list-style-type: none"> 1. Daniel L. Hartl, Bruce Cochrane, 2017, Genetics, 9th Edition, Jones and Bartlett Publishers, Inc. 2. Douglas J. Futuyma, Mark Kirkpatrick, 2017, Evolution, 4th Edition, Sinauer 3. Douglas S. Falconer, Trudy FC Mackay, 1995, Introduction to Quantitative Genetics, 4th Edition, Longman Scientific & Technical, UK 4. Gardner, E.J., Simmons, M.J. and Snustad, D.P., 2006, Principles of Genetics, 8th Edition, John Wiley & Sons Inc. 5. Gupta, PK, 2009, Genetics, Rastogi Publications. 6. Monroe W. Strickberger, 1985, Genetics, Macmillan USA. 7. Rasmus Nielsen, Montgomery Slatkin, 2013, An Introduction to Population Genetics Theory and Applications, Oxford University Press, USA. 8. Verma, PS, Agarwal, VK, 2009, Genetics, 9th Edition, S. Chand & Co. Ltd 9. Verma, PS, Agarwal, VK, 2013, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Pvt. Ltd. 10. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, University of Alberta, 2016, Essentials of Genetics, 9th Edition, Prentice Hall Internationals. 	
Web Sources	<ol style="list-style-type: none"> 1. https://journals.sagepub.com/doi/full/10.1177/0962280215597579 (mendelian genetics) 2. https://www.sciencedirect.com/science/article/abs/pii/S0962892416301271 (cell cycle, division) 3. https://onlinelibrary.wiley.com/doi/abs/10.1111/mec.13736 (linkage and crossing over) 4. https://onlinelibrary.wiley.com/doi/abs/10.1002/em.21945 (Structural, numerical chromosomal mutations) 5. https://www.genetics.org/content/203/2/699.short (pedigree analysis) 	

Course Outcomes (CO)

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

	Course Outcomes	Knowledge level according to (Blooms taxanomy)
CO1	Outline the basic principles of Mendelian genetics and compare and analyse different inheritance patterns as well as solve problems based on genetic principles	K1, K2, K3, K4
CO2	Understand about the linkage, crossing over and population genetics	K1, K2, K3, K4
CO3	Compare and contrast different mutations, their effects on cells and the application of the same to research	K1, K2, K4, K5
CO4	Get an idea about the human genetics including inborn errors of metabolism, sex linked inheritance, medical genetics	K1, K2, K3, K4, K5
CO5	Understand the genetics in bacteria and virus	K1, K2

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 – Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	H	M	H	H	M	L	M	L	M	H	L	L	L	L	M
CO2	H	M	H	H	M	L	M	L	M	H	L	L	L	L	M
CO3	H	M	H	H	M	L	M	L	M	H	L	L	L	L	M
CO4	H	M	H	H	M	L	M	L	M	H	L	L	L	L	M
CO5	H	M	M	H	L	L	M	L	L	H	L	L	L	L	H

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	M	L	L	H	L	L
CO2	M	L	L	H	L	L
CO3	M	L	L	H	L	M
CO4	M	L	L	H	L	M
CO5	M	L	L	H	L	L

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –VI/ Core 11
 BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS**

BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATION

Semester	VI Semester				
Course Type	Core Paper 11				
Title of the Course	BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATION				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATION	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should possess basic knowledge on descriptive and non-descriptive methods of Mathematics and their application in Biology incorporating computer system. The course explains the applications of computer in biology and statistical analysis of experimental data. Further the course gives an idea on the origin and evolution of bioinformatics and its importance in biotechnology, genomics and proteomics. It gives an outline on the various bioinformatics and computational tools used in analyzing protein, gene and genome data base.					
CODE:	BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATION	L	T	P	C
		4	-	-	4
Course Objectives	<ol style="list-style-type: none"> 1. To know the basic concepts of biostatistics like history & growth of statistics and statistical methods and to understand about data, their types, and methods involved in collection of data and presentation of data through various modalities. 2. Enable to understand the statistical measures through determination of averages, deviations, test of significance, hypothetical analysis, correlation & Regression analysis, etc. 3. To understand about basic computer application in relation with analysis of biological data by using various computer software technique. 4. To recognize the basic concept in bioinformatics and its major data base, which includes definition, scope and application of bioinformatics in Biology such as sequence analysis & data base and the common bioinformatics tools which are applied in data base analysis. 				
Module 1	BASIC CONCEPTS OF STATISTICS			10 hours	
Collection of data – Primary and secondary data. Classification and tabulation of data. Diagrammatic and graphic representations. Measures of Central tendency – Mean, median, and mode – Individual and continuous series only					
Module 2	DATA INTERPRETATION			14 hours	
Measures of Dispersion and Analysis: Range, Quartile Deviation, Standard Deviation, Standard error. Correlation and Regression. Test of Significance: Chi-square test, Student's t- test, F test.					

