



ALAGAPPA UNIVERSITY

(A State University Established in 1985)
Karaikudi - 630003, Tamil Nadu, India



2017 Accredited with A+ Grade by NAAC (CGPA : 3.64)	2018 MHRD Govt. of India Graded as Category - 1 & Granted Autonomy	2018 UGC University Grants Commission	2018 MHRD GOVERNMENT OF INDIA Swachh Campus Rank : 4	2019 NATIONAL INSTITUTIONAL RANKING FRAMEWORK Rank : 28	2019 India Rank : 20 BRICS Rank : 194 Asia Rank : 216
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DEPARTMENT OF OCEANOGRAPHY AND COASTAL AREA STUDIES



M.Sc., OCEANOGRAPHY & COASTAL AREA STUDIES

[Choice Based Credit System (CBCS)]

[For the candidates admitted from the academic year 2019-2020]

Panel of Members-Broad Based Board of Studies

<p><u>Chairperson</u> Dr.C.Stella, Professor and Head, Department of Oceanography and Coastal Area Studies, Alagappa University, Karaikudi. Teaching Experience: 28, Research experience: 40, Area of Research: Biodiversity, Ecology- EIA and Molluscan Taxonomy & Biology.</p>	
<p><u>Foreign Experts</u> Dr.Nilmini Viswaprakash, Assistant Professor for Anatomical Sciences, Cauburn Campus, nviswaprakash@auburn.vcom.edu, Teaching Experience –20 Year, Research Experience-25, Area of Research: Marine Biology.</p>	
<p><u>Indian Experts</u> Dr. C. Raghunathan, Joint Director / Scientist-E, Zoological Survey of India. raghuks@rediffmail.com, Professional experience: Research – 25 Year, Area of Research: Marine Biology, Zoology and Ecology.</p>	
<p>Dr.Gulab Khedkar, Director, Paul Hebert Centre for DNA Bar-coding and Biodiversity Studies, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad- India (MS). gdkhedkar@gmail.com, Teaching Experience – 20 Year, Research Experience- 27, Area of Research: Molecular genetics and genomics.</p>	
<p>Dr. T. T. Ajith Kumar. Nor, Principal Scientist, ICAR–NBFGR, Peninsular and Marine Fish Genetic Resource Centre, Cochin, ttajith87@gmail.com. Professional experience: 24Years, Area of Research: Aquaculture for conservation and livelihood development.</p>	
<p>Dr. P. Madeswaran, Scientist-G, Ministry of Earth Sciences, National Centre for Coastal Research. Work experience: 30Years, Area of Research: Coastal and Marine Area Management,</p>	
<p><u>Expert from Industry</u> Dr. M. Jaikumar ,Field Scientist, Sea6 Energy Pvt ltd, Ccamp Lncubator, NCBS –TIFR, GKVK Post, Bellary road, Bangalore - 560065.</p>	
<p>Members Dr.V. Sugumar, Assistant Professor in Oceanography and Coastal Area Studies, Alagappa University, Karaikudi, Teaching Experience: 11 years, Research Experience: 15 years, Area of Research: Crustacean Biology, Marine Biomaterial.</p>	

Dr.S. Paramasivam, Assistant Professor in Oceanography and Coastal Area Studies, Alagappa University, Karaikudi, Teaching Experience: 11 years, Research Experience: 15 years, Area of Research: Marine Microbiology/Seafood safety.



Alumni

Dr.V.Yoganandan, Assistant Professor, Department of Marine Science, Bharathidasan University, Tiruchirappalli – 620 024. yoganandan@bdu.ac.in, Teaching Experience: 10 Years: Research Experience: 15 Years. Area of Research: Paleoceanography/Paleoclimate, Climate change, Biogeochemistry, Climate change impact on Marine environment.



REGULATIONS AND SYLLABUS

[For the candidates admitted from the academic year 2019 onwards]

1. Programme general objective

The students in the Marine Biology program at the university will acquire specialized and deep knowledge, relevant to topics such as marine ecology, marine biology, biogeography, invasion biology, population genetics, biosystematics and general evolutionary themes based on the marine organisms.

2. Programme specific objectives

1. To make students learn about the diverse groups of marine organisms, variety of ecosystems and habitats and current events in today's oceans such as overfishing, ocean acidification, restoration and marine protected areas.
2. The students gain knowledge on ecology and evolution, the marine environment, taxonomic classification of marine organisms, a survey of major marine ecosystems and marine conservation.
3. To increase awareness of anthropogenic impacts in the marine environment and potential solutions.

3. Programme Outcome

The graduates of Marine Biology program will:

1. Explain key concepts and terminology in biology/ marine biology
2. Describe typical marine habitats and associated flora and fauna.
3. Understand interactions between marine organisms and the environment, and adaptations of marine organisms.
4. Understand the dynamics and structural processes in marine populations and communities

4. Eligibility for admission

The Eligibility criteria for M.Sc. Oceanography and Coastal Area Studies, B.Sc., in Zoology/Botany/Chemistry/FisheryScience/EarthScience/Physics/Agriculture/Microbiology/Biotechnology/Geology/Aquaculture/Marine Biology/Applied sciences.

5. Duration of Course

The course shall consist of five academic years, divided into ten semesters.

