VIKRAMA SIMHAPURI UNIVERSITY

DEPARTMENT OF MARINE BIOLOGY

CURRICULUM AND SYLLABUS

M. Sc. MARINE BIOLOGY

(2020 ONWARDS)

PROGRAMME OUTCOMES :-

PO1: Apply the knowledge of marine biology and ecology including with the subject areas of coastal aquaculture, fishery science, marine pollution and toxicology, marine biotechnology in the recent research areas with students in post graduate level.

PO2: Understand the applications of different advanced biological techniques in coastal aquaculture, fishery science and marine biotechnology.

PO3: Demonstrate the research-based ability to design experiments, interpret and analyze data and report result with international standards.

PO4: Marine Biology Master Degree graduates will be skilled in advance level of farming, hatchery, feed formulation techniques of aquaculture species and industry orientation.

PO5: Explore the basics of physical and chemical oceanography in terms of waves, tides, currents, physical and chemical properties of sea water.

PO6: Demonstrate knowledge and understanding of the different technological aspects related to farming/hatchery operations of commercially important marine species.

PO7: Understand the impact of marine pollution and carryout the various experiments and train the various techniques using different instruments.

PO8: Analyze the relationships among the animals, plants and microorganisms in the Marineenvironment including marine invertebrates and vertebrates.

PO9: Impart the knowledge in Ocean management and remote sensing, disaster management,coastal and marine biodiversity of marine organisms including marine flora and fauna

PO10: Students will be able to evaluate and highly motivated towards the value of marine resources and they will know and carry out their knowledge practically in the marine biology areas individually and meticulously.

PROGRAMME SPECIFIC OUT COMES :-

At the end of the Programme, the student will be able to

PSO1: Understand the knowledge and basic concepts of marine biology and ecology,biological oceanography and taxonomy of marine biota.

PSO2: Perform the different procedures as per the laboratory standards in the areas of marine microbiology, biotechnology, bioinformatics, biostatistics, physiology and biochemistry, fishand shrimp processing etc.

PSO3: Gain the knowledge related to the molecular biology and immunology by using the tools and techniques to detect the different diseases in aquatic species.

PSO4: Practice the students with proficient in the farming/hatchery operations of cultivable marine organisms and utilization of marine/coastal resources to make as an entrepreneur.

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

COURSE STRUCTURE :-

S. No.	Course code	Course Title	No. of Credits	Internal Marks	External Marks	Lab Marks	Total
SEMESTER – I							
1	20RMSCMAB101	Introduction to Marine Biology and Ecology	4	30	70	-	100
2	20RMSCMAB102	Biological Oceanography	4	30	70	-	100
3	20RMSCMAB103	Marine Invertebrates	4	30	70	-	100
4	20RMSCMAB104	Marine Vertebrates	4	30	70	-	100
5	20RMSCMAB105	Marine Biology and Ecology Lab	2	-	-	50	50
6	20RMSCMAB106	Biological Oceanography Lab	2	-	-	50	50
7	20RMSCMAB107	Marine Invertebrates Lab	2	-	-	50	50
8	20RMSCMAB108	Marine Vertebrates Lab	2	-	-	50	50
SEMESTER – II							
1	20RMSCMAB201	Physical and Chemical Oceanography	4	30	70	-	100
2	20RMSCMAB202	Fishery Science	4	30	70	-	100
3	20RMSCMAB203	Physiology and Biochemistry	4	30	70	-	100
4	20RMSCMAB204	Microbiology and Immunology	4	30	70	-	100
5	20RMSCMAB205	Physical and Chemical Oceanography Lab	2	-	-	50	50
6	20RMSCMAB206	Fishery Science Lab	2	-	-	50	50
7	20RMSCMAB207	Physiology and Biochemistry Lab	2	-	-	50	50
8	20RMSCMAB208	Microbiology and Immunology Lab	2	-	-	50	50

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SEMESTER - III							
1	20RMSCMAB301	Coastal Aqua culture	4	30	70	-	100
2	20RMSCMAB302	Pollution and Toxicology	4	30	70	-	100
3	20RMSCMAB303	Fish Nutrition and Feed Technology	4	30	70	-	100
4	20RMSCMAB304 (A)	Fish Processing Technology (Internal Elective)	4	30	70	-	100
5	20RMSCMAB304 (B)	Coastal and Marine Biodiversity (Internal Elective)	4	30	70	-	100
6	20RMSCMAB305	Aquaculture (External Elective)	4	30	70	-	100
7	20RMSCMAB306	Coastal Aquaculture Lab	2	-	-	50	50
8	20RMSCMAB307	Pollution and Toxicology Lab	2	-	-	50	50
9	20RMSCMAB308	Fish Nutrition , feed Technology Lab	2	-	-	50	50
10	20RMSCMAB309 (A)	Fish Processing Technology Lab (Internal Elective)	2	-	-	50	50
11	204MSCMAB309 (B)	Coastal and Marine Biodiversity Lab (Internal Elective)	2	-	-	50	50
SEMESTER - IV							
1	20RMSCMAB401	Marine Biotechnology	4	30	70	-	100
2	20RMSCMAB402	Research Methodology, Bioinformatics and Biostatistics	4	30	70	-	100
3	20RMSCMAB403 (A)	Ocean Management and Remote Sensing (Internal Elective)	4	30	70	-	100
4	20RMSCMAB403 (B)	Coastal Disaster Management (Internal Elective)	4	30	70	-	100
5	20RMSCMAB404	Ornamental fish culture (External Elective)	4	30	70	-	100
6	20RMSCMAB405	Marine Biotechnology Lab	2	-	-	50	50
7	20RMSCMAB406	Research methodology, Bioinformatics and Biostatistics Lab	2	-	-	50	50
8	20RMSCMAB407 (A)	Ocean Management and Remote Sensing Lab (Internal Elective)	2	-	-	50	50
9	20RMSCMAB407 (B)	Coastal Disaster Management Lab (Internal Elective)	2	-	-	50	50
10	20RMSCMAB408	Internship/Project work	6	50		100	150

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SEMESTER - I			
Course Code & Title	**20RMSCMAB101 INTRODUCTION TO MARINE BIOLOGY AND ECOLOGY**		
Programme	Marine Biology	Semester	I
Number of Credits	04	Number of Hours	60
Course Objectives	CO1: To learn about the zonation of the marine environment, its biotic and abiotic factors. CO2: Classify and distribution of Phytoplankton and their significance in primary productivity. CO3: To know the Zooplankton distribution and relationship between phytoplankton and zooplankton. CO4: To understand the Deep sea environment and adaptations of deep sea fauna and their ecological factors.		
UNIT	**Content**		**Number of Hours**
I	Marine Environment: The Sea as biological environment – Classification of the marine environment –biotic and abiotic divisions.		14
II	Phyto Plankton : Classification, composition, and adaptations to planktonic life, factors affecting distribution and abundance, Red tide phenomena – causes and effects; biological productivity, primary production – methods of measuring primary production, factors affecting primary production		16
III	Zoo Plankton: Classification, composition, and adaptations; factors affecting distribution and abundance. Phytoplankton, zooplankton relationships, diurnal vertical migrations. Indicator species among zooplankton.		16
IV	Benthos and Deep Sea: Benthos- Methods of collection and analysis; benthic communities; Meiobenthos; Deep-Sea- Life and environmental conditions. Adaptations of the deep sea fauna. Marine Bio- deterioration - Fouling and boringorganisms.		14
Reference Books	1. Nybakken,J.W.Marine Biology Anecological approach.Harper Collins College Publishers, New York. 2. Fincham, AA. Basic Marine Biology. Cambridge University Press.		

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	3. Sverdrup, HU, WJohnsonandRHFleming.Theoceans,theirphysics,chemistryand general biology. Prentice Hall, Engel wood cliffs. 4. Boaden,JSandR.Seed.AnIntroduction to coastal Ecology,Chapmanand Hall,NewYork. 5. Raymont,JEG.PlanktonandProductivityintheOceans.APergmonPress,NewYork. 6. Wickstead,JH.Anintroductiontothestudyoftropicalplankton.Hutchinson 7. Introduction toMarine BiologyS.N.Prasad 8. CBLSrivastavaAtextbookoffisheryscienceandIndianfisheries. 9. Jhingran.V.G.1985fishandfisheriesofIndia,Hindusthanpublishingcorporation,New Delhi. 10. Begon,M.,J.L.HarperandCRTownsend.Ecology,Individuals,Populationsand Communities. Blackwell Science, Oxford, UK 11. Koromondy,E.J.Conceptsofecology,PrenticeandHall,NewDelhi. 12. Clarke,GL.ElementsofEcology, NewYork: Johnwileyandsons 13. Odum,EP., FundamentalsofEcology.Philadelphia;WBSaunders 14. Krebs, CJ. Ecology.Harper&Row, NewYork.	
Course outcome	On the successful completion of course students will be able to	Knowledge
	CO1: Understand the basics and structure of marine ecosystem and importance of marine environment.	K2
	CO2: Identify and Classify the Phytoplankton and understand the Significance of the Primary Productivity in the marine environment.	K3 & K2
	CO3: Identify and Classify the Zooplankton and understand the Relationship between Phyto and zooplankton.	K3 & K2
	CO4: analyze the benthos and obtain the knowledge of deep-sea life and their adaptations, boring and fouling organisms.	K4

CO-Pos-Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3			3			3	3	3	3			3
CO2	3				3			3	3	3	3			3
CO3	3				3			3			3			
CO4	3							3		3				3

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB102 BIOLOGICAL OCEANOGRAPHY		
Programme	Marine Biology	Semester	I
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know different upwelling regions in the world and its significance inmarine ecosystem. 2. To know different types of environmental conditions and their effect on organisms. 3. To understand the classification of flora and fauna in estuaries and theiradaptations in estuarine ecosystem. 4. To explain the distribution of mangroves and their ecological significance.		
UNIT	**Content**		**Number of Hours**
I	**Upwelling ecosystems:** Major upwelling areas in the world causes and mechanism of upwelling, Biological significance of upwelling – phytoplankton production		15
II	**Intertidal ecosystems:** Zonation, Environmental conditions-Tides-Temperature-waveaction–salinity-other factors- adaptations of intertidal organisms-Rocky – Sandy and Muddy shores.		15
III	**Estuarine ecosystems:** Classification and origin of estuaries, Physical and chemical environmental factors, Flora and fauna of estuaries, Estuarine productivity, adaptations (morphological, anatomical and physiological) ecological role – estuarine food web.		16
IV	**Mangroves, Sea grasses and salt marshes:** Distribution – adaptations (morphological, anatomical and physiological), ecological role, uses, need for conservation. Coral reef biome.		14
ReferenceBooks	1. Wimpenny, R.S., 1966.PlanktonoftheSea. Feber and Feber Limited London. 2. Raymont,J.E.G.,1973.PlanktonandProductivityintheOceansPergamonPress, London. 3. Boney,A.D.,1975.Phytoplankton.Edward,Arnold,London. 4. Chapman,V.J.,1976.MangroveVegetation.J.Gramer,Berlin. 5. Chapman,V.J.andD..T.Chapman,1980.SeaweedsandTheirUsesChapman &Hall London Ltd. 6. SpoelS.VanderandR.P.Heyman,1983.ComparativeAtlasofZooplanktonBiol ogical Patterns in the Oceans. Springer – Verlag Berlin. 7. Tomilson,P.B.,1986.TheBotanyofMangroves.CambridgeUniversityPress 8. Nyabakken,J.W..1997.MarineBiology–AnEcologicalApproach.Fourth Edition. Addison 12esley Edu. Pub. Inc. 9. JeffreyS.Levinton. 2001.CDMarineBiology:Function.Biodiversity, Ecologypp.515. 10. Kathiresan,KandS.Z.Qasim,2005.BiodiversityofMangroveEcosystems.Hind		