Module 3	BASICS IN COMPUTER	12 hours
Introduction to computer, Generation of computer – Components of computer, Input devices and Output devices – CPU – Primary and Secondary Memory operating system. Introduction to M.S. Office software, covering, word processing, spread sheet and presentation software. MS Word basics: Creating word document – File, edit, Format, Save menus, adding bullets, numbering and symbols – printing. MS Excel – entering and editing cell entries – adjusting row and column height – Pie-bar-line chart preparation. Uses of Internet – Email, Internet Browsing, World Wide Web (WWW), MS Power point.		
Module 4	BASICS IN BIOINFORMATICS	12 hours
Introduction – Definition of Bioinformatics – History – Importance of Bioinformatics – Scope and application of Bioinformatics – Components of Bioinformatics - Bioinformatics in life science. Biological sequence analysis – Sequence alignment – Pair wise sequence comparison – multiple sequence alignment.		
Module 5	MAJOR DATA BASES IN BIOINFORMATICS	12 hours
Nucleic acid sequence databases – EMBL – Genbank – Protein sequence database – SWISS – PROT. Databases similarity search Tools: BLAST, FASTA – Application of bioinformatics tools. Database Retrieval Tools: ENTREZ – Locus link – Pub Med (Publishers on Medicine) SRS. Protein structure visualizing tools – RasMol, Swiss PDB viewer.		
ReferenceBooks	<ol style="list-style-type: none"> Gupta, S.P., 2010, Practical Statistics, S. Chand and Company, New Delhi. Jerold H. Zar, 1984, Biostatistical analysis (2nd Edition), Prentice Hall International Edition. Rangaswamy R.A., 2010, Text Book of Agriculture Statistics, 2nd Edition, New Age International Publishers. Arora, P.N., and Malhan, P.K., 2012, Biostatistics (5th Edition), Himalaya Publishing House. Gurumani. N., An Introduction to Biostatistics (Computer Application included), 2nd Edition M.J.P. Publishers. MS OFFICE for Win 95 - Microsoft Office Press. Christine Solomon, 1995, Developing Applications with MS OFFICE, Microsoft Office Press, US. Rajaraman, V., 2010, Fundamentals of Computers, 5th edition, PHI Learning. Dan, E. Krane and Michael L. Raymer, Fundamental Concepts of Bioinformatics, Pearson Education (Singapore) PTE Limited. Ignacimuthu, S., 2013, Basic Bioinformatics, 2nd Edition, Narosa Publishing House Private Limited. Ranga, M.M., 2007, Bioinformatics, 2nd Edition, Agrobios India. Murthy, C.S.V., 2007, Bioinformatic, Himalaya Publishing House. 	
Web Sources	<ol style="list-style-type: none"> Biostatistics & Epidemiology: Web Resources - Alfaisal https://libguides.alfaisal.edu › biostat › web › resources What are some online sources to learn biostatistics? - Quora https://www.quora.com › What-are-some-online-sources What is Biostatistics? https://www.biostat.washington.edu › about › biostatistics 	

Course Outcomes (CO)