6. Teaching Methods

The classroom teaching would be through conventional lecture, use of OHP, PowerPoint presentation, novel innovative teaching ideas like television, smart board and computer-aided instructions. Periodic field visit enables the student for gathering the practical experience and up to date industrial scenario. Student seminars would be arranged to improve their communicative skills. In the laboratory, safety measures instruction would be given for the safe handling of chemicals and instruments. The lab experiments shall be conducted with special efforts to teach scientific knowledge among students. The students shall be trained to handle advanced instrumental facilities and shall be allowed to do experiments independently. The periodic test will be conducted for students to assess their knowledge. Slow learners would be identified and will be given special attention by remedial coaching. Major and electives would be held in the Department and for Non-major electives students have to undertake other subjects offered by other departments.

7. Examinations

The examinations shall be conducted separately for theory and practicals to assess the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II). The internal assessment shall comprise of maximum 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Internal Assessment

Theory paper (Internal Assessment)

Average marks of two CIA test	15 marks
Seminar/group discussion/quiz	5 marks
Assignment/field trip report/case study report.	5 marks
Total	25 marks

Practical's (Internal Assessment)

CIA tests	20 marks
Attendance	5 marks
Total	25 marks

External Examinations

The external examinations of theory and practicals shall be conducted for three hours duration to each paper at the end of each semester. The external examinations shall comprise of a maximum of 75 marks for each subject. The candidate failing in any subject will be permitted to appear for each failed subject in the subsequent examination. Practical examinations and demonstration of experiments shall be conducted at first, second, and third semester. At the end of the fourth semester, the project work viva-voce examination will be held based on the dissertation report submitted by the student. Two examiners (one internal and one external) will jointly conduct the viva-voce examination for evaluation.

Scheme of External examination

Question paper pattern (Theory)

1. The question paper carries a maximum of 75 marks.
2. The question paper consists of three sections, namely Part-A, B, and C.
3. **Part-A** consists of 10 questions of 2 marks each ($10 \times 2 = 20$ marks) with no choice. The candidate should answer all questions.
4. **Part-B** consists of 5 either or choice questions. Each question carries 5 marks ($5 \times 5 = 25$ marks).
5. **Part-C** consists of 5 questions. Each question carries 10 marks. The candidate should answer any three questions ($10 \times 3 = 30$ marks).

Question paper pattern (Practical) (Maximum 75 marks)

1. Major Practical	15 Marks
2. Minor Practical	10 Marks
3. Experimental setup	5 Marks
4. Spotters	25 Marks
5. Viva-voce	10 Marks
6. Practical Record Note	10 Marks

Total **75 Marks**

8. Passing minimum

- a) For Internal and External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
- b) In the aggregate (External + Internal), the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
- c) Grading shall be based on overall marks obtained (internal + external).

9. Dissertation Work (Maximum Marks: 100)

The duration of the Dissertation Work shall be a minimum of three months in the fourth semester.

a) Plan of work

The candidate shall undergo Dissertation Work during the fourth semester. The candidate should prepare a scheme of work for the dissertation and should get approval from the guide. The candidate, after completing the dissertation work, shall be allowed to submit to the university at the end of the fourth semester. If the candidate is desirous of availing the facility from other universities/laboratory, they will be permitted only after getting approval from the guide. In such a case, the candidate shall acknowledge the same in their dissertation.

b) No. of copies of dissertation

The candidate should prepare three copies of the dissertation and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the department library, and the student shall hold one copy.

c) Format to be followed for dissertation

The format /certificate for dissertation to be followed by the student are given below

- Title page
- Certificate
- Acknowledgment
- Content as follows:

Chapter No	Title	Page No
1	Introduction	
2	Materials and Methods	
3	Results	
4	Discussion	
5	Summary	
6	References	

d) Format of the title page

Title of Dissertation

Dissertation submitted in partial fulfilment of the requirement for the degree of Master of Science in
Oceanography and Coastal Area Studies to the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

University Logo

Department of Oceanography and Coastal Area Studies

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi - 630003

(Year)

Format of certificate

Certificate

This is to certify that the dissertation entitled _____ submitted in partial fulfilment for the requirement of the Degree of Master of Science in Department of Oceanography and Coastal Area Studies to the Alagappa University, Karaikudi is a bonafide record of research work done by Mr./Mrs _____ under my supervision and guidance and that no part of the dissertation has been submitted for the award of degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or in full in any scientific journal or magazines.

e) Dissertation evaluation

Dissertation Work	:	50 Marks
Internal Assessment	:	25 Marks
Viva -voce	:	25 Marks
Total	:	100 Marks

10. Village Extension Programme (VEP)

The Sivaganga and Ramnad districts are very backward districts where a majority of people lives in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this Village Extension Programme is to extend out to reach environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three days.

1. Environmental awareness
2. Hygiene and Health

A minimum of two faculty members can accompany the students and guide them.

11. Maximum duration for completion of the course

The maximum period for completion of M.Sc. Degree in Oceanography and Coastal Area Studies shall not exceed four semesters.

12. Commencement of regulation

These regulations shall come into effect from the academic year 2019-2020 for students who are admitted to the first year of the course during the academic year 2019-2020.

13. Industrial visit/Internship/Field/Institutional visit:

Students have to undertake an industrial / Internship/Field/ institutional visit/educational tour and have to submit a report for evaluation (Satisfactory / Not Satisfactory).

14. Classification of the successful candidate

A candidate who secured not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First class. All other successful candidates shall be declared to have passed in the Second class. Candidate who obtains 76% of marks in the aggregate shall be deemed to have passed the examination in first class with distinction provide they should have passed all the examination at the first appearance.

Candidates who passed all the examinations prescribed for the course in the first instance and within two academic years from the year of admission to the course are alone eligible for university ranking.