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Course outcome	On the successful completion of course, students will be able to CO1: Understand the mechanism, significance of upwelling and its role in Productivity of the oceans. (k2) CO2: Recognize the flora and Fauna of estuaries and their adaptations.(k1) CO3: Know the environmentalconditionsonestuarineorganismsAdaptationsdevelopedby estuarine organisms to survive in adverse conditions.(K1) CO4: Understand the morphologyanddistributionoforganismsinEstuarineecosystemsandtheir adaptive mechanisms (K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3				3			3			3	3		
CO2	3				3				3	3	3	3		
CO3	3				3			3	3		3	3		
CO4	3				3			3	3		3	3		

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	**20RMSCMAB103** **MARINE INVERTEBRATES**		
Programme	Marine Biology	Semester	I
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know general principles of the taxonomy and significance of classification. 2. To understand the functional morphology, development and evolution of minor phyla. 3. To Recall crustacean classification, development and life history. 4. To know the classification and general characters of Mollusca and Echinodermata.		
UNIT	**Content**		**Number of Hours**
I	**MajorPhyla:** General principles of taxonomy – characteristic features of invertebrates, classification up to order level – Protozoa, Porifera, Coelenterata, Annelida, Arthropoda with specialreference to Crustacea, Mollusca and Echinodermata.		16
II	**MinorPhyla:** Functional morphology, development and evolution: Nemertinea, Endoprocta, Ectoprocta, Phoronida and Pogonophora; Classification, distribution, morphology, anatomy, and evolution of Chaetognatha and Brachiopoda		14
III	**Crustacea:** Classification, comparative morphology, crustacean appendages, larval forms and their phylogeny, life history of selected species e.g. Penaeids and Brachyurans		16
IV	**Mollusca & Echinodermata:** Mollusca-Classification, General characters with reference to bivalves and gastropods, Torsion in Gastropoda, Echinodermata – Classification and General characters, Water vascular system, larval forms, their evolutionary significance		14
ReferenceBooks	1. Hyman,1967.TheInvertebrateZoologyVols, I toVl. CGrawHillBookCo.Ltd.,New York. 2. Kaestner,A.,1967. Invertebrate Zoology Vols.1toIII.Wiley Inter science Publis hers, New York. 3. Barnes,R.D.,1980.Invertebrate Zoology.4th Edition. Saunders College Publishers, Philadelphia. 4. Ruppert,E.E.andR.D.Barnes,1994.Invertebrate Zoology 6th Edition. Saunders College Publishers, Philadelphia.		
Course outcome	On the successful completion of course, students will be able to		

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	CO1: Understand the general principles androle of classification in identifying the organisms.(K2) CO2: Identify the development and evolution of Minor Phyla organisms.(K3) CO3: Identify the larval stages of penaeids and Brachyurans.(K3) CO4: Identify the Molluscs and echinoderms, larval forms of the Echinoderms and their evolutionary significance.(K3)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3				3			3	3		3			
CO2	3				3			3	3		3			
CO3	3				3			3	3		3			
CO4	3				3			3	3		3			

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	20RMSCMAB104 MARINE VERTEBRATES		
Programme	Marine Biology	Semester	I
Number of Credits	04	Number of Hours	60
Course Objectives	1. To study the origin and evolution of species and also Classification and comparative morphology of Chordates 2. To learn the general characters of bony fishes, marine reptiles, birds and Marinemammals and their evolution studies. 3. To obtain Knowledge on General Characters , Classification of marinereptiles and Birds 4. To learn the General characters and Classification of marine mammals and their adaptations		

UNIT	Content	Number of Hours
I	**Origin of Chordates:** Geological time scale – progression of vertebrates throughtime, chordate features and theories on the origin of chordates; Prochordata – classification and comparative morphology.	16
II	**Bony Fishes:** Characteristic features and classification of bony fishes and Dipnoi fishes. Classification and evolution of jawless and primitive vertebrates. Evolution and adaptive radiation of elasmobranchs and bony fishes	16
III	**Marine Reptiles and Birds:** General characters and classification of reptiles, Reptilian features of symuria. Mammal- like reptiles, sea snakes and marine turtles. General characters and classification of Aves, marine birds, migration, aerial adaptations of birds, importance of marine birds.	14
IV	**Marine Mammal:** General characters and classification of mammals – aquatic mammals, adaptations and evolution of Cetacea and Sirenia ; Adaptations for life in the Sea.	14

ReferenceBooks

1.RobertT.Orr.1976.VertebrateBiology.W.B.SaundersCompanyPhiladelphi ap. 472.
2Farland,W.N.,Punch,F.H.,Cod,T.J.andHeisser,J.B.,1979. VertebrateLife-Collier; MacmillanInternationalEdition, MacmillanPublishingCompanyInc..NewYork.
3.Minkoff,E.C.,1983.EvolutionaryBiology,AddisonWesley shing Company, Massachusetts.
4.Lull.R.S.1984.OrganicEvolution.SeemaPublication,NewDelhi.
5.Colbert.Edwin.H.1989.Evolutionofthevertebrates.WileyEasternLtd.,New

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	DelhiP.535. 6.Strickberger,W.Monroe,1996.Evolution.Jonesand Barlett Publishers. Massac husetts,p.670
Course outcome	On the successful completion of course, students will be able to CO1: Obtain the Knowledge on Origin of chordates. Identify and classify the Chordates. (k3) CO2: Identify and classify the bony fishes and understand the evolution andadaptive radiation of elasmobranchs and bony fishes.(K3&K2) CO3: Identify and classify the marine reptiles, birds and mammals Understand the adaptations of Birds and significance of marine birds.(K3&K2) CO4: Identify and classify the marine mammals. Obtain the knowledgeon adaptations of mammals in the sea (K3&K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3				3			3	3	3	3			
CO2	3				3			3	3	3	3			
CO3	3				3			3	3	3	3			
CO4	3				3			3	3	3	3			

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB105 MARINE BIOLOGY AND ECOLOGY LAB		
Programme	Marine Biology	Semester	I
Number of Credits	02	Number of Hours	30
	Content		

1. Enumeration and identification of phytoplankton.
2. Zooplankton species - composition and identification.
3. Primary productivity estimation: Light and dark bottle technique.
4. Estimation of dissolved oxygen by Winkler"s method.
5. Estimation of salinity in different estuarine and coastal waters.
6. Estimation of Chlorophyll
7. Identification of rocky, sandy, free floating and estuarine fauna.
8. Identification of locally available Aquatic weeds and Mangrove plants
9. Field Visit : Observation of sandy shore environment, Collection of samples and submission of report.
10. Field Trip : Observation and Identification of Mangroves near Nellore coastand submission of field report with herbarium sheets

Course outcome	On the successful completion of course, students will be able to
	CO1: Identify and Classify different types of Phytoplankton and Zooplankton present in water samples (K2&K3)
	CO2: Assess the primary productivity of water samples (K5)
	CO3: Find sandy shore and estuarine flora and fauna(K1)
	CO4: Demonstrate the estimation of Dissolved oxygen and Explain significance of oxygen in water bodies (K2)
	CO5: Examine the sandy shore environment and understand the importance of sandy shore (K4)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3					3	3		3		3	
CO2	3		3		3			3	3		3			
CO3	3		3		3			3	3		3			
CO4	3		3		3			3	3		3			
CO5	3		3		3				3		3			

Low:1, Medium:2, High:3

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Programme	**Marine Biology**	**Semester**	**I**
Course Code & Title	**20RMSCMAB106 BIOLOGICAL OCEANOGRAPHY LAB**		
Number of Credits	02	Number of Hours	30
	Content		

1. Identification of Phytoplankton-Diatoms, Dinoflagellates, Bluegreen algae
2. Identification of Marine Zooplankton
3. Estimation of salinity in brackish water samples
4. Identification of locally available Sea weeds and Mangrove plants
5. Estimation of chlorophyll content in different marine and brackish water samples.
6. Identification of rocky, sandy and muddy shore fauna
7. Identification and observation of estuarine flora and fauna
8. FieldtripObservationandIdentificationofMangrovesnearNellorecoast and submission of field report with herbarium sheets.

Course outcome	On the successful completion of course, students will be able to CO1: Determine the salinity content of sea water samples and analyze salinity variations (K5) CO2: Identify and classify the seaweeds and mangrove plants (K2&K3) CO3: Estimate the Chlorophyll content of Different water samples to understand the availability of fishery resources(K5) CO4: Illustrate rocky shore flora and fauna (K2) CO5: Understand the importance of mangroves to protect the Coastal zone (K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3				3		3		3		3			
CO2	3						3		3	3	3			
CO3	3				3		3		3	3				3
CO4	3				3		3		3		3			
CO5	3	3					3		3		3			

Low:1, Medium:2, High:3

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Course Code & Title	**20RMSCMAB107 MARINE INVERTIBRATES LAB**		
Programme	Marine Biology	Semester	I
Number of Credits	02	Number of Hours	30
	Content		

1. Identification of selected Invertebrate species.
2. Appendages of Shrimp.
3. Dissection and display of digestive system of Shrimp.
4. Dissection and display of Nervous system of Shrimp.
5. Isolation of X-organ in Shrimp.
6. Identification of coastal vertebrate fauna.
7. Larval stages of Shrimp.
8. Anatomy of gastropod and bivalve.
9. Identification of minor phyla.
10. Mounting of gastropod radula.