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

	Course Outcomes	Cognitive
CO1	Understand about the basic concepts of Biostatistics, meaning of data, different types of statistical data, their collection methods, presentation of data by following various methodologies like tabulation, diagrammatic and graphical representations, Interpretation and determination of biological data through Measures of Central tendency. Dispersion and variation analysis.	K1, K2, K3
CO2	Interpret and determine the biological data through some basic statistical measures like measures of Dispersion and variation analysis and to test and analyse the biological data through hypothetical assumption or creation by following some statistical treatments with Chi square test, students 't' test, ANOVA test, Correlation and Regression analysis.	K2, K3, K4
CO3	Know about computer application in statistical data analysis, study about available basic software's & hardware's and statistical packages related to data base in biology.	K2, K4, K6
CO4	Understand about the definition, history, scope and application of bioinformatics in biology and biological sequence analysis.	K2, K3, K4
CO5	Know about different data base analysis like nucleic acid data base (EMBL gene bank, SWISS PORT) and the data base similarity bioinformatics tools like BLAST, FASTA, ENTREZ, Pub Med, SRS etc.	K2, K4, K5, K6

K1 – Remember, K2 – Understand, K3 – Application, K4 – Analysis, K5 – Evaluate, K6 – Create

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	M	L	M	M	L	L	M	L	M	M	L	L	L	L	L
CO2	M	M	M	H	M	L	M	L	L	M	L	L	L	L	M
CO3	H	L	H	M	L	L	M	L	M	M	L	L	L	L	L
CO4	M	M	M	H	M	L	M	L	M	H	L	L	L	L	M
CO5	H	M	M	M	L	L	M	L	L	H	L	L	L	L	H

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	M	L	L	H	L	L
CO2	M	H	L	H	L	L
CO3	L	L	H	L	H	M
CO4	M	H	L	H	L	M
CO5	M	L	L	H	L	L

MSU/ 2022-23/ CMST-Integrated UG Marine Science/Semester –VI/ Core 9,10,11/practical MAJOR PRACTICAL (Core 8,9,10: Lab in recent developments in live feed, Fundamentals of Genetics, Biostatistics, Computer Applications & Bioinformatics)

SEMESTER VI

RECENT DEVELOPMENTS IN LIVE FEED, FUNDAMENTALS OF GENETICS, BIOSTATISTICS, COMPUTER APPLICATIONS & BIOINFORMATICS

Semester	VI				
Course Type	MAJOR PRACTICAL III				
Title of the Course	RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION, FUNDAMENTALS OF GENETICS, BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATION				
Course Code					
Teaching Hours	3 Hours/ Week				
	RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION, FUNDAMENTALS OF GENETICS, BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATION	Credits: 4	Max. Marks: 100		
Course Prerequisites:					
The student should have basic practical knowledge on recent developments in live feed production.					
The student should have basic practical knowledge on genetics					
The students should possess basic knowledge on descriptive and non-descriptive methods of Mathematics and their application in Biology incorporating computer system					
CODE:	RECENT DEVELOPMENTS IN LIVE FEED PRODUCTION, FUNDAMENTALS OF GENETICS, BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATION	L	T	P	C
			-	2	2
Course Objectives	<ul style="list-style-type: none"> To visualize and analyse the morphology and anatomy of cell types, cell division and physiological activities. To inculcate/impart skills to perform various tests/assays and experiments. To provide an idea about the Mendelian Genetics. To provide students an idea about the sex linked inheritance To inculcate/impart skills to perform various bio statistical interpretations To visualization of structure database- RASMOL, PDB VIEWE To obtain knowledge on Submitting DNA sequence in the database 				

Course Outcome

On the successful completion of the course, students will

No.	CourseOutcome	Knowledge Level (according to Bloom'sTaxonomy)
CO1	Acquire hands on training on Isolation and culture of microalgae by different methods, Different culture Media preparation for microalgae, Get experiences on Isolation and culture of Zooplankton by different methods	K1,K2,K3,K5
CO2	Acquire experiences on isolation and culture of any three alternative live feed and Artemia cyst decapsulation, hatching and feeding to larvae	K1,K2,K3,K5,K5
CO3	Improved skills to perform various tests/assays and experiments. Design and analyze the experiments related with the Genetics Use the techniques, skills, and modern tools necessary for design a research project, collect and analyze data, and interpret results	K1,K2,K3,K5
CO4	Diagrammatic representation of data, Computation of regression equation using MS EXCEL, Calculation ANOVA – one way using MS EXCEL, Tab setting, page setting for printing, and Header & Footer setting, 9. Visualization of structure database- RASMOL, PDB VIEWER	K1,K2,K3,K5,K6
CO5	Submitting DNA sequence in the database PDB analysis of protein structure by RASMOL NCBI, EMBL and DDBJ (accession of informations). BLAST and FASTA search	K1,K2,K3,K6