A candidate is deemed to have secured the first rank provided if he/she should have passed all the papers in the first attempt itself and should have secured the highest Cumulative grade point average (CGPA).

Each student should have taken **90** credits to complete the course. Each paper carries **4/3/ 2** credits with 50% marks in the university examination and 50% marks in CIA.

Raw score	Letter Grade	Description	Grade point
91 and above	S	First Class-Exemplary	9.01-10
76-90	D	First Class-Distinction	7.51-9.00
61-75	A	First Class	6.01-7.50
56-60	B	Second Class	5.51-6.00
50-55	C	Second Class	5.00-5.50
Below 50	RA	Re-appear	-
I - inadequate attendance; W-withdrawal from the course			

CREDIT STRUCTURE

M.Sc. OCEANOGRAPHY AND COASTAL AREA STUDIES

Semester	Course/ Title	Course Code	Credit	Hours /Week	Marks		Total
					Internal	External	
I	Geological Oceanography	461101	4	4	25	75	100
	Physical Oceanography	461102	4	4	25	75	100
	Chemical Oceanography	461103	4	4	25	75	100
	Biological Oceanography	461104	4	4	25	75	100
	Practical I	461105	3	6	25	75	100
	Practical II	461106	3	6	25	75	100
	Elective Course		2	2	25	75	100
	Total		24	30	-	-	700
II	Marine Ecology and Zoogeography	461201	5	5	25	75	100
	Marine Pollution, Environment and Health	461202	5	5	25	75	100
	Applications of Remote Sensing and GIS in Oceanography	461203	5	5	25	75	100
	Practical III	461204	5	10	50	100	150
	Elective Course		2	2	25	75	100
	Non-Major elective Course		2	3	25	75	100
	SLC	MOOC	Extra Credit	-	-	-	-
	Total		24	30	-	-	650
III	Fish and fisheries	461301	5	5	25	75	100
	Aquaculture	461302	5	5	25	75	100
	Post Harvest Technology	461303	5	5	25	75	100
	Practical IV	461304	5	10	50	100	150
	Elective Course		2	2	25	75	100
	Non-Major elective Course		2	3	25	75	100
	SLC	MOOC	Extra Credit	-	-	-	-
	Total		24	30			650
IV	Research Methodology	461401	8	8	25	75	100
	Project Work	461999	10	20	50	150	200
	Library			2			
	Total		18	30	-	-	300
	Grand Total		90	120			2300

M.Sc., OCEANOGRAPHY AND COASTAL AREA STUDIES

SEMESTER - I			
Course Code: 461101	GEOLOGICAL OCEANOGRAPHY	Credits: 4	Hours: 4
Objectives	<ul style="list-style-type: none"> ➤ This course offers the basic knowledge about the earth and its processes. It provides the paleo oceanography of the past historical evidences and the changes of the oceans. ➤ It provides the outline of the Geological Oceanography for the students, which will gain the depth knowledge in this course 		
Unit -I	Introductory concepts in Earth Science - Origin of the universe and earth - earth's interior - crust, mantle and core - Geological time scale - division of geological time. Pangaea - continental drift and paleomagnetism, crustal movement plate tectonics, isostasy sea floor spreading. Emergent and submergent margins, convergent and divergent boundaries, changing sea level - Crustal deformation - folds, faults.		
Unit-II	Products of Earth process - Materials of earth's crust - igneous rock, metamorphic rock and sedimentary rock. Weathering and erosion – mechanical and chemical weathering, rates of weathering. Erosion by wind, water and glaciers.		
Unit-III	Introduction and Concepts in Marine Geology - Introduction to marine geosciences - morphology of the near shore environment - beach, estuaries, continental shelf, Continental slope, rise, submarine canyons morphology and characteristics. Morphology of the ocean basins, ocean floor, abyssal plains, hills plateau, mid oceanic ridges. Sediment transport by waves and currents - long shore currents. General coastal geomorphology of India.		
Unit-IV	Depositional environment and features - Major coastal deposits and land forms - marine deltas, estuaries, spits and related features, beach ridges, barrier islands organic reefs and atolls. sedimentary structures - texture and their depositional significance. Physical properties of particles - size, mass properties - shape, sphericity and roundness, mineral stability and significance - Porosity and permeability – Turbidites - Sea floor sediments, geochronology - relative dating - absolute dating. Analysis of sediments -graphical representation and determination of depositional environment.		
Unit -V	Marine mineral resources - Beach placers, hydrocarbon resources, manganese nodules, phosphotites, sulphur, dissolved salts, limestone deposits, evaporates - their mechanism of origin and global distribution pattern. Methods of deep-sea exploration of mineral resources - gravity, magnetic and seismic methods - principle and techniques.		
References and Textbooks:			
Benn, D.I., & Evans, D.J.A. (1998). <i>Glaciers and Glaciation</i> . London: Arnold.			
Blatt, H., & Tracy, R.J. (1996). <i>Petrology: Igneous, sedimentary, and metamorphic (2nd ed.)</i> . New York: W.H. Freeman.			
Bolt, B.A. (1993). <i>Earthquakes (3rd ed.)</i> . New York: W.H. Freeman.			
Carter, R.W.G., & Woodroffe, C.D. (1994). <i>Coastal evolution</i> . Cambridge University Press.			
Chorley, R.J., Schumm, A.A., & Sugden, D. E. (1995). <i>Geomorphology</i> . New York: Methuen.			
Cox, A., & Hart, R.B., (1986). <i>Plate tectonics: How it works</i> . Palo Alto, CA: Blackwell.			
Craig, J.R., Vaughan, D.J., & Skinner, B.J. (1988). <i>Resources of the Earth</i> . Englewood Cliffs, NJ: Prentice-Hall.			
Davis, G.H., & Reynolds, S.J. (1996). <i>Structural geology of rocks and regions</i> . New York: John Wiley and Sons.			
Duxbury, A.C., & Duxbury, A.B. (1994). <i>An introduction to the world's oceans (4th ed.)</i> . Dubuque, Iowa: Wm. C. Brown.			
Dyer, K.R. (1986). <i>Coastal and Estuarine sediment dynamics</i> . New York: Wiley Inter sciences.			
Hardisty, J. (1990). <i>Beaches form and process</i> . New York: Karper Collins Academic.			