Course outcome	On the successful completion of course, students will be able to
	CO1: Identify different types of marine Invertebrates (K3)
	CO2: Examine he appendages of shrimp (K4)
	CO3: Dissect and demonstrate digestive system of Prawn (K2)
	CO4: Dissect and Explain nervous system of prawn (K2)
	CO5: Determine and Isolate x organ in shrimp and demonstrate Radula of Pila

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3				3	3		3			
CO2	3	3				3				3	3			
CO3	3	3		3				3		3				
CO4		3				3		3			3			
CO5	3	3				3		3			3			

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB108 MARINE VERTIBRATES LAB		
Programme	Marine Biology	Semester	I
Number of Credits	02	Number of Hours	30
	Content		
1. Identification of selected vertebrate species. 2. Dissection and display of digestive system of Fish 3. Dissection and display of Reproductive system of Fish 4. Slides of prochordates (Cephalochordata,. Hemichordate and Urochordata). 5. Functional morphology of respiratory organs-gills of Fish. 6. Mounting of fish scales 7. Isolation of fish Swim bladder 8. Identification of fish tail fins 9. Identification of different types caudal fins 10. Fieldtrip – Identification of migratory birds at Pulicot, Nelapattu and submission of report			
Course outcome	On the successful completion of course, students will be able to CO1: Identify and classify the different vertebrate species (K2&K3) CO2: Demonstrate the digestive, reproductive systems in the fish species(K2) CO:3 Classify and identify the different scales in the fishes.(K2&K3) CO4: Understand about the different tails and fins in the fish species.(K2) CO5: Find out the moments and identification of migratory birds at Pulicot and Nelapattu.(K5)		

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3					3		3			
CO2	3	3		3					3		3			
CO3	3		3	3					3		3			
CO4	3		3	3					3		3			
CO5	3							3	3		3			

Low:1, Medium:2, High:3

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SEMESTER - II			
Course Code &Title	**20RMSCMAB 201** **PHYSICAL & CHEMICAL OCEANOGRAPHY**		
Programme	Marine Biology	Semester	II
Number of Credits	04	Number of Hours	60
Course Objectives	1. To develop the concepts about the chemistry of marine environment that concerns the study of the properties and interactions of substances present inthe marine environment. 2. To understand the significance of Dissolved gases in the sea transport ofmarine sediments. 3. To know the biology, geology and chemistry of the ocean, and it's imperative toknow different physical process. 4. To learn and handling of different types of Oceanographic instruments.		
UNIT	**Content**		**Number of Hours**
I	**Chemical composition of seawater:** Ionic composition of seawater, major and minor constituents, trace elements, their importance and distribution; Concept of chlorinity and salinity; Nitrogen, phosphorus and silicon cycles		14
II	**Dissolved gases & Marine sediments:** Carbon dioxide system in the sea; oxygen in the sea, hydrogen sulphide, noble gases – methane. Origin and physical properties of sediments, classification of marine sediments; distribution and transport of sediments, organic matter in the marine sediments.		16
III	**Ocean dynamics:** Sub marine Topography, Ocean currents, forces causing surface and deep currents, trade winds and monsoon, wind driven and thermohaline circulation, Ekman spiral, waves-Tides.		14
IV	**Oceanographic Instruments:** Oceanographic instruments: Grabs (Petersen, Vanveen, Smith-McIntyre) for benthos collection, naturalist's dredge (Ekman, Sanders deep-sea anchor dredge), Plankton nets, Continuous plankton recorder, Multiple Plankton Sampling System; Reversing Nansen bottles, reversing thermometer, salinometer, bathythermograph, secchi disc, Ekman current meter, echo sounders, CTD, underwater photographic equipment, SCUBA apparatus.		16
Reference Books	*1.* Sverdrup, H.U.,M.W.JohnsonandR.H.Flemming1958.The Oceans –their Physics, Chemistry and General Biology Prentice - Hall Inc. NewJersey.		

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	2. Reading in Earth Sciences (vol.1toIII) 1975. Scientific American Resource Library. W.H.Freeman & Co. 3. McCormick,J.M. and J.V. Thiruvathakal 1976. Elements. of Oceanography. W.B. Saunders, Philadelphia. 4. Neshyba,S.1987. Oceanography:perspectives on a fluidearth.John Wiley & Sons. New York. 5. Gross, G".1993.Oceanography:A view the earth (sixth edition). Prentice -HallInc.. New Jersy. 6. Pickard, G.L. and W.J. Emery,1995. Descriptive Physical Oceanography - anIntroduction (fifth edition). Pergamon Press. London. 7. Stowe, K.,1996.Exploring Ocean Science John Wiley Sons Inc. 8. Harold V.Rhurman,1997.Introductory Oceanography.Prentice HallInc, New Jersy. 9. Duxbury, A.C.,A.B.Duxbury and K.A.Sverdrup, 2000. An introduction to the World's Oceans. Wm. C. Brown Publishers. 10. Natarajan, M. and T. Balasubramanian, 2001.Oceanographic Equipments, Annamalai University.

Course outcome	On the successful completion of course, students will be able to CO1: Understand larger picture of a coupled ocean-atmosphere(K2) CO2: Identify the different process Involved in the controlling the marine ecosystem. (K3) CO3: Provide a comprehensive understanding of the properties of sea water (K2) CO4: Understand the interactions of the substances present in the marineenvironment.(K2) CO5: Learn about the usage and operation techniques of oceanographic instruments.(K4)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3				3			3	3		3			
CO2	3				3			3	3		3			
CO3	3				3			3	3		3			
CO4	3				3		3	3			3			
CO5	3	3			3		3				3			

Low:1, Medium:2, High:3

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Course Code & Title	**20RMSCMAB 202 FISHERY SCIENCE**		
Programme	Marine Biology	Semester	II
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know morphology, Classification and Life history of different Indian fishes. 2. To understand the anatomy, functions and reproductive system of fishes. 3. To Know population dynamics. 4. To understand the fishing technology.		
UNIT	**Content**		**Number of Hours**
I	**Eco-biology of fishes:** General morphology and classification of fishes – major groups of fishes in the world. General account of life history in Indian fishes: Sea bass, cobia.oil sardines, mackerel		15
II	**Basic Anatomy and Reproduction of fish:** Digestive, circulatory, respiratory, nervous and reproductive systems of fish. Maturation and spawning habits of marine fishes - process of maturation, methods to determine spawning, biotic and a biotic factors affecting spawning in fishes		15
III	**Population Dynamics:** Theory of fishing, unit stock, recruitment, growth, mortality, migration, fish tagging and marking. General account of major Marine fisheries of India, survey of fish eggs and larvae, analyzing population features. Length – weight relationship, condition factor.		16
IV	**Fishing Technology:** Principal methods of exploitation of sea fishes - indigenous and modern craft and gear. Evaluation of fishing craft: boat types and their classification; types of boats used in India; maintenance of fishing boats and control of marine fouling: classification of fishing gears; materials used in different types of fishing gear; fishing hooks and baits		14
Reference Books	1. Lagler, K.F.J.E. BardachandR.R.Miller,1962.Icthyology.John Wiley & Son since., New York. 2. CarlE.Bond,1979. Biology of Fishes. W. B. Saunders Company, Philadelphia. 3. Jones, E.R.H.,1980. Fish Migration. Edward Arnold Ltd. London. 4. Bal, D.V. and K.V. Rao. 1990. Marine Fisheries of India. TataMcGrawHill Publishing Company Limited, New York.		

	5. King,M.,1995. Fisheries Biology. Assessement and Management. Fishing Ne ws Books. 6. Biswas, K.P.,1996. A Text Book of Fish, Fisheries and Technology, IIED. Narendra Publishing House,Delhi. India. 7. Srivastava, C.B.L.,1999. Fish Biology. Narendra Publishing House, Delhi (In dia). 8. Shanmugam,K.,1990. Fishery Biology and Aquaculture. Leo Pathippagam, Madras, India. 9. MohanJoseph, M and A. A.Jayaprakash,2003. Status of Exploited Marine fishery resources of India, 308 pp. 10. Dholakia, A.D., 2004.Fisheries and Aquatic resources of India,Daya Publishing House, Delhi.413 pp.
Course outcome	On the successful completion of course, students will be able to CO1: Explain the morphology, Classification and identify the different stages in the Life history of fishes.(K2) CO2: Identify the different systems, isolate the organs and understand their functions in Fishes.(K3) CO3: Obtain the Knowledge on population dynamics and calculate the length weight relationship in fishes.(K4) CO4: Identify the different types of boats and gears and their role in fish harvesting, maintenance of fishing boats and control of marine fouling.(K3)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3					3			3
CO2	3	3				3					3			3
CO3	3	3				3		3						3
CO4	3							3	3		3			

Low:1, Medium:2, High:3

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Course Code &Title	**20RMSCMAB 203** **PHYSIOLOGY AND BIOCHEMISTRY**

Program me	Marine Biology	Semester	II
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know the Digestion and absorption mechanism, respiratory structures and functions. 2. To study endocrine glands and their secretions, osmo regulation mechanismand their adaptations. 3. To know Classification, structure and Functions of biomolecules.Classification and mechanism of enzyme action. 4. To understand the metabolism of carbohydrates, amino acids and fatty acidmetabolism		

UNIT	**Content**	**Number of Hours**
I	**Physiology of digestion and Respiration:** Digestion and absorption. Digestive enzymes and their role with food habits. Respiratory structures and functions - factors affecting respiration, structure and function of blood pigments, role of transport of O2 and CO2, Adaptations to hypoxia and anoxia	15
II	**Endocrine systems and Osmoregulation:** Physiology of Endocrine system - hormones, neurohormones, hormones of reproduction in fin fishes and shell fishes. Moulting in crustaceans. Physiology of ionic and osmo regulations- ions in body fluids, mechanism of ionic regulation, responses to osmotic conditions, types of osmoregulatory adaptations	16
III	**Biomolecules:** Major biomolecules – classification, structure and function - carbohydrates, proteins, amino acids, lipids and fatty acids and Nucleic acids - Enzymes - nature, classification and mechanism of action, factors affecting enzyme activity	14
IV	**Metabolism and Biosynthesis:** Metobolism of carbohydrates - Glycolysis, gluconeogenesis and citricacid cycle. Metabolism of amino acids - Nitrogen transamination, deamination and Urea cycle. Fatty acid metabolism- β - Oxidation	15

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Reference Books	1. ColinNicol,J.A., 1961.The Biology of Marine Animals. Sir Issac Pitman & Sons Ltd., London. 2. Conn,E.E. andP.K.Stumff,1963.Outline of Biochemistry. JohnWiley & SonInc.,New York and London. 3. Vernberg,W.B. and F.J.Vemberg, 1972. Environmental Physiology of Marine Animals. Springer Verlag: New York. 4. Prosser, C.L.,1973. Comparative Animal Physiology. Saunder, Philadelphia. 5. Folk.G.E., 1974.Text Book of Environmental Physiology. Leans Fabiger, P hiladelphia. 6. Palmer,J.D.,F.A.BrownandL.N.Edmunds,1976.An Introduction of Biological Rhythms. Academic Press Inc.. New York. 7. Lehninger, A.L.,D.L.NelsonandM.M.Cox,1993.Principles of Biochemistry. CBS Publishers & Distributors, New Delhi. 8. Baldwin,E.,1996. Dynamic Aspects of Biochemistry. Cambridge University press. London. P. 554. 9. Denniston, K.J.,J.J.Topping and R.L.Caret, 2004. General.Organic and Bio chemistry, 880 pp. 10. Nelson,D.L and M.M.Cox, 2005. Lehninger principles of Biochemistry,1119pp. 11. Bio chemistry by AVSS Rama Rao.
Course outcome	On the successful completion of course, students will be able to CO1: Know the Digestion and absorption mechanisms and their significance. structure and functions of respiratory organs and transport of respiratory gases.(K3) CO2: Identify and Isolate the different endocrine glands. Functions of hormones. (K4) CO3: Knowing the Osmoregulatory mechanism in fishes.(K2) CO4: Understanding the different types of bimolecular and their role in metabolismand classification and mechanism of enzyme action.(K2) CO5: find the metabolism of carbohydrates, amino acids and fatty acids.(K4)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3				3					3	3		
CO2	3	3				3			3			3		
CO3	3					3			3			3		
CO4						3			3			3		

Low:1, Medium:2, High:3

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Course Code& Title	**20RMSCMAB 204 MICROBIOLOGY AND IMMUNOLOGY**		
Programme	Marine Biology	Semester	II
Number of Credits	04	Number of Hours	60
Course Objectives	1. To understand the working principles of different types of Micro scopes and study of different groups of Microorganisms- their cultivation, isolation andIdentification. 2. To know the collection of Water, sediment and seafood samples. Identification of bacteria 3. To study the fundamental aspects of Immunology like types of Immunity,Immune cells and organs. 4. To know principles of the vaccine and Immunological techniques and their applications in contemporary scenario.		