Syllabus

(Core 8,9,10: Lab in recent developments in live feed, Fundamentals of Genetics, Biostatistics, Computer Applications & Bioinformatics)

Practical (Any 6)

1. Isolation and culture of microalgae by different methods from marine, brackish, saltpan and fresh water
2. Different Culture Media preparation for microalgae
3. Isolation and culture of Zooplankton by different methods from marine, brackish, saltpan and fresh water
4. Enumeration of Phyto and Zooplankton by counting chamber and Sedgwick rafter chamber method respectively
5. Isolation and culture of any three alternative live feed
6. Artemia cyst decapsulation, hatching and feeding to larvae
7. Harvest and feeding of Zooplankton to finfish young ones and survival assessment

Harvest and feeding of Phytoplankton to Shell fish larvae and survival assessment

Fundamentals of genetics

1. Observation of simple mendelian traits in man – to be recorded.
2. Breeding experiments : to be illustrated with beads a) Monohybrid and b) Dihybrid – Chisquare test.

3. Observation and study of polygenic inheritance of quantitative traits to be interpreted in graphs.- a. height of the student b. Weight of the student. c. Length of shells. d. Length of pods.
4. Blood group to be analyzed in a population with a minimum of 30 students.
5. Models of genetic significance to be studied – syndromes, sex – linked inheritance (colour blindness, homophilia, hypertrichosis, webbed toes).
6. Life cycle of *Drosophila*.

Biostatistics, Computer Applications and Bioinformatics

1. Diagrammatic representation of data – bar (simple, multiple), pie diagram using MS EXCEL Computation of measures of central tendency using MS EXCEL
2. Computation of measures of dispersion using MS EXCEL
3. Computation of correlation using MS EXCEL
4. Computation of regression equation using MS EXCEL
5. Calculation ANOVA – one way using MS EXCEL
6. Create a document with tables, and do the following formatting - tab setting, page setting for printing, and Header & Footer setting
7. Create a document, Format the document and edit the document.
8. Design a presentation to market the product using MS Powerpoint
9. Visualization of structure database- RASMOL, PDB VIEWER
10. Submitting DNA sequence in the database
11. PDB analysis of protein structure by RASMOL
12. NCBI, EMBL and DDBJ (accession of informations).
13. BLAST and FASTA search

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –VI Elective:
ORNAMENTAL FISHES AND TRADING**

ORNAMENTAL FISHES AND TRADING

Semester	VI				
Course Type	ELECTIVE 6 (A)				
Title of the Course	ORNAMENTAL FISHES AND TRADING				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	ORNAMENTAL FISHES AND TRADING	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should have a basic knowledge on ornamental fishes and trading.					
CODE:	ORNAMENTAL FISHES AND TRADING	L	T	P	C
		4	-	-	4
Course Objectives	<ol style="list-style-type: none"> 1. To study the ornamental fish culture in marine and fresh water medium 2. To manage of aquarium farming, fish rearing, breeding. 3. To know the procedures involved in ornamental fish trading. 				
Module 1	INTRODUCTION TO ORNAMENTAL FISHES			12 hours	
Present global and national scenario on ornamental fish farming. Basic knowledge and profile of some selected indigenous and exotic ornamental fishes- Commercially important ornamental fishes- Status of ornamental fish farming in India. Scope and importance of marine ornamental fish farming.					
Module 2	ORNAMENTAL FISH FARMING AND MANAGEMENT			12 hours	
Principles of a balanced aquarium. Water quality management-Food/feed production in ornamental fisheries-Cultivation of some common live food- Fabrication, setting up and maintenance of freshwater and marine aquarium- Introduction to aquarium and aquarium accessories. Aquarium plants and its propagation techniques - Introduction to some selected aquarium plants and their export potential. Design and construction of public fresh water, marine aquaria and oceanarium. Aquarium accessories and equipments. Management practices in ornamental fish farm- Management practices					
Module 3	FISH BREEDING AND REARING			12 hours	
Breeding of ornamental fish with reference to live bearer and egg layer species. Rearing of live bearers. Important indigenous and exotic ornamental fishes- Criteria of selection of suitable fish species for aquarium- External morphology of important fresh water aquarium fishes (egg layers and live bearers)-External morphology of important marine aquarium fishes-Other ornamental organisms (Sea anemone, lobsters, and star fish)					
Module 4	ORNAMENTAL FISH-DISEASES AND THEIR MANAGEMENT			12 hours	