Johnston, A.C., & Kanter, L.R. (1990). *Earthquakes in stable continental crust*. Scientific American, 262(3):68-75.

Kearey, P., & Vine, F.J. (1990). *Global Tectonics*. Oxford: Blackwell Scientific.

Sharma, P.V. (1986). *Geophysical Methods in Geology (2nd ed)*. New York: Elsevier.

Sverdrup, H. U., Johnson, M., & Richard H. Fleming. (1942). *The Oceans, Their Physics, Chemistry, and General Biology*. New York: Prentice-Hall.

Outcome

- The students able to study the topography, structure and geological processes of the ocean floor
- They get aware of geophysical technologies to examine the makeup of the ocean bedrock and the natural processes of rock movement.

Course Code: 461102	PHYSICAL OCEANOGRAPHY	Credits: 4	Hours: 4
Objectives	<ul style="list-style-type: none"> ➤ The Objective of this course is to offer the students about the history of Oceanography, physical properties of seawater, waves, tides, currents, Estuaries, deltas, coastal lagoons, meteorology and clouds precipitation. ➤ To make the students to predict the weather map and climatic conditions of Coastal regions and to comprehend the El Nino and La Nina effects. 		
Unit -I	History of Oceanography: Classical Period - Contributions of the Greeks - The Golden Age of Discovery - Nineteenth century: The golden age of Oceanography - Development of oceanography in the Twentieth century - Ocean Exploration - Early scientific investigations - National Expeditions - Post War Oceanography - Modern Oceanography - Current and Future Oceanographic research.		
Unit-II	Ocean Dynamics: Waves - Properties of Ocean waves - wave motions - waves in shallow waters - wave refraction - wave diffraction - standing waves - Other types of progressive waves. Breakers - Types of breakers. Tides - tidal characteristics - origin of tides. Tides in small and elongated basins - tidal currents - Power from the tides. Wind and Ocean Circulation - Surface ocean currents - Deep ocean circulation - water flow in semi-enclosed seaways. Ocean Currents - General character and Origin of Ocean currents - Types of Ocean currents.		
Unit-III	Physical properties of seawater: Temperature of the Oceans: Sources of Heat - Surface temperature of the ocean water - Factors affecting the horizontal distribution of surface temperature of the oceans - Range of sea surface temperature. Pressure and their changes in the Sea. Salinity - Various sources of Oceanic salts - Factors causing variations in Salinity - Distribution of salinity - Partially or Wholly enclosed seas, Inland seas and Lakes, vertical distribution of salinity. Density of Ocean water - Horizontal and Vertical distribution of Density. Ice in the sea - Formation and Classification - Effect of Polar Ice on the Atmospheric Circulation. Practical Significance of T-S curve - water masses. Transmission of Sound – Absorption of radiation – Eddy conductivity – Diffusivity – viscosity.		
Unit-IV	Meteorology: Fundamental Principles - Indian climatology with special reference to seasonal distribution. Climatic Zones of India. Clouds and their classification. Monsoons & Cyclones: Synoptic features associated with monsoon and tropical cyclones. General Circulation of the atmosphere. Satellite Meteorology: Polar orbiting and Geostationary satellites - visible and infrared radiometers - Multi-scanner radiometers. Identification of synoptic systems, fog and sandstorms, detection of cyclones, estimation of SST, cloud top temperatures, winds and rainfall - temperature and humidity soundings.		
Unit -V	Climate and Sea level change: Global warming - Greenhouse effect - Ozone deflection. ElNino and La Nina - Southern Oscillation - ENSO and its impact on Indian Monsoon. The Geoid - Eustasy and Isostasy - Regional and global effects of Sea level changes - Effect of sea level changes on shorelines and case studies.		
References and Text books: Alan P. Trujillo. (2013). <i>Essentials of Oceanography (11th ed)</i> . Pearson. Bharatdwaj, K. (1993). <i>Physical Geography-Oceanography</i> . Discovery Publishing House. Duxbury, A. C., Duxbury, A. B., & Sverdrup, K. A. (2000). <i>An Introduction to The World's Oceans</i> . UK: Wm. C. Brown Publishers. Lal. D.S. (2010). <i>Oceanography</i> . Allahabad: Sharda Pustak Bhawan. Matthew Fontaine Maury. (1855). <i>The Physical Geography of the Sea</i> . Harper & Brothers. Natarajan, M., & Balasubramanian, T. (2001). <i>Oceanographic equipments</i> . ENVIS Centre, CAS in Marine Biology, Annamalai University.			

Paul. R. Pinet. (1992). *Oceanography - An Introduction to the Planet Oceans*. UK: West Publishing Company.

Paul. R. Pinet. (2000). *Invitation to Oceanography (2nd ed)*. Sudbury, Massachusetts: Jones and Bartlett Publishers.