UNIT	**Content**	**Number of Hours**
I	**Introduction to Micros copy and Marine Microbiology:** Study of cells using Microscopes (Bright-fieldand Electron microscope). General characters, Morphology and fine structure of bacteria, viruses, fungi, actinomycetis and cyanobacteria	15
II	**Methods in Microbiology:** Methods of studying marine microorganisms - collection of water, sediment and seafood samples, isolation and enumeration of bacteria - total and viable counts, identification of bacteria based on their morphological, physiological and biochemical characteristics.	15
III	**Immunology – fundamental concepts:** Organs and cells of the immune system- primary and secondary lymphoid organs. Immune System in marine in vertebrate sand vertebrates- specific and nonspecific, immune responses.	15
IV	**Vaccinology and Immunological Techniques:** Vaccine technology - Active and passive immunity; Live, killed, attenuated, sub unit vaccines; recombinant DNA and protein based vaccines; Peptide vaccines, conjugate vaccines. Immunological techniques in the disease diagnosis - mono clonal anti bodies and ELISA	15

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Reference Books	1. Dube, H.C.,1994. A Textbook of Fungi, Bacteria and Viruses, Vikas publishing House. 2. Lederberg, J.1992. Encyclopedia of Microbiology Vol.1-4., Academic Press. 3. Pelzer, M.J.Jr.,Chan,E.C.S, and N.R.Kxeig.1993. Microbiology: Concepts and Applications. McGraw Hill Inc 4. General Microbiology by Prescott 5. A Textbook of Microbiology by Anantha Narayana. 6. A text book of Immunology by Nandini settee. 7. Essential Immunology by Roitts 8. Immunology by Tizard Immunology by R.kollmann
Course outcome	On the successful completion of course, students will be able to CO1: Learn about the basic principles of Microscopy and comparative characteristics of microorganisms like bacteria, viruses, fungi , algae.(K2) CO2: understand some of the key fundamentals of Immunology and advances in Vaccine technology in coordinating with contemporary pandemic diseases like COVID-19 (K2) CO3: They will able to analyze and evaluate the efficacy of some important methods in Microbiology and their applications in identification of bacteria.(K4&K5) CO4: Students will get awareness on the fundamental aspects of immune system, cell involved and also understand about how the immune system has evolved among different phyla.(K2)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3					3				3			3	
CO2	3	3				3				3			3	
CO3	3	3	3			3				3			3	
CO4	3		3			3				3			3	

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB205 PHYSICAL & CHEMICAL OCEANOGRAPHY LAB		
Programme	Marine Biology	Semester	II
Number of Credits	02	Number of Hours	30
	Content		

1. Preparation of charts showing ocean topography with special reference to Indian Ocean and Bay of Bengal.
2. Oceanographic instruments, drawing sketches and familiarization with working.
3. Sediments: Analysis of textural classes.
4. Determination of temperature and pH in different water samples.
5. Estimation of Organic carbon in sediment soils.
6. Estimation of organic matter in different water samples.
7. Estimation of alkalinity in different water and soil samples.
8. Estimation of carbon dioxide in water samples.
9. Estimation of hardness in different water samples.
10. Estimation of Ammonia in different water samples.
11. Estimation of Chlorine content in different water samples.
12. Fieldtrip– Observation and identification of coastal environment near Nellore coast andsubmission of field report with sketch diagram.

Course outcome	On the successful completion of course, students will be able to CO1: Learn about the ocean topography and environment (K2) CO2: Understand the usage and identification of different oceanographic instruments.(K2) CO3: Analyze the different physical- chemical parameters of the sea water.(K4)CO4: Evaluating the different properties of sediment soils samples of marine Environment.(K5) CO5: Understand the local marine and coastal environments.(K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3			3			3						
CO2	3	3			3				3		3			
CO3	3	3			3				3		3			
CO4	3				3		3				3			
CO5	3				3				3		3			3

Low:1, Medium:2, High:3

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Course Code & Title	**20RMSCMAB206 FISHERY SCIENCE LAB**		
Programme	Marine Biology	Semester	II
Number of Credits	02	Number of Hours	30
	Content		

1. Identification of common fish and shell fishes in South Andhra Coast.
2. Estimation of Gonado somatic Index(GSI)and fecundity in fishes
3. Determination of age using scale orotolith.
4. Biometric Analysis- morph metric and meristic
5. Study of external morphology of fin fish and shell fish.
6. Identification of different types of fish scales.
7. Identification of types of fins in fishes
8. Observation of sensory organs in fishes
9. Estimation of gut content analysis in fin fish and shell fishes
10. Fieldtrip: Observation of fishing harbor and identification of different marine fish funna and preparation of report.

Course outcome

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

CO1: Identify and classify the fishes and prawns (K2&K3)

CO2: Determine the age , gonado somatic index and fecundity of fishes (K5)

CO3: Explain external morphology of fin fishes ,shellfishes and Analyze morph metric and meristic data (K20

CO4: Illustrate types scales and fins in fishes (K2)

CO5: Assess the gut content analyses of finfish and shell fishes (K4)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3								3
CO2	3	3		3		3								3
CO3	3	3		3						3				3
CO4	3	3		3		3				3			3	
CO5	3	3		3						3			3	

Low:1, Medium:2, High:3

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Course Code & Title	**20RMSCMAB207 PHYSIOLOGY AND BIOCHEMISTRY LAB**		
Programme	Marine Biology	Semester	II
Number of Credits	02	Number of Hours	30
	Content		

1. Oxygen consumption and metabolic rate in fin fishes.
2. Estimation of haemolymph chlorides with reference to salinity.
3. Effect of eyes talk ablation on oxygen consumption.
4. Quantitative estimation of glucose in blood and haemolymph.
5. Estimation of excretory ammonia with reference to different feeds
6. Estimation of proteins, carbohydrate sand lipids in fish tissues
7. Effect size, sex and salinity on oxygen consumption in shell fishes
8. Estimation of enzymes (amylase, proteaseandlipase)
9. Dissection: Isolation and identification of pituitary gland in fishes

Course outcome	On the successful completion of course, students will be able to
	CO1: Understand the relationship between oxygen consumption and metabolic rate in fishes.(K2)
	CO2: Explain about the effect of salinity on heamolyph chloride content.(K2)
	CO3: Analyse the effect of eyestalk ablation on oxygen consumption.(K4)
	CO4: Learn eye stalk ablation technique, estimate the activity of enzymes.(K5)
	CO5: Explain about the isolation of pituitary gland in fish.(K2&K4)
	CO6: Understand about the proximate composition of feeds.(K2&K4)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1		3	3					3			3	3		
CO2	3	3	3					3				3		
CO3	3	3				3								
CO4	3	3				3		3						3
CO5	3	3				3		3				3		3

Low:1, Medium:2, High:3

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Course Code &Title	20RMSCMAB208 MICROBIOLOGY AND IMMUNOLOGY LAB		
Programme	Marine Biology	Semester	II
Number of Credits	02	Number of Hours	30
	Content		

1. Preparation of solid & liquid media, Differential and Selective media:
2. Isolation of bacteria from seawater/sediments and sea food samples, Serial dilution methods, enumeration plating.-Total and Viable counts
3. Maintenance of organisms: Streaking, slants and stabs cultures
4. Staining of bacteria-Simple staining, Negative staining, Gram's staining.
5. Isolation of Vibrio on TCBS agar
6. Isolation of pathogens from sea foods -Salmonella- shigellaspp.
7. Cultivation of fungi: Slide, chunk and cover slip techniques
8. Study of morphology and cultural characteristics-Tease mounts
9. Preparation of cell suspension from fish lymphoid organs.
10. Determination of RBC and WBC count in the blood
11. Detection of antibodies, antigens through enzyme linked immunosorbant assay (ELISA).
12. Antibiotic sensitivity test.

Course outcome	On the successful completion of course, students will be able to CO1: Know the preparation different media for microbiological analysis(K4) CO2: Learn about different microbiological procedures for analysis.(K4) CO3: Understand the morphology of different microbial species(K2) CO4: Explain about the different cell count in the blood samples of fish.(K2) CO5: Understand the various immunological tests using the detection of the diseases(K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3				3				3			3	
CO2		3				3						3		
CO3		3				3				3		3		
CO4		3				3				3		3		
CO5		3				3				3		3	3	

Low:1, Medium:2, High:3

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SEMESTER - III			
Course Code & Title	**20RMSCMAB301 COASTAL AQUACULTURE**		
Programme	Marine Biology	Semester	III
Number of Credits	04	Number of Hours	60
Course Objectives	1. This paper is planned to teach in the lines of understanding the candidate species of important cultivable fin and shell fishes. 2. To gaining knowledge in the food and feeding of cultivable species,artificial seed production through hatchery technology. 3. To acquaint technology related to farm management and their detailed methods of farming, 4. To provide the knowledge related to disease and health management of shrimp species.		

UNIT	Content	Number of Hours
I	**Shrimp Hatchery Management:** Importance of Coastal aquaculture –global scenario, present status of shrimp farming in India; Natural collection and resources of shrimp seed. Shrimp hatchery management, techniques of induced breeding, larval rearing, packing and transportation. Selection Criteria for shrimp seed; seed quality rating	16
II	**Shrimp Culture Management:** Culture practices - Traditional, extensive, semi - intensive and intensive; Culture systems- Monoculture and poly culture. Shrimp culture management – Pre-stocking, stocking and Post stocking management - water quality management, feed management. Best management Practices (BMP,s) in shrimp farming	14
III	**Design & Construction of shrimp farms and Hatcheries:** Selection of site: topography, water availability and supply, soil conditions. Design and layout of shrimp farms- water intake system, drainage system. Design and construction of shrimp hatcheries; structure and construction, Different accessories used in coastal aqua farms and hatcheries	14
IV	**Diseases and Health Management:** Control of predators and parasites. Viral and Bacterial diseases in shrimp - causes, symptoms, prophylactic and therapeutic treatments. Nutritional deficiency diseases, environmental stress diseases. Role of Probiotics in diseases prevention. Disease diagnosis: Microbiological, immunological and molecular diagnosis methods	16