Common ornamental fish diseases and their management- Diseases of ornamental fishes- Bacterial diseases-Protozoan diseases-Fungal diseases-Parasitic diseases- Ornamental fish diseases and prophylactic measures-Live Food culture for tropical ornamental fish- Health management in Ornamental Fish Farming.

Module 5	TRADING OF ORNAMENTAL FISH AND EXPORT POTENTIAL	12 hours
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World trade of ornamental fish and export potential-Small scale ornamental fish farming business- A new dimensions in aquaculture entrepreneurship-Management of ornamental fishes and its trading-Definition of trading and its application in ornamental fisheries - Ornamental fish trade, its regulations- Trade regulations and wildlife act-Ornamental fish marketing, extension and legislation in India. Patents and patenting process- Overview of Patents in Indian fisheries sector.-Agreement on TRIPS. Bio-piracy. GMOs in fisheries. Salient features of Indian Patent (Amendment) Act 2005.

ReferenceBooks	<ol style="list-style-type: none"> 1. Axlrod, H.R. and Schultz, P.L., 1983. Hand Book of Tropical Aquarium Fishes. T.F.H. Publications, Hongkong. p.28-30. 2. Ahilan. B, Felix. N and Santhanam.R., 2008. Text book of Aquariculture. Daya Publishing House, New Delhi. p.157. 3. Boyd, C.E., 1992. Water quality management for pond fish culture. Elsevier science publishers, Netherland. p.317 4. Dey, V.K., 1993. Ornamental fishes. Marine Products Export Development Authority, Kochi. pp.7-10. 5. Dey, V.K., 2008. Global Trade in Ornamental Fish: Trends, Prospects and Issues. Abstract, International seminar on Ornamental fish breeding, farming and trade, Cochin, India. pp.2. 6. FAO, 2007. Fishery statistics, Aquaculture production, 2005. Food and Agriculture Organization of the United Nations, Rome. 7. Hervey, G.F. and Hems, J., 1968. The Goldfish. Faber and Faber Limited, Great Britain. Pp.265 8. Joseph Smart . 2001. Goldfish varieties and genetics. Fishing News Books. USA p 216. 9. Lochmann, R.T. and Phillips, H., 1994. Dietry protein requirement of golden shiners (<i>Notemigonus crysoleucas</i>) and goldfish (<i>Carassius auratus</i>) in aquaria. <i>Aquaculture</i>, 128:277-285. 10. Moyle, P.B. and Cech, J.J., 1988. Fishes – An introduction to ichthyology. 2nd edition, Prentice Hall, Englewood Cliffs, NJ. 11. MPEDA, 2000. Statistics of Marine Products Exports, 2000. MPEDA, India. p.25. 12. Petrovicky, I., 1993. Tropical Aquarium Fishes. Chancellor press, London. p.258. 13. Purdom, C.M., 1993. Genetics and Fish Breeding. Chapman and hall London. p.277. 14. Ramachandran, A., 1999. International Trade in Ornamental Fish. 12th Indian Seafood Trade Fair, Souvenir. Seafood Exporters Association, India. pp.24-29. 15. Shinji Mekino 1972. Home Aquarium, Aquatic Gems – Tropical Fish. Ward Lock Limited, London. p.97. 16. Singh, T. and Dey, V.K., 2003. Ornamental fish trade runs into billions,
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	<p>Info fish Int., 5:54-60.</p> <p>17. Thomas, K., 2008. Status of Ornamental fish trade in India with special reference to investment and trade opportunities. Abstract, International seminar on ornamental fish breeding, farming and trade, Cochin, India. pp.7.</p> <p>18. Zaidi, S.G.S (2002) Ornamental fish culture</p>
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Course Outcomes (CO)