Robert. H. Stewart. (2008). *Introduction to Physical Oceanography*. Texas: Texas A & M University.

Roland Stull. (2015). *Practical meteorology - An algebra-based survey of Atmospheric Sciences*. Vancouver, Canada: The University of British Columbia.

Outcome	<ul style="list-style-type: none"> ➤ Students able to study the physical properties and dynamic processes of the oceans and also studies the interaction of the ocean with the atmosphere. ➤ With satellite data, students can able to understand not only how the ocean behaves at a given point in time, but also how the ocean changes and fluctuates.
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Course Code: 461103	CHEMICAL OCEANOGRAPHY	Credits: 4	Hours: 4
Objectives	<ul style="list-style-type: none"> ➤ To understand the chemical composition of the oceans and their physical, chemical, and biological processes governing the composition in the past and present. ➤ Cycling of carbon, nitrogen, phosphorus, silicon, and oxygen, and processes of primary production, export production, remineralization, diagenesis and air-sea gas exchange. 		
Unit -I	Introduction: marine chemistry - historical development - International Indian Ocean Expedition (IIOE).		
Unit-II	Chemical properties of water and seawater - structure of water molecules. pH, salinity and chlorinity of seawater. Dissolved gases: Solubility of gases in seawater - Carbon dioxide, Dissolved oxygen - BOD and COD - Air and sea gas exchange - N ₂ - H ₂ S, Methane - Noble gases - Their origin - distribution and importance - Hydrothermal vents.		
Unit-III	Trace elements: Elements - Major and Minor elements in sea water - Oxidation - Reduction Potential of seawater - Ions and its composition. Trace element inputs from estuarine waters. Cycling of major, minor and trace elements in coastal waters and their Interaction with marine organisms. Exploration of Manganese nodules		
Unit-IV	Nutrients: Origin - Significance - Silicon, Nitrogen, Phosphorus and Carbon cycle- Seasonal variations.		
Unit -V	Organic matter: Dissolved and particulate organic matter-sources classification-composition estimation - Distribution - Seasonal variation. Petroleum hydrocarbons.		
Reference and Text Books:			
David A. Ross. (1977). <i>Introduction to Oceanography</i> . New Jersey: Prentice-Hall Inc.			
Grant Gross, M. (1993). <i>Oceanography: A view of the earth</i> . New Jersey: Prentice - Hall Inc.			
McCormic, J. M., & J. V. Thiruvathakal. (1976). <i>Elements of Oceanography</i> . Philadelphia: W.B. Saunders Company.			
Pickard, G. L. (1975). <i>Disruptive physical oceanography</i> . Pergamon Press London.			
Riley, J. P., & G. Skirrow. (1975). <i>Chemical oceanography (Vol.1-8)</i> . London: Academic press.			
Ross, D. A. (1970). <i>Introduction of oceanography</i> . London: Prentice Hall Inc.			
Strickland, J. D. H., & T. R. Parsons. (1972). <i>A practical handbook of seawater analysis</i> .			
Sverdrup, H. U., Honson, M. W., & Fleming, R. H. (1959). <i>The ocean their physics, chemistry and general biology</i> . New Jersey: Prentice-Hall Inc.			
Outcomes	<ul style="list-style-type: none"> ➤ Students able to study the chemical properties and dynamic mixing system, in which composition changes take place partly from internal processes and partly as a result of the circulation and mixing of water masses. ➤ Understands the concept of primary production, Knows the major primary producers in the Ocean, can describe the fate of primary production in the ocean, understand Redfield Ratios and be able to use them in identifying limiting nutrients. 		

Course Code: 461104	BIOLOGICAL OCEANOGRAPHY	Credits: 4	Hours: 4
Objectives	<ul style="list-style-type: none"> ➤ The main objective of this course is to make the students aware of the major life forms in the ocean, describes the characteristics that differentiate these life forms and how these forms interact with each other. ➤ To Explain how marine organisms, influence the cycling of bio elements, particularly carbon. 		
Unit -I	Plankton - classification based on size, mode of life and habitat. Phytoplankton and Zooplankton - methods of collection, estimation of standing crop-wet and dry weight estimation-plankton volume settling and displacement methods.		
Unit-II	Adaptation of plankton - structural (weight, increase of surface area, flotation) physiological mechanisms. Phytoplankton and Zooplankton interrelationship - red tide phenomenon - causes and effects.		
Unit-III	Organic production - Primary and secondary productions methods of estimation of primary production. Factors affecting primary production - regional differences in (primary and secondary) production.		
Unit-IV	Seaweeds - Occurrence and distribution in India - economic importance. Life cycles of economic important seaweeds. Seagrasses - morphological and anatomical adaptations ecological role. Mangroves - distribution, adaptation, conservation and ecological role. Coral reef ecosystem.		
Unit -V	Salt marsh and sand dune, mud flat vegetation - morphological, anatomical and physiological features, ecological role, uses, conservation and management.		
References and Text Books			
Chapman, V.J. (1978). <i>Coastal vegetation</i> . Oxford: Pergamon Press.			
Naskar, K., & R. Mandal. (1999). <i>Ecology and Biodiversity of Indian Mangroves (Vol. I & II)</i> . Daya Publishing House.			
Nybakken, J. W. (2001). <i>Marine Biology an Ecological. Approach (8th ed)</i> . Addison Wesley Edu. Pub. Inc.			
Parsons, T.R., M. Takahashi & B. Hargrave. (1977). <i>Biological Oceanography Processes, (2nd ed.)</i> , Oxford. Pergamon Press.			
Peter Mc Roy, C. & G. Helfferich. (1977). <i>Seagrass Ecosystems - A scientific Perspective</i> . New York: Marcel Dekker Inc.			
Sumich, J. L. (1999). <i>Introduction to the Biology of Marine Life (7th ed)</i> . The Mc Graw Hill Companies Inc.			
Tomas., & Carmelo, R. (1997). <i>Identifying Marine Phytoplankton</i> . Academic Press			
Outcome	<ul style="list-style-type: none"> ➤ Students able to define the major life forms in the sea and also describe the characteristics. ➤ They able to explain how marine organisms influence cycling of bio elements and describe the prominent characteristics of the primary marine habitats. 		