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Reference Books	1. Pillay,T.V.R.,1990.Aqua culture principles and Practices. Fishing News Books. 2. Samuel Paulraj,1994.Shrimp Farming Techniques: Problems and Solutions. Palani pub. 3. Anand S., Upadhyay, 1995. Hand Book on Design, Construction and Equipments in Coastal Aquaculture. Blackie Academic Pub. 4. Stickney,1995.IntroductiontoAquaculture.JohnWiley&Sons,NewYork. 5. Coche,G. and J.F.Muir,1996.Simple Methods for Aquaculture Pond Construction for Freshwater Fish Culture : Pond farm structures and layouts.Daya Pub. 6. Conroydas,R.andL.Heruman,1997.Text Book of Fish Disease. NarendraPub. 7. JohnE.Bardach,1997. Sustainable Aquaculture. JohnWiley & Sons, New York. 8. James,W. Meade, 1998.Aquaculture Management, CBS pub., New Delhi. 9. RobertR.Stickney (ed.),2000.Encyclopedia of Aquaculture. John Wiley and Sons, Inc., New York. 10. JoachimW. Hertrampft and Felicitas Piedad - Pascal, 2000. Hand Book on Ingredients for Aquaculture Feeds. Kluwer Academic Publishers,London.
Course outcome	On the successful completion of course, students will be able to CO1: Know the technology of various culture practices and intensive management practices of shrimp *P.monodon* and *L.vannamei*.(K1) CO2: Understand the culture methods and seed production techniques of important cultivable shrimp species. (K2) CO3: Understand the methods of construction of aqua farms and hatcheries.(K2) CO4: Learn about various diseases, diagnosis and preventive/treatment measures of diseases in coastal aquaculture.(K3)

CO-POs-Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3						3				3
CO2	3	3		3						3		3		
CO3	3	3		3						3				
CO4	3	3		3						3		3		

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	**20RMSCMAB302 POLLUTION AND TOXICOLOGY**		
Programme	Marine Biology	Semester	III
Number of Credits	04	Number of Hours	60
Course Objectives	1. To understand the principles of toxicology, direct and indirect impact of toxicants on marine life. 2. To know about the ecological significance of eutrophication and sources, causes of sewage and plastic pollution and its impact on marine environment. 3. To learn about the impact of pesticides and heavy metals on the marine biota. 4. To obtain knowledge on key aspects of different types of pollution like thermal, Oil and radioactive pollutants and their impact on marine life.		
UNIT	**Content**		**Number of Hours**
I	**Marine Pollution & Toxicology:** Marine Pollution-definition- major pollutantants- sources, transport path, dynamics. Toxicology- lethal and sub lethal effects of pollutants to marine organisms, bio concentration, bioaccumulation and biomagnifications- methods of toxicity testing, factors influencing toxicity- synergistic and antagonistic effects.		14
II	**Sewage and Plastic Pollution:** Sewage pollution -Industrial, agricultural and domestic, impact on marine environment, treatment methods. Eutrophication and ecological significance. Plastics and Litter;source and impact in the marine environment		14
III	**Heavy metal & PesticidePollution:** Heavy Metal pollution- sources, distribution, ecological impacts and analytical approaches; Pesticide pollution - classification, sources, distribution, and ecological impacts with special reference to marine fishes, birds and mammals		16
IV	**Oil, Thermal and Radioactive Pollution:** Oil Pollution- composition, sources, biological impacts on fishes, birds, mammals, treatment techniques. Thermal pollution- sources and ecological impacts. Radioactive pollution-sources (natural and artificial) biological effects of radiation		16
Reference Books	1. ClarkR.B1992.Marine pollution 3rd edition Clavendron, Press Oxford. 2. Williams1996. Introduction to Marine Pollution Control. John Wiley. 3. MichaelJ.Kennish1994.Practical Hand book on Estuarine and		

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	Marine Pollution. 4. Johnston,R.(ed),1976.Marine Pollution, Academic Press, London. 5. Goldberg,E.D.1974.The Health of the oceans, UNESCO Press. Paris. 6. Park, P.K,KesterD.R.,J.W.Deudall and B.HKetchum,1983.Wastes In the Ocean. Vols. 1 to 3. Wiley Inter science Publishers, New York.
Course outcome	On the successful completion of course, students will be able to CO1: Assess the toxicity levels in various aquatic environments and can measure the lethal and sublethal concentrations of toxicants.(K5) CO2: Analyse the ecological significance of eutrophication and allied issues and also relate it to water pollution.(K4) CO3: Evaluate the analytical approaches and ecological impacts of pesticides and heavy metal pollutants and pollution.(K5) CO4: Find out the causes,composition and impacts of oil, thermal and radio active pollutions in correlation with marine biota.(K1)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3		3				3		3					3
CO2	3		3				3				3			3
CO3		3					3			3	3			
CO4							3		3		3			

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB303 FISH NUTRITION & FEED TECHNOLOGY		
Programme	Marine Biology	Semester	III
Number of Credits	04	Number of Hours	60
Course Objectives	1. To known about nutritional requirement of shell fish, Fin fish and significance of live feed in aquaculture 2. To know the food and feeding habits of prawns, shrimp, fish and crab. 3. To understand the feed processing methods and feed quality testing. 4. To explain the different types of feeding methods and feed management practices.		

UNIT	Content	Number of Hours
I	Fish Nutrition & Live feed culture: Nutritional requirements, nutritive needs of fin fish and shell fish with special reference to shrimp, prawn and crab; Natural feed and live feed. Spirulina, Azolla;Rotifers (Brachionus and Moina), Copepodsand Artemia	16
II	**Food and Feeding Habits:** Types of food–basic food,secondaryfood, incidental food, obligatory food; feeding habits – detritivores, scavengers, herbivores, omnivores, carnivores, surface feeders, column feeders, bottom feeders; feeding strategies; food and feeding habits of prawns, shrimps, crabs and brackish water fishes.	14
III	**Feed Production Technology:** Supplementary feed and formulations; feed ingredients; water stability of feeds; use of attractants in feeds; feed additives; binders; processing of feeds (importance of anabolic agents, antioxidants and mould inhibitors; anti nutritional factors); determination of proximate composition in feeds; Shrimp feedmill design; Feed manufacturing ,process and preparation protocol	16
IV	Feeding and Feed Management: Feeding and shrimp production; water quality and feeding rates; feeding devices; Feeding methods-manual, mechanical and automatic feeding; relationship between feeding and	14

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	growth; Feed ration and feeding schedule; Check tray monitoring; Feed management in shrimp (*Penaeus monodon and P. vennamei)*	
Reference Books	1. Halver,J.E.1972.FishNutrition.AcademicPress, New York. 2. Sena, S.DeSilva and Trever A. Anderson. Fish Nutrition in Aquaculture. Chapman & Hall London. 1998, p.319. 3. Lovell, J.1989.Nutrition and Feeding of Fish. Von No strand. 4. MPEDA,1990.Hand Book on Aqua farming–Live feed. 5. MPEDA,1990. Hand Book on Aqua farming–Aquaculture feed. 6. MPEDA1990. Aquaculture Engineering and Water Quality Management.Coch in,India. 7. Pillay,T.V.R.Aquaculture : Principles and Practices. Fishing News Books. 8. Jhingran,V.G.1985.Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi. 9. Boyd,C.E.1982.Water Quality Management for Pond Fish Culture. Elsevier Science Publishers. 10. Chakroff,M.1993.Fresh water Fish Pond Culture and Management.Daya Publishing House, New Delhi. 11. Pillay, T.V.R. and W.A.Dill.1979.Advances in Aquaculture. Fishing News Books Ltd.	
Course outcome	On the successful completion of course, students will be able to CO1: Find the nutritional requirement of shell fish ,fin fish and learn live feed culture. (K1) CO2: Compare the feeding habits of prawns, shrimp, fish and crab.(K2) CO3: Learn to test the quality of feed and understand feed processing method.(K2) CO4: Demonstrate feeding schedule and check tray monitoring.(K2)	

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3								3
CO2	3	3		3		3							3	
CO3	3	3		3		3								3
CO4	3	3		3		3								3

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB304 (A) FISH PROCESSING TECHNOLOGY (INTERNAL ELECTIVE)		
Programme	Marine Biology	Semester	III
Number of Credits	04	Number of Hours	60
Course Objectives	1. To understand the Biochemical composition as well as the nutritional and medicinal value of shellfish and raw fish. 2. To understand the fish decomposition and post –mortem changes and rigor mortis, causes of spoilage in fishes especially enzymatic spoilage, microbial spoilage, chemical spoilage, and identification and isolation of common bacteria from spoiled fishes. 3. To understand the principle and different types of fish preservation methods and changes during the freezing method of preservation and problems during the storage of fishes. 4. To understand the fish byproducts and their extraction methods fromfishes and their uses for humans.		

UNIT	Content	Number of Hours
I	**Biochemical Composition of raw fish and shellfish:** The nutritive and medicinal value of fish, Protein, fat, carbohydrates, moisture, ash, Fish oils, Minerals, Vitaminsetc; Nutritional value of preserved and processed fish.	15
II	**Fish Decomposition (Post-mortem changes and Rigor mortis) :** Post-mortem changes and Rigor mortis; decay and spoilage of fish- enzymatic spoilage, microbial spoilage, bacterial spoilage, chemical spoilage, factors of fish spoilage; effect of temperature on spoilage; Intoxications and food poisoning from fish	15
III	**Fish Preservation :** Principles of preservation; Methods of preservation-canning, curing, Freezing - techniques of freezing, different types of freezers, changes during freezing and storage of fish; industrial methods of freezing fish and shellfish; problems in fish preservations; fish preservatives	16
IV	**Fish By products :** Methods of extraction of fish liver oil; processing of Fish meal, Fish Silage, fish sausages, Fish manure and guano; Chitosan, chitin pearl essence, Isinglass, Fish leather, Fish Caviar, Fish Macaroni	14
Reference	1. R.R.Colwell(ed):Biotechnology in Marine Science,1982.	

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Books	2. Aitikin,A: Fish handling & processing 2nd edition, Min.Agr.Fishand Food,U.K.,1982. 3. Borgstorm,G: Fish as Food Vol. I,III and IV, Academic Press,1961,1965 4. Brandi, A.V: Fish catching methods of theWorld,3rdedition,Fishing NewsBooks ltd. 1984. 5. Connel,J.J.:Control of Fish Quality, FishingNewsBooksLtd.,1975. 6. Sanisburry, J.C: Commercial Fishing Methods, Fishing News Books Ltd.,1971 7. C.B.L.Srivastava: A text book of Fishery Science and Indian Fisheries, KitabMahal Agencies, 2002
Course outcome	On the successful completion of course, students will be able to CO1: Describe the significance of major nutrients (Proteins, Fats, Carbohydrates, Moisture,) and Minor nutrients (Minerals, Vitamins, Fish oils, and Ash) and Nutritional value of preserved and processed fish.(K5) CO2: Identify and recognize the difference between fresh fish and spoiled fish and also learned causative agents of fish spoilage (intrinsic and extrinsic factors).(K4) CO3: Describe canning, curing, freezing, different types of fish preservatives, and problems during fish preservation.(K5) CO4: Classify the fish byproducts with reference to liver oil fish manure, fish meal, etc and their uses for a human being (pharmacy, hormones, vitamins, and cosmetics, etc) (K4)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3						3		3
CO2	3	3		3		3						3		
CO3	3	3		3		3						3		
CO4	3	3		3		3						3		

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	20RMSCMAB304 (B) COASTAL AND MARINE BIO-DIVERSITY (INTERNAL ELECTIVE)		
Programme	Marine Biology	Semester	III
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know the Marine Biodiversity conservation and significance, 2. To create knowledge about threats to Marine Biodiversity 3. To understand biodiversity conservation strategies, polices and legislations. 4. To understand the marine conservation strategies.		
UNIT	**Content**		**Number of Hours**
I	Introduction to Marine Biodiversity: Origin of conservation biology, divisions of biodiversity, Understanding the marine biodiversity and conservation, keystone species, ecosystem functioning, worlds marine biological diversity, marine hot spots-cold species, hydrothermal hotspots, marine biosphere reserves and their importance in India, Values of biodiversity-ecological, economic, ethical, and conservation feasibility values		15
II	Threats to Marine Biodiversity: Species diversity, species richness, species evenneus, factors affecting species diversity. Biodiversity with reference to mangroves and coral reefs. Species extinction vulnerability to extinction, habitat destruction degradation and fragmentation with reference to coral reefs and mangroves, maximum sustainable yield (MSY), alien species, global climatechange-coral bleaching		15
III	Conservation Strategies: Importance of conservation, IUCN and their importance, various conservation strategies- germ plasma banks, crypto reservation, marine protected areas, sea ranching, mesh size regulation, TED, fishing holidays, conservation and development at national international level		15
IV	Conservation policies and Legislations : Various legislations and regulations in conservation of marine biodiversity the role of MoEn and Fin conservation, NGO"s involvement in conservation and various cases tidies related to coastal marine conservation science and policy with reference to Indian maritime states		15
Reference Books	1. Biodiversity measurement and estimation. Chapman &Hall,140pp.Qubiroga,H., 2006. 2. Marine biodiversity, SPkringer,353pp.RichardB.Primack., m2002. 3. Essential of conservation biology-32rdedition, simauer Assoc.		