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

	Course Outcomes	Knowledge level according to (Blooms taxanomy)
CO1	Understand about the basic concepts of ornamental fishes and fish farming.	K1, K2
CO2	Know about the management of ornamental fish farming.	K2, K3
CO3	Find out the types of fish breeding and rearing.	K1, K2, K3, K4
CO4	Determine the types of ornamental fish diseases and their management.	K3, K4, K5
CO5	Make the knowledge about the trading of ornamental fish and export potential.	K4, K5, K6

K1- Remember; K2- Understand; K3- Apply; K4- Analyze; K5- Evaluate; K6- Create.

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	L	M	M	M	M	L	H	L	L	L	M	L	L	L	M
CO2	L	M	L	M	M	L	H	M	L	H	M	L	L	M	M
CO3	L	M	L	M	L	M	L	L	L	H	L	L	M	M	L
CO4	L	M	M	L	M	L	M	L	M	H	H	L	M	L	L
CO5	M	L	H	L	M	H	L	M	L	H	L	M	L	H	L
CO6	L	M	M	M	M	L	H	L	L	L	M	L	L	L	M

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	H	L	L	L	L
CO2	L	H	L	M	M	M
CO3	M	H	L	L	L	M
CO4	L	H	L	M	L	H
CO5	H	H	L	H	L	L

**MSU/ 2022-23/ CMST-Integrated UG Marine Science/ Semester –VI Elective:
FOOD AND FOOD PROCESSING TECHNOLOGY**

FOOD AND FOOD PROCESSING TECHNOLOGY

Semester	VI				
Course Type	ELECTIVE : 6.4				
Title of the Course	FOOD AND FOOD PROCESSING TECHNOLOGY				
Course Code					
Teaching Hours	60 Hours/ Semester : 4 Hours/ week				
	FOOD AND FOOD PROCESSING TECHNOLOGY	Credits: 4	Max. Marks: 100 (Internal: 25, External: 75)		
Course Prerequisites: The student should acquire knowledge on general aspects about food and food processing technology, which includes food production and types of preservation. The produced and processed foods will be employing various methodologies and the industrial applications of the food processing will be studied.					
CODE:	FOOD AND FOOD PROCESSING TECHNOLOGY	L	T	P	C
		4	-	-	4
Course Objectives	<ol style="list-style-type: none"> 1. To understand the history and evolution of food processing. 2. To study the structure, composition, nutritional quality and post harvest changes of various plant foods. 3. To study the structure and composition of various animal foods. 				
Module 1	FOOD AND FOOD PROCESSING TECHNOLOGY	12 hours			
Historical development of food science and technology, Evolution of Food Processing from prehistoric times till date, Introduction to various branches of Food Science and Technology. Cereals and Millets: wheat, rice, their composition and uses, varieties of millets: sorghum, barley, rye, oats, triticale, pearl millet and finger millet. Pulses: different types, composition of pulses, processing of pulses, toxic constituents in pulses and its detoxification processes.					
Module 2	PRINCIPLES OF FOOD PROCESSING	12 hours			
Scope and importance food processing – National and International perspectives. Sources of food, scope and benefit of industrial food preservation, perishable and non perishable food, causes of food spoilage. Thermal processing methods of preservation: Canning, blanching, pasteurization, sterilization and evaporation. Use of low temperature: Chilling, cold storage, and freezing. Preservation by drying: Methods and effect on quality. Preservation by radiation: Methods of Irradiation, direct & indirect effect, measurement of radiation dose, dose distribution, effect on microorganisms. Presentation by preservatives: chemicals, antioxidants, mould inhibitors, antibodies, acidulates etc. Preservation by salt & sugar: Method and effect on food quality. Preservation by fermentation: Recent methods in preservation: Pulsed electric field processing, High pressure processing, processing using ultrasound, dielectric, ohmic and infrared heating					
Module 3	FRUITS AND VEGETABLES	12 hours			
Classification of fruits and vegetables, general composition, Post harvest changes in fruits and vegetables – physical and chemical changes during the storage of fruits and vegetables, processing					