PRACTICALS – FIRST SEMESTER

Course Code: 461105	PRACTICAL - I	Credits: 3	Hours: 6
GEOLOGICAL OCEANOGRAPHY			
<ol style="list-style-type: none"> 1. Observation of Geomorphological changes of islands and coral reef environment. 2. Study of Geological information system. 3. Study of one type fossil: - Foraminifera and Ostracods and their preservation methods. 4. Study the nature of sediment and classification in south east coast of India. 5. Measurement of elevation in sea level. 			
PHYSICAL OCEANOGRAPHY			
<ol style="list-style-type: none"> 1. Water sampling devices: Mayer's water sampler-Knudsen water sampler – universal water sampler - Nansen water sampler - Horizontal water sampler – Niskin water sampler - Bacteriological water sampler. 2. Light measuring devices: Secchi disc – Lux meter – Turbidity meter – underwater Photometer. 3. Temperature and pressure measuring devices: Towing surface thermometer – Six's maximum and minimum thermometer –Reversing thermometer- Bathythermograph – Thermohydrobarograph - Fortin's barometer. 4. Current measuring devices: Watt's current meter - Direct reading current meter. 5. Bottom sampling devices: Ekman's dredge - Peterson's grab – Van Veen's grab - Vertical gravity corer - Ooze sucker - Mud snapper - Box corer - Boomerang water sampler, grab and corer. 6. Depth measuring devices –Echo sounder, Side scan Sonar. 7. Weather Instruments: Thermometers, Barometers, Humidity Sensors, Wind Speed, Wind Vane, Rain Gauge, Hail Pad, Campbell Stokes Recorder, Hygrometer, Pan evaporation, weather prediction charts of the local region. 			

Course Code: 461106	PRACTICAL - II	Credits: 3	Hours: 6
CHEMICAL OCEANOGRAPHY			
1. The determination of Salinity			
2. Total alkalinity			
3. Dissolved oxygen			
4. Biological oxygen demand			
5. Chemical oxygen demand			
6. Calcium and magnesium			
7. Nitrite			
8. Nitrate			
9. Reactive silicate			
10. Total Phosphorous			
11. Inorganic Phosphate			
12. Ammonia			
13. Total Nitrogen			
14. Particulate organic matter			
15. Total dissolved phosphorous			
BIOLOGICAL OCEANOGRAPHY			
1. Identification of Phytoplankton			
2. Identification of Zooplankton			
3. Identification of locally available Seaweeds, Seagrasses and Mangrove plants.			
4. Extraction and Estimation of Chlorophyll, Primary productivity.			
5. Identification of coastal invertebrate fauna.			
6. Mounting of gastropod radulae.			
7. Anatomy of crabs, shrimp, gastropod and bivalve.			
8. Identification of minor phyla.			

SEMESTER-II			
Course Code: 461201	MARINE ECOLOGY AND ZOOGEOGRAPHY	Credits: 5	Hours: 5
Objectives	<ul style="list-style-type: none"> ➤ To make the students to understand the divisions of the marine environment and physico - chemical parameters and adaptations of living organisms. ➤ To study the structure and function of marine ecosystems and their feeding relationship in the form of food chain and food web. ➤ To understand the structure, composition and adaptations of community ecology, besides studying the animal associations. 		
Unit -I	Marine environment ecological factors: light – temperature – salinity - pressure. Classification of marine environment: pelagic environment, planktonic and nektonic adaptations, benthic environment intertidal, interstitial and deep-sea adaptation.		
Unit-II	Marine Ecosystem: Concept - Ecosystem Structure and Function - Functional attributes Food chain, Food – web, Ecological Pyramid, Energy Flow. Recycling of Nutrients. Evolution and management- system ecology and modeling.		
Unit-III	Population Ecology - group attributes, population growth, density variations, concept of carrying capacity. Dispersal, prey-predator relationship - density dependent - density independent factors.		
Unit-IV	Structure and composition, diversity and stability, concept of niche, succession, community wise adaptation, e.g. fouling and boring community. Animal association in marine environment - endoecism, inquilinism – phoresis - epizoism-mutualism - communalism – symbiosis - parasitism. Marine zoogeography with reference to Indian Arctic and Antarctic Oceans.		
Unit -V	Marine biodiversity: Definition and Importance, Biodiversity Assessment Technique Threats to Marine Biodiversity, Over-Exploitation, Physical Alteration, Pollution, Alien Species. Bio-Security. Marine bioresources		
References and Text Books:			
Balakrishna Nair, N., & Thampy, D. M. (1980). <i>A text Book of Marine Ecology</i> . New Delhi: The Macmillan Co. of India Ltd.			
Barnes R. S. K. (1999). <i>Introduction to Marine Ecology</i> . Blackwell Science.			
Bertness, M. D., Gaines, S. D., & Hay, M.K. (2000). <i>Marine Community Ecology</i> . Sinauer Associates.			
Crowder. (1991). <i>William Seashore Life Between the Tides</i> . Dover Publication.			
Gage. J. D., & Tyler, P. A. (1991). <i>Deep Sea Biology</i> . Cambridge: Cambridge University Press.			
Jeffery S. Levinton. (2000). <i>Marine Ecology, Biodiversity and Function</i> . Oxford University Press.			
Outcome	<ul style="list-style-type: none"> ➤ Learn and gain knowledge on the characteristics of community ecology and the adaptation of animals. ➤ Awareness on the marine biodiversity and importance. 		