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	Inc.Pub.,USA, 698pp. Ruth,2002. 4. Dynamic modeling for marine conservation. Springer, 446pp, Singh, J.S.,S.P.Singhad S.R. Guptha.,2006. 5. Ecology, Environment and Resource conservation., Anamayapub., NewDelhi,68 8pp.
Course outcome	On the successful completion of course, students will be able to CO1: Understand the Marine Biodiversity Conservation and its significance.(K2) CO2: Understand and Identify threats to Marine Biodiversity. (K2 & K3) CO3: Know the Biodiversity conservation strategies, polices and Legislations involved in Biodiversity conservation. (K1) CO4: Explain the marine conservation strategies.(K2)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3								3	3	3			3
CO2	3								3	3	3			3
CO3	3								3	3	3			3
CO4	3	3							3	3	3			3

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code &Title	**20RMSCMAB305 : AQUACULTURE (EXTERNAL ELECTIVE PAPER)**		
Programme	Marine Biology	Semester	III
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know major cultivable fishes, Ornamental fishes and their culture. 2. To know the Different types of Culture techniques and hatchery management of Shrimp and Prawn 3. To know the food and feeding habits of Fishes, prawn and shrimp 4. To Know differently pes Bacterial, Fungal and protozo and is eases and Diagnostic methods.		

UNIT	**Content**	**Number of Hours**
I	**Fresh Water Aquaculture** Culture of Indian major carps: *Catla, Rohu* and *Mrigala*; Induced Breeding technique in Fishes;Types of fish hatcheries; Importance of ornamental fish culture in India; Identification of fresh water ornamental fishes; ornamental fish culture; setting of aquaria	15
II	**Coastal Aquaculture** Importance of Coastal aquaculture; Culture practices - traditional, extensive, semi - intensive and intensive systems, monoculture and poly culture; Design and layout of shrimp farm- structure and construction, Different accessories used in coastal aqua farms; Shrimp hatchery management; Culture and hatchery management of *M. rosenbergii,* Selection of shrimp seed, seed quality rating; Culture management practices of shrimp.	15
III	**Fish Nutrition & Feed management** Food and feeding habits of fishes, prawns and shrimp, Types of food; supplementary feeds and formulations; Types of supplementary feeds; feed ingredients; feed attractants; feed additives; binders; feed formulation and preparation protocol; feed management in fish, prawn and shrimp	15
IV	**Disease Management in Fisheries** Viral, Bacterial, Fungal and protozoan diseases in fishes, prawns and shrimp - causes, symptoms, prophylactic and therapeutic treatments; Nutritional deficiency diseases; environmental stress diseases; Disease diagnosis methods; Role of probiotics and chemicals in diseases prevention.	15

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Reference Books	1. Pillay,T.V.R.,1990.Aquaculture-principles and Practices.Fishing News Books. 2. Samuel Paulraj,1994.Shrimp Farming Techniques: Problems and Solutions. Palani pub. 3. AnandS., Upadhyay,1995.Hand Book on Design, Construction and Equipments in Coastal Aquaculture. Blackie Academic Pub. 4. RobertR.Stickney(ed.),2000.Encyclopedia of Aquaculture.JohnWileyand Sons, Inc., New York. 5. Lovell.J.1989, Nutrition and Feeding of fish. Von Nostrand. 6. MPEDA,1990,Hand book on Aqua farming-Live feed. 7. MPEDA,1990,Hand book on Aqua farming-Aquaculture feed. 8. MPEDA,1990, Aquaculture Engineering and water quality management, Cochin, India. 9. Jhingran,V.G.1985.Fish and Fisheries of India, Hindusthan Publishing Corporation, New Delhi.
Course outcome	On the successful completion of course, students will be able to CO1: Identify the cultivable and Ornamental fish/prawn/shrimp species.(K3) CO2: Design the shrimp/fish culture pond layout, conduct seed quality test.(K6) CO3: Understand the feed management and calculate feed ration.(K2) CO4: Identify and diagnose bacterial, Fungal and protozoan diseases of fish/ shrimp.(K3)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3							3	
CO2	3	3		3		3								3
CO3	3			3		3							3	3
CO4	3			3		3						3	3	

Low:1, Medium:2, High:3

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Course Code & Title	**20RMSCMAB306 COASTAL AQUACULTURE LAB**		
Programme	Marine Biology	Semester	III
Number of Credits	02	Number of Hours	30
	Content		

1. Dissection of digestive and reproductive systems of fish and shrimp.
2. Identification of eggs, larvae of cultivable shrimp species.
3. Identification of live feed (rotifers, copepods and artemia).
4. Identification of Commercially important fish and shell fish.
5. External examination of diseased finfish and shellfish.
6. Isolation of vibrio bacteria from shrimp culture pond water
7. Observation of seed quality in shrimp
8. Estimation of plank ton density in shrimp culture ponds
9. Identification of different diseases in shrimp culture ponds
10. Field trip: Observation of shrimp farm and preparation of report by gatheringinformation from the farmer/owner of the farm.

Course outcome	On the successful completion of course, students will be able to
	CO1: Explain about the digestive and reproductive systems of fish/shrimp.(K2)
	CO2: Identify the commercially important fish/shrimp/prawn species.(K3)
	CO3: Identify and classify the different live feed organisms.(K3)
	CO4: Understand the seed quality rating in shrimp/fish seed. (K2)
	CO5: Identify the different diseases in fish/shrimp. (K3)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3							3	
CO2	3	3		3		3							3	3
CO3		3		3		3					3		3	
CO4		3		3		3							3	

Low:1, Medium:2, High:3

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Course Code & Title	**20RMSCMAB307 POLLUTION AND TOXICOLOGY LAB**		
Programme	Marine Biology	Semester	III
Number of Credits	02	Number of Hours	30
	Content		

1. Estimation of LC 50 and LD 50 values
2. Estimation of BOD
3. Estimation of COD
4. Estimation of Heavy metals/ Pesticide residues.
5. Estimation of antibiotic residues from Marine biota
6. Field trip: Evaluation of pollution status in EEZ of different marine environment.

Course outcome	On the successful completion of course, students will be able to CO1: Analyze the Lethal concentrations and dosage values. (K4) CO2; Calculate the biological oxygen demand and chemical oxygen demand.(K5) CO3: Acquire the knowledge related to heavy metal/pesticide residues in marine biota. (K3) CO4: Understand about the antibiotic residues in marine biota (K2) CO5: Know the evaluation process of pollution status in local EEZ areas.(K1)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1		3		3			3				3	3		
CO2		3		3			3				3	3		
CO3		3		3			3				3	3		
CO4	3		3	3			3				3			
CO5	3		3	3			3				3			

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB308 FISH NUTRITION AND FEED TECHNOLOGY LAB		
Programme	Marine Biology	Semester	III
Number of Credits	02	Number of Hours	30
	Content		

1. Estimation of fiber and ash content in fish feeds.
2. Identification of live feed organisms (Chetoceros,artemea,skeletonetc)
3. Proximate analysis of feeds fish & shrimp (moisture,CHO,protein,fat,ash,Mineral)
4. Estimation of water stability of feeds.
5. Formulation and preparation of artificial feeds for finfish and shrimps
6. Identification of different feeds used in shrimp/fish farming
7. Assessment off equality
8. Fieldtrip: Visit to Shrimp feed mill and quality control a band preparation of report with observation of differentsections in feed mill.

Course outcome	On the successful completion of course, students will be able to CO1: Analyze proximate analyses of shrimp and fish feed (K4) CO2: Identify live feed organisms and understand their significance in aquaculture (K3) CO3: Know about the formulate artificial feeds for shrimp and fish.(K1) CO4: Assess feed quality and recognize different types of feeds. (K5) CO5: Understand the feed mill design and quality control protocol.(K2)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3					3			
CO2	3	3				3					3			3
CO3	3	3				3					3			
CO4	3	3				3						3		3
CO5	3	3				3					3	3		3

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB309 (A) FISH PROCESSING TECHNOLOGY LAB (INTERNAL ELECTIVE)		
Programme	Marine Biology	Semester	III
Number of Credits	02	Number of Hours	30
	Content		

1. Assessment of fish fresh ness by hypoxanthine measurement.
2. Estimation of salt content in dried fish
3. Estimation of moisture content in fish tissues
4. Determination of edible muscle in fish
5. Assessment of freshness for selecting fish
6. Estimation of volatile reducing substances (VRS) in assessment of fish spoilage.
7. Estimation of α–amino nitro geninspoilage of fish muscle.
8. Isolation of vibrio bacteria from sea foods.
9. Estimation of total proteins, carbohydrates and lipid sin fin fish and shell fish samples
10. Field trip: Observation of sea food processing plant and preparation of report
11. Field trip: Visit to MPEDA/ NACSA and other quality controllable

Course outcome	On the successful completion of course, students will be able to
	CO1: Assess the fish/ shrimp freshness in the processing plants/markets (K5)
	CO2: Acquire knowledge related to isolation of bacteria in seafoods.(K3)
	CO3: Understand the values of proteins, carbohydrates and lipid in fish/shrimp samples.(K2)
	CO4: Explain about the different sections in sea food processing plant(K2)
	CO5: Know the handling procedures of various equipment in the MPEDA/NASCA lab.(K1)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3		3						3		
CO2	3	3				3						3	3	
CO3												3		
CO4		3		3		3						3		
CO5			3	3		3				3		3		

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	**20RMSCMAB309 (B) COASTAL AND MARINE BIODIVERSITY LAB (INTERNAL ELECTIVE)**		
Programme	Marine Biology	Semester	III
Number of Credits	02	Number of Hours	30
	Content		

1. Identification of marine bioactive compounds.
2. Identification of marine floral communities.
3. Identification of marine faunal communities.
4. Quantification of faunal changes in marine water.
5. Observation of marine biodiversity hotspots.
6. Identification of estuarine fauna.
7. Identification of different types of mangroves.
8. Identification of marine endangered species.
9. Environmental impact Assessment of coastal areas.
10. Field visit: Visit to various marine ecosystems to study marine biodiversity and to collect specimens.