steps, and their equipments. Products from fruits and vegetables: jam, jellies, marmalade, preserves, pickles and chutneys, defects and factors affecting the quality of products. Thermal processing of fruits and vegetables, dehydration process of fruits and vegetables, freezing process of selected fruits and vegetables.

Module 4	FLESH FOODS - MEAT, FISH, AND POULTRY	12 hours
Meat - definition of carcass, composition of meat, concept of red meat and white meat. Fish - Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish. Poultry - composition and nutritive value of meat and egg, characteristics of fresh egg, deterioration of egg quality. Milk and Milk Products: Definition of milk, composition of milk of different species i.e. buffalo, cow, goat, various steps in processing of milk, milk products-cheese, paneer, ice cream, ghee, butter, flavoured milk, imitation milk		
Module 5	DEVELOPMENT OF MEAT, FISH AND POULTRY PRODUCTS	12 hours
Slaughter of meat animals, different cuts of lamb and their uses, post mortem changes, Rigor mortis. Preparatory operations of meats and meat products, cured and smoked meats, sausage products, canned meat and meat pickles. Handling and dressing of poultry: Inspection of poultry birds, dressing and preparation of ready to cook poultry, factors affecting the quality- Egg and Egg products: spoilage of eggs and preservation of whole eggs and egg products, preparation of egg powder. Fish and fish products: Types of fish, nutritive value, judging and freshness of fish, grading and cooking of fish, smoking, pickling, salting and dehydration, preservation of fish and processed fish products. Frozen storage of fresh and processed meat, fish and poultry. Byproducts of fresh and processed meat, fish, poultry and egg industry.		
ReferenceBooks	<ol style="list-style-type: none"> 1. Srilakshmi, B., 2010, Food Science New Age International (P) Ltd. Publications. 2. Potter, N.N., and Hotchkiss, J.H., 2007, Food Science, CBS publishers and Distributors. 3. Fellows, P.J., 2016, Food Processing Technology: Principle and Practices, 4th Edition, Woodhead Publishing Ltd. 4. Desrosier, N.W., and Desrosier, J.N., 2006, The Technology of Food Preservation, 4th Edition, CBS Publishers. 5. Bender, A.E., 1978, Food Processing and Nutrition, Academic Press, London. 6. Jelen, P., Introduction to Food Processing, Prentice Hall, Reston Virginia, USA 	

Course Outcomes (CO)

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

	Course Outcomes	Knowledge level according to (Blooms taxanomy)
CO1	Understand about the basic concepts of food science and technology.	K1, K3
CO2	Know about the principles of food processing and its methods.	K2, K3, K4
CO3	Find out the types fruits and vegetables and its preservation techniques.	K3, K4

CO4	Determine the types of flesh foods meat, fish and poultry and its industrial application.	K4, K5
CO5	Make the knowledge about the development of Meat, Fish and poultry products.	K5, K6

K1- Remember; K2- Understand; K3- Apply; K4- Analyze; K5- Evaluate; K6- Create.

Mapping of CO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	L	L	L	L	L	M	L	H	M	L	L	M	L	M	M
CO2	L	L	L	L	L	M	L	H	M	L	M	L	L	L	M
CO3	L	L	L	L	L	M	L	H	H	M	L	L	L	L	M
CO4	L	L	L	L	L	M	L	H	M	M	L	M	L	M	L
CO5	L	M	L	L	L	L	M	H	H	M	M	M	L	M	L
CO6	L	L	L	L	L	M	L	H	M	L	L	M	L	M	M

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	L	L	L	L	H
CO2	L	L	L	L	L	H
CO3	L	L	L	L	L	H
CO4	L	L	L	L	L	H
CO5	L	L	L	L	L	H