Course Code: 461202	MARINE POLLUTION, ENVIRONMENT AND HEALTH	Credits: 5	Hours: 5
Objectives	<ul style="list-style-type: none"> ➤ To provide students with an understanding of the sources, links and biological effects of major classes of pollutants in the marine environment. ➤ To make students aware of how to protect the ocean from marine pollution and also to know policies and government laws of National and International level. 		
Unit -I	Marine Pollution - Definition, categories of additions, Pollutant and its classification. Organic wastes - BOD, COD, and dilution factor, Fluctuations in DO - Consequences of organic discharges to estuaries with examples - their origin and transport to the oceans. Mechanism of dispersion of different pollutants- physical, chemical and biological effect on marine organisms- bioaccumulation and biomagnification.		
Unit-II	Sewage Pollution - Definition, sources, nature and their treatment processes with reference to wastes from river run off, agricultural, paper, fertilizer, pulp and soap manufacturing industries. Thermal Pollution- The state of some ocean and seas in the world (pollution aspect) - The Pacific Ocean and Indian Ocean - Mediterranean Sea		
Unit-III	Oil Pollution - Sources, major accidental spills, fate of spilled oil on the sea - consequences of oil spills and treatment of oil spills. Pesticide pollution - inputs, fate in the sea, factors affecting the bioaccumulation of pesticides - DDT the most widespread molecule - Impact of pesticides on the Environment - Mode of poisoning of pesticides - Methods to minimize pesticide pollution.		
Unit-IV	Heavy metal Pollution - Sources, Classification and effects of marine and coastal waters (Hg, Pb, Cd, Cu, Zn and Fe). Distribution- toxicity and disease -minamita, itaiitai, etc. and their toxic effect - eutrophication and ecological significance. The present status of coastal pollution in India and future strategies. Maximum permissible dose concept - dose limits, Disposal of radioactive wastes -beneficial aspects of radiation and food safety.		
Unit -V	Criteria for selection of indicator organism - Quantitation of pollution load, basic pre-requisites. Macro algae, crustaceans and mollusks as indicator organisms for monitoring of trace metal pollution - Red tides phenomena- distribution, types of poisoning, effects and methods to minimize red tides in the sea. Monitoring strategies of marine pollution – Mitigation. Global warming and Climate change - Role of international and national organizations and role of NGO.		
References and Text Book:			
AaradhanaSalpekar. (2018). <i>Marine, Nuclear and Thermal Pollution</i> . JnanadaPrakashan.			
Andres Hugo Arias., & Jorge Eduard. (2017). <i>Marine Pollution and Climate Change</i> . Taylor and Francis Group.			
Carl J. Sindermann. (1995). <i>Ocean Pollution: Effects on Living Resources and Humans</i> . CRC Marine Science.			
Clark, R. B.(1989). <i>Marine pollution</i> . Oxford, New York: Clarendon Press.			
Coffield, R. L. (2019). <i>Saving Our Oceans</i> . Moonlight Mesa Associates.			
Judith S. Weis. (2015). <i>Marine Pollution</i> . Oxward University Press.			
Mishra, P. (2007). <i>Environment Pollution and its Control</i> . Sumit Enterprises.			
Ricardo Beiras. (2018). <i>Marine Pollution: Sources, Fate and Effects of Pollutants in Coastal Ecosystem</i> . Elsevier.			
Singh, P. (1995). <i>Environmental Pollution and Management</i> . Chugh Publications.			

Sinha, P. (1998). *Marine Pollution*. Anmol Publications Pvt. Ltd.

Outcome

- This course helps the students to prepare for their careers in academic programs and research centers.
- And also able to work in consulting firms by providing them with an in-depth understanding of causes, consequences and methods of assessment of marine pollution.