Course outcome	On the successful completion of course, students will be able to CO1: Identify and classify the different bioactive compounds (K3 & K3) CO2: Know the different marine floral faunal communities (K1) CO3: Understand about the different marine biodiversity hotspots.(K2) CO4: Identify and classify the different types of locally available mangroves.(K2 & K3) CO5: Know the different types of marine endangered species (K1)

CO-POs-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3							3	3			3		3
CO2	3				3				3			3		
CO3	3							3	3			3		
CO4	3						3		3	3				3
CO5					3		3		3	3		3		

Low:1, Medium:2, High:3

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DEPARTMENT OF MARINE BIOLOGY

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SEMESTER - IV			
Course Code &Title	**20RMSCMAB401 MARINE BIOTECHNOLOGY**		
Programme	Marine Biology	Semester	IV
Number of Credits	04	Number of Hours	60
Course Objectives	1. To understand the principles involved and applications of basic tools and techniques associated with Genetic engineering. 2. To Learn about the practical applications of genetic like hybridization and breeding among fishes 3. To know the structure aspects, operational protocols functional significance of different biophysical instrumentation including ICPMS. 4. To study the importance of marine resources and their isolations and applications.		
UNIT	**Contet**		**Number of Hours**
I	**Biotechnology & Genetic engineering;** Introduction.Definition and types of vectors, restriction endo nucleases.Nucl eotideprobes, PCR, RAPD, RFLP, Blotting techniques, DNA bar-coding		15
II	**Genetic techniques:** Principles of genetics, interactions and environmental influences, practical applications of genetics - hybridization of fishes, recent trends and techniques in hybridization, selective breeding, cross breeding, development of disease resistance and high quality new strains		15
III	**Tools and Techniques:** Electrophoresis - Agarose, PAGE, PFGE & Iso - Electric Focusing. Chromatography: Principles of paper, thin layer, gas-liquid chromatography and HPLC. Spectroscopy: Absorption and emission principles, UV-vis, Atomic absorption and emission spectrophotometers, NMR and Mass spectrometer, ICPMS		16
IV	**Marine natural products**: Bioactive compounds from marine organisms, Isolation and mode of action. Eicosonoid sand relatedcompounds from marine algae. Antitumour and cytotoxic compounds from marine organisms		14
Reference Books	1. Skoog, D.A.andJ.J. Leary,1992. Principles of instrument analysis. 4"edition. Saunders College publishers,		

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Philadelphia.
2. Mckane,L. and J.Kandel,1996.Microbiology, Essentials and Applications. McGraw HillInc., NewYork.
3. AustinB. And D.A.Austin,1999.Bacterial Fish Pathogens – Diseases of Fanned and Wild Fish, Springer Praxis Publishing.
4. AlanT.Bull,Geoffrer Holtand MalcolmD.Lilly,1983.Biotechnology International Trends and Perspectives. Oxford & 1BH Publishing Co., New York,84 pp.
5. Ewing,G.W.,1988.Instrumental methods of chemical analysis,McGraw-Hill Book Company.
6. Jeffrey W.PollandandJohn M.Walk,1990.Methods in Molecular Biology -5: Animal cell Culture. Human Press, New Jersey.
7. David H. Atta way and R. Oskar, 1993. Marine Biotechnology. Vol. I. Pharmaceutical
8. Milton Finger man.R. Naga bushanam and Man'-FrancesThompson,1999.Recent Advances in Marine Biotechnology, Vol. 1 -515 pp. vol.2-313 pp. vol.3- 312 pp.
9. Pat Vaughan,2000.Methods in Molecular Biology:DNA Repair protocols: Prokaryotic Systems, Human press, Totowa, New Jersey. P. 209.
10. Marine Biotechnology in twenty first century, National Research council. National Acadamies press.
11. Marine Biotechnology D.H. Atta way andO.R.Zabrosky.Springer473pp.
12. Biotechnology by U.Satyanarayana
13. Biotechnology by B.D. Singh

Course outcome

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

COI : Evaluate the efficacy of different tools and techniques and their effective implementation as genetic engineering tools.(K5)

CO2 : Analyze the effectiveness of different breeding techniques in improvement of disease resistance among fishes. (K4)

CO3 :Compare and contract the biophysical techniques useful in isolation purificationand characterization studies of biomolecules.(K5)

CO4: Get a conclusion on the importance of marine natural products in human health and pharmaceutical industry.(K5)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3							3		3		
CO2	3	3		3		3				3		3		
CO3		3		3						3		3		
CO4		3		3		3				3		3		

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	**20RMSCMAB402 RESEARCH METHODOLOGY, BIOINFORMATICS AND BIOSTATISTICS**		
Programme	Marine Biology	Semester	IV
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know meaning and objectives of research, research design and their significance 2. To understand and analysis of biological databases 3. To understand the application of statistics in biosciences.		
UNIT	**Content**		**Number of Hours**
I	**Research Methodology**: Research Methodology – Meaning, aim and objective of research, Significance of research, Types of research, Research Problem, selecting the problem. Thrust areas in research in Marine Sciences and Technology. Research Design. Sampling- Types of sampling design. Data Collection - Collection of primary data through different methods		14
II	**Bio informatics:** Introduction – Origin of bioinformatics biological data (genome projects), computer and information technology contributions. Disciplines of bioinformatics – Genomics, transcriptomics, proteomics, functional genomics, structural genomics, metabolomics, pharmacogenomics, structure prediction and drug design. Biological database – Introduction of database (DB), need, organization, search of DB. An over view of biological databases - NCBI, EMBL, DDBJ, SWISS-PROT, PDB, and KEGG.; Sequence analysis - concepts of sequence analysis and their importance. BLAST – blastn, blastp, blastx, tblastx, output analysis matrix BLOSSUM, PAM, e-value.		16
III	**DataAnalysis** Collection and Analysis of Biological data – Mean, Median, Mode, Standard Deviation, Standard error, Co efficient of variation, Simple random sampling, Use of random number tables		15
IV	**Biostatistical methods** Student„t" test,Skewness,Kurtosis,Chi-Squaretest,Z-test,CorrelationandRegression, ANOVA, Duncans Multiple Range Test (DMRT).		15
Reference Books	1. S.C.Gupta: Fundamentals of Statistics, Himalaya Publishing House Delhi. 2. Gupta & Kapoor: Fundamentals of Mathematical Statistics. S.Chand &Co.,New Delhi. 3. Yule & Kendall:Elementary Statistics, Charless Griffin & Co. London		
Course outcome	On the successful completion of course, students will be able to		

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	CO1: Understand the research problem selection, design of the research work and its significance. (K2) CO2: Know the collection and analysis of biological data through statistical tools.(K1) CO3: Understand about the different bioinformatics tools for analysis ofdata.(K2&K4) CO4 : Understand the fundamental concepts of biostatistics. (K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1		3	3					3		3		3		3
CO2		3	3					3		3				3
CO3		3	3					3				3		3
CO4		3	3					3				3		3

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	**20RMSCMAB403 (A) OCEAN MANAGEMENT AND REMOTE SENSING (INTERNAL ELECTIVE)**		
Programme	Marine Biology	Semester	IV
Number of Credits	04	Number of Hours	60
Course Objectives	1. Students will be exposed to different satellite data and technology andits application on ocean and coastal studies 2. To study the coastal hazards, risk assessment and disaster management strategies 3. To study the principles and applications of remote sensing and types of sensors and their applications. 4. To explain about the law of the sea and national, international organizations in ocean management.		
UNIT	**Content**		**Number of Hours**
I	**Ocean Management:** Introduction – Law of the Sea- EEZ and its significance – Role of national and International agencies and organizations in ocean management: FAO, UNEP, DOD, UNCED. Major oceans and their importance		14
II	**Coastal Zone Management and Issues:** Coastal zone – definition and importance – Coastal developmental activities: Mariculture, tourism, shorefront constructions and their impacts–National and global problems:loss of habitats, sea level change, Coastal Biodiversity – Endangered species, protected areas, Marine Biosphere Reserve, UNCED.		15
III	**Remote Sensing:** Introduction – Basic principles of remote sensing and Aerial Photography - Satellites and airborne remote sensing, Remote sensing techniques for identification of fishing grounds, coastal and ocean resource assessment- Mangroves - coral reefs and other pollution assessment. SST, Phytoplankton assessment		16
IV	**Disaster management:** Communication and dissemination of disaster relatedInformation and awareness generation Disaster cycle –Definition of hazard, risk, vulnerability; Risk assessment .Reliefand Response – search and Rescue (SAR) First aid, shelter management, drinking water, electricity; rehabilitation – environmental problem of Rehabilitaiton ; Disaster Recovery		15

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Reference Books	1. Goldberg,E.D..1976.The Health of the Ocean.UNESCOPress.Paris.172pp. 2. Borgese.EM. and N. Ginsburg.1979 -1996.Ocean year books1-12vols. TheUniversity of Chicago Press, Chicago. 3. Brian Groom bridge (Ed.)1992. Global Biodiversity –Status of the Earth's LivingResources, Chapman & Hall. 4. Jean-MarineMassin.1994.RemoteSensingfortheControlofMarinePollution. Academic Publishers, Plenum Press. 466 pp. 5. Health,A.G.,1995.Water pollution and fish physiology, CRC press, New York,359 pp. 6. Sabins,F.F.,1997.Remote Sensing Principles and Interpretation. Third edition.W. H. Freeman & Company,NewYork.494pp. 7. Mario Soares, 1998.The Ocean our Future –The Report of the Independent World Commission on the Oceans. Cambridge University Press,248 pp. 8. asim.S.Z.andG.S.Roonwal,1998.India's Exclusive Economic Zone.Omega Scientific Publishers, New Delhi
Course outcome	On the successful completion of course, students will be able to CO1: Understand the application of remote sensing in the assessment of marineflora and ocean colour monitoring.(K2 &K3) CO2: Know the remote sensing technology for identification of fishing grounds in marine environment.(K1) CO3: Define about the law of the sea and national and international organizations in ocean management.(K5) CO4: Understand the prevalent national and global management practices in disaster management.(k2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3		3						3	3				3
CO2	3		3						3	3				3
CO3	3		3						3	3				3
CO4			3				3		3			3		3

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code & Title	20RMSCMAB403 (B) COASTAL DISASTER MANAGEMENT (INTERNAL ELECTIVE)		
Programme	Marine Biology	Semester	IV
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know disaster cycle–risk and vulnerability 2. To study different types of natural and Hydrological hazards 3. To know the principle s of Disaster relief and recovery 4. To understand planning of Disaster Management		
UNIT	**Content**		**Number of Hours**
I	**Introduction to Disaster Management :** Definition Disaster Communication and dissemination of disaster of related information land awareness generation : institutional framework and financial management- Disaster cycle- risk and vulnerability- vulnerability Atlas of India		15
II	**Natural and Hydroligical Hazards:** Hazard definition–Types of hazard, Seismic hazard: Earthquake, Landslide, volcano: Coastal hazard : Tsunami, strom surge, Erosion : Hydrological hazards- Floods, Drought. Meteorological hazard: Cyclone: Thunder storms, Lightning, Meteorites, Nature fire hazard		15
III	**Disaster Relief and Recovery :** Basic principles of disaster recovery: steps for disaster recovery planning: Disaster Recovery among stack holders : organizing disaster recovery team: role of Information Technology in disaster management: Budger for disaster recovery		15
IV	**Planning of Disaster Management:** Role of Early warning System /(EWS) Disaster Management : Risk assessment : Role of Government agencies for CRZ regulation an implementation of management lplans : Early warning system for cyclone, Tsunami, stork surge, earthquake: Studies on impact of long term disasters like Sea level rise, global warnings in pennisular and Island Nations. Mock drill.		15