Course Code: 461203	APPLICATION OF REMOTE SENSING & GIS IN OCEANOGRAPHY	Credits: 5	Hours: 5
Objective	<ul style="list-style-type: none"> ➤ To attain a foundational knowledge and comprehension of the physical, computational, and perceptual basis for remote sensing. ➤ To gain familiarity with a variety of earth science applications of remote sensing. ➤ To gain basic experience in the hands-on application of remote sensing data through visual interpretation and digital image processing exercises. Analyze and synthesize understanding by identifying and developing a research and application proposal using remote sensing. 		
Unit -I	Remote sensing Definition-Principles and Concepts-Electromagnetic spectrum-Electromagnetic energy interaction in the Atmosphere: Absorption, Transmission and Scattering- Electromagnetic spectrum- Electromagnetic energy interaction in the Earth surface: Vegetation, Soil and Water.		
Unit-II	Define sensors and Platforms-Types of sensors(Active and Passive)-Types of Platforms(Air borne and Spaceborne)-Aerial camera-Basic principles of photogrammetry-Aerial photography missions-Multispectral scanners.		
Unit-III	Introduction of visual image interpretation-Landuse, landcover, Geologic, Soil and Wetland mapping-Applications of Agricultural, Forestry, Rangeland, Water resource and Urban planning-Principles of Landform identification and Evaluation-Multispectral, Thermal, Hyperspectral and Microwave sensing		
Unit-IV	Earth observation system (Low,medium,High and Imaging spectrometry systems)-Lansatseries,SPOT,IRS,RESURS,ADEOS,JERS,SPIN,IKONOS,QuikBird,OrbView,E ROS,NOAA,GOES,DMSP,Seasat,EOS and MODIS-Global Positioning System.		
Unit -V	Basic principles & uses of GIS-Application of GIS in Geology and natural Resource management - Components of GIS-Raster and vector data – DEM-Digital Image Classification-Principle of image classification-image classification process(Supervised,Unsupervised)-Problems in image classification.		
References and Text Books:			
Anji Reddy, M. (2011). <i>Textbook of Remote Sensing and Geographical Information systems</i> . Hyderabad: BS Publications.			
Chandra, M., & Gosh, S. K. (2009). <i>Remote Sensing and GIS</i> . New Delhi:Narosa Publishing Home.			
Drury, S. A. (1993). <i>Image interpretation in Geology</i> . Chapman and Hall, London.			
George Joseph. (2005). <i>Fundamentals of Remote Sensing</i> . Hyderabad: Universities Press.			
Gupta, R.P. (2003). <i>Remote sensing Geology</i> . Springer.			
Jean-yvesscanvk. (1997). <i>Aerospatial Remote Sensing in Geology</i> . A.A. Balakarma, Netherlands.			
John J. Qu, Wei Gao, MenasKafatos, Robert E. Murphy., & Vincent V. Salomonson. (2007). <i>Earth Science - Satellite Remote Sensing</i> . Springer.			
Pandey, S. N. (1987). <i>Principles and applications of Photogeology</i> . Wiley eastern.			
Thomas M. Lillesand., Ralph W. Kiefer., & Jonathan W. Chipman. (2008). <i>Remote sensing and Image Interpretation</i> . John Wiley & Sons.			
Outcomes	<ul style="list-style-type: none"> ➤ They can characterize the natural features or physical objects on the soil and wetland. ➤ They get idea about remote sensing platforms and remote sensors ➤ They get knowledge on GIS technology which can be used for scientific investigations, resource management, and development planning. 		

PRACTICALS – SECOND SEMESTER

Course Code: 461204	PRACTICAL - III	Credit:5	Hours:10
MARINE ECOLOGY AND ZOOGEOGRAPHY			
1. Rocky, sandy, muddy shore Fauna			
2. Seagrass – Macrofauna & Meiofauna			
3. Mangrove associated Macro fauna& Meiofauna			
4. Biodiversity assessment of Population density in an Ecosystem			
5. Field visit to Rock shore, sandy shore and Muddy shore			
6. Visit to Marine National Park and Report Submission			
MARINE POLLUTION, ENVIRONMENT AND HEALTH			
1. BOD – TOC – TDS - TSS			
2. Heavy Metal Analysis			
3. Identification of phytoplankton and zooplankton			
4. Identification of Pollution indicator organisms			
APPLICATION OF REMOTE SENSING & GIS IN OCEANOGRAPHY			
1. Preparation of simple Vector map, Toposheet reading and GPS field survey.			
2. Visual Interpretation of Geomorphic features from the Satellite image and Aerial photographs.			

SEMESTER - III			
Course Code: 461301	FISH AND FISHERIES	Credits:5	Hours:5
Objectives	<ul style="list-style-type: none"> ➤ The main objective of this course is to make students aware of fisheries resources, their biology and management. ➤ To impart the students about the different fishing technologies and alternative livelihood options. 		
Unit -I	Fisheries Resources: Major fisheries resources of the world - global trends in production - Target and non-target fisheries resources of the Indian subcontinent and the EEZ. Distribution, composition, trends and dynamics of major exploited fishery resources in lagoons, estuaries, territorial waters, oceanic waters, deep sea oceanic islands. Sports, game and ornamental fisheries. Endangered and threatened species - in-situ and ex-situ conservation.		
Unit-II	Fishery Biology: General morphology and outline classification of fishes - Biology of economically important fish species - Food and feeding habits - methods of studying food and feeding habits - Reproductive biology - maturity stages, fecundity, ova diameter studies and breeding cycles - Length - weight relationships, Condition Factor, Gonado-Somatic Index, Age and growth studies. Catch per unit effort - Concept of Maximum Sustainable Yield and Maximum Economic Yield.		
Unit-III	Fisheries Management: Concepts and principles of fisheries management - Fisheries Acts and Legislations - Fisheries policies for inland, coastal and open ocean fisheries management - International fishery regulations and treaties - Input control measures - access control, size, type, number and power of boats, duration of fishing. Output control measures - Total Allowable Catch, Catch Quotas, Licensing, Technical control measures such as size limitations, closed fishing areas, closed seasons, size of nets and mesh size regulations, limited entry. UNCLOS, FAO Code of Conduct for Responsible Fisheries.		
Unit-IV	Fishing Technology: Different types of craft and gear, their operation and their maintenance - Selectivity of fishing gears - by-catch reduction devices in trawls - turtle excluder devices - Use of modern techniques and equipment for fish finding and capturing.		
Unit -V	Fisheries Livelihood: Relevance of capture fisheries in food, nutrition, employment income and livelihood securities of fishers - Impact of dams, river linking, CRZ, Biodiversity Bill, protected/closed area, fishing bans, protected areas