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Reference Books	1. Ghosh,G.K.Disaster Management, Macmillan, NewDelhi. 2. SathisModh, Introduction to disaster management, Macmillan,Newdelhi. 3. Sharma,R.K.&Sharma.G2005(ed)Natural disaster APH publishing corporations,New delhi. 4. Bryant Edwards2005:Naturalhazard,CambridgeUniversitypress UK. 5. Sinha,P.C.2011.IntroductiontodisasterManagement.Anmolpublication 6. Goesl.S.L.Disasteradministrationandmanagement,2007.Deep&Deeppublicationpvt .Ltd. 7. 7.Srivatsava.H.NandGupta,G.D.2006.Management ofnaturaldisastersin developing countries. Daya publications 8. BryantEdwards2005.Naturalhazard,CambridgeUniversitypress UK. 9. UNDR Omitigation natural isaster:Phenomena, effectandoptions.UnitedNations,NewYork1991.
Course outcome	On the successful completion of course, students will be able to CO1: Understand the Disaster cycle and risk vulnerability (K2) CO2:Understandthedifferent types of natural and Hydrological hazards(K2) CO3:KnowtheprinciplesofDisasterreliefandrecoveryandparticipate in disaster relief Measures(K1) CO4:Understandearlywarningsystemfordisasteranddisseminatethe information to stack holders.(K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3				3			3					3
CO2	3	3				3			3					3
CO3	3	3				3			3					3
CO4		3	3			3			3					3

Low:1, Medium:2, High:3

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Syllabus for M.Sc., Marine Biology (2 Year Course) at Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021.

Course Code &Title	**20RMSCMAB404 ORNAMENTAL FISH CULTURE (EXTERNAL ELECTIVE)**		
Programme	Marine Biology	Semester	IV
Number of Credits	04	Number of Hours	60
Course Objectives	1. To know the ornamental fish culture and their Importance 2. To know the collection of fresh water and marine ornamental fishes, transportation of live ornamental fishes. 3. To understand the setting, construction and maintenance of Aquarium 4. To know Nutrition and Health management of Ornamental Fishes.		

UNIT	Content	Number of Hours
I	**Freshwater Ornamental fishes:** Importance of fresh water ornamental fish culture in India; ornamental fisheries –word scenario; Fresh water ornamental species-live bearers, egg layers; Breeding of ornamental fishes- maturation, spawning ,hatching, larval raring; Feeding-larva land adult feeds; Induced breeding in ornamental fishes	15
II	**Marine Ornamental fishes:** Biology of different marine ornamental fishes; methods of collection of marine ornamental fishes; transportation of live marine ornamental fishes-use of sedatives etc.; marine ornamental organisms- lobsters, starfishes, octopus etc.	15
III	**Setting, construction and maintenance of Aquarium :** Materials used for setting of aquarium- Gravel, pebbles, stones, other materials, aquarium plants; ornamental objects; selection of species for aquarium; Construction- materials used- wooden, metal frames, sealants and gums, aerators, filters, hand nets and other equipments; design and construction of aquarium	15
IV	**Nutritional requirements and health management:** Different kinds of feeds; culture of food organisms; preparation of dry feeds; feeding methods; Common diseases- Viral, bacterial, fungal and external parasitic diseases; prophylactic and therapeutic treatments; chemicals and disinfectants used in aquariums; Aquarium management- cleaning, maintenance of water quality.	15
Course outcome	On the successful completion of course, students will be able to CO1: Understand the culture technology of the ornamental fishes(K2)	

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	CO2: Know the collection and transportation of live ornamental fishes.(K1) CO3: Handle and setting and maintenance of Aquarium.(K3) CO4: Understand the nutritional requirement and health management of different ornamental fishes. (K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3			3		3				3				3
CO2	3			3		3				3				3
CO3		3		3		3				3				3
CO4		3		3		3				3				3

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB405 MARINE BIOTECHNOLOGY LAB		
Programme	Marine Biology	Semester	IV
Number of Credits	02	Number of Hours	30
	Content		

1. Estimation of DNA.
2. Estimation of RNA
3. Identification of eyestalk peptide hormone through HPLC
4. Electrophoresis- Agarose gel electrophoresis
5. Blotting techniques (Southern & Western).
6. PAGE
7. Chromatography-TLC–Paper–Column,(HPLC- demonstration only).
8. Observation of chromosomes and meiotic chromosomes.
9. Observation of ploidy variations in different tissues.
10. Field visit :Visit to quality control labs (MPEDA,NACSAetc.)

Course outcome	On the successful completion of course, students will be able to
	CO1: Quantitatively measure the amounts of DNA, RNA biomolecules in theunknown samples by interpolating with the standards. (K5)
	CO2: Identify partially purity the DNA& RNA and Protein samples using agarose gel electrophoresis and different types of blotting techniques.(K4)
	CO3: Observe the mitotic and meiotic chromosomes along with ploidy variations in different tissues.(K5)
	CO4: Get real time exposure to various sophisticated instrumentation required and related to marine biotechnology after visiting the renownedlaboratories of institutions.(K5)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3							3		3		
CO2	3	3	3							3		3		
CO3	3	3	3							3		3		
CO4	3	3	3									3		3

Low:1, Medium:2, High:3

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Course Code &Title	20RMSCMAB406 RESEARCH METHODOLOGY BIOINFORMATICS AND BIOSTATISTICS LAB		
Programme	Marine Biology	Semester	IV
Number of Credits	02	Number of Hours	30
	Content		

1. Methods of sampling and collection of biological data.
2. Calculation of mean, median, mode, standard deviation, standard error and co-efficient of variation.
3. Calculation of correlation coefficient values and finding probability values.
4. Calculation of F value and finding out the probability of F value, Regression analysis.
5. Familiarization with windows, UNIX, Internet.
6. Use of tools at NCBI,EMB Land SWISSPORT.
7. BLAST analysis and FAST Analysis.
8. Pair wise and Multiple sequence alignment.
9. Finding composition of sequence, open reading frames.
10. Phylogenetic tree construction.
11. PCR Primer designing.
12. Preparation of Research proposal.

Course outcome	On the successful completion of course, students will be able to CO1: Analyze the methods of sampling and collection of data (K4) CO2: Understand the fundamental concepts of biostatistics (K2) CO3; Know the different bioinformatic tools for analysis (K1) CO4: Write and prepare the research proposal (K3)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3							3		3		
CO2	3	3	3							3		3		
CO3	3	3	3							3		3		
CO4		3	3							3		3		

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB407 (A) OCEAN MANAGEMENT AND REMOTE SENSING LAB		
Programme	Marine Biology	Semester	IV
Number of Credits	02	Number of Hours	30
	Content		

1. Identification of locally available Macro algae, Sea weeds, Sea grasses and Mangrove.
2. Sediment Analysis estimation of sand, silt and clay percentage in the sediments.
3. Identification of different geomorphic structures.
4. Beach Profiling.
5. Sediment Analysis: estimation of sand, silt and clay percentage in the sediments.
6. Identification of Underwater Geomorphic Structure.
7. Study of elements of aerial photographs.
8. Hazard identification using digital images.
9. Mapping of Living resources.
10. GIS applications in flood hazard.
11. Observation of remote sensing patterns and flow charts.
12. Field Visit: Observation of Beach structure and pollution status/flora and fauna.

Course outcome	On the successful completion of course, students will be able to
	CO1: Identify and classify the locally available macroalgae, sea grasses and mangroves.(K2 &K3)
	CO2: Analyze and identify the sediment samples of marine environment (K3)
	CO3: Know the remote sensing mapping of marine resources.(K1)
	CO4: Explain about the GIS application in flood hazard.(K2)
	CO5: Understand the beach structure and profile of local coastal areas.(K2)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3				3				3	3	3			
CO2	3				3				3	3	3			
CO3	3				3				3		3			3
CO4	3				3				3		3			3

Low:1, Medium:2, High:3

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Course Code & Title	**20RMSCMAB407 (B) COASTAL DISASTER MANAGEMENT LAB (INTERNAL ELECTIVE)**		
Programme	Marine Biology	Semester	IV
Number of Credits	02	Number of Hours	30
	Content		

1. Risk Assessment for Hazards.
2. First Aid Practices for Hazards.
3. Vulnerability Assessment for Hazards.
4. Observation of marine protected areas in Bay of Bengal coast.
5. Identification of marine pollution agents.
6. Analysis of marine polluted water.
7. Estimation of heavy metals from the biological materials.
8. GIS applications in cyclone hazard.
9. Observation of meteorological data in the near coast.
10. Disaster cycle.
11. Preparedness for the Hazard Occurrence.
12. Observation of deforestation of mangroves in the near coastal environments.

Course outcome	On the successful completion of course, students will be able to CO1: Understand the risk assessment for hazards in coastal areas.(K2) CO2: Know the first aid and vulnerability assessment practices.(K1) CO3: Describe about the marine polluting agents and disaster cycle.(K5) CO4: Understand about the observation of meteorological data collection near the coast.(K2) CO5: Know the impact of the deforestation of mangroves in near coasts.(K1)

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3				3			3	3					3
CO2	3				3			3	3		3			
CO3					3		3		3		3			3
CO4					3		3		3	3				3
CO5					3		3		3		3			3

Low:1, Medium:2, High:3

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Course Code & Title	20RMSCMAB408 INTERNSHIP / PROJECT WORK		
Programme	Marine Biology	Semester	IV
Number of Credits	06	Number of Hours	90
	Content		

1. Brief report to be enclosed.
2. Certificate original to be shown.
3. Presentation of the work done

A research project/Internship will be allotted to each student after the III semester (or after II Semester in the Summer Vacation period). They will be required to complete the data collection, analysis and writing of the dissertation so as to submit it at the end of IV Semester before practical examinations and to present it at seminar in the department in the internal assessment.

Course Objectives	To enable students explore, independently, topics of research importance related to the food industry and to empower students to design a research study based on the principles of scientific research. To provide students exposure to industrial set-up
Course outcome	On the successful completion of course, students will be able to CO1: The student will be able to plan and execute experiments or undertake literature surveys independently, (K5) CO2: The student will develop the skills to design experiments for solving problems in food research. (K6) CO3:The student will be exposed to the diverse setting in aquaculture related industries.(K5) CO4: Acquire the knowledge related to aquaculture industry (K3).

CO-Pos-Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PS6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1		3	3							3	3			3
CO2		3	3					3		3	3			
CO3			3					3		3	3			
CO4			3					3		3	3			3

Low:1, Medium:2, High:3

HEAD
Department of Marine Biology
VIKRAMA SIMHAPURI UNIVERSITY
NELLORE - 524320. A.P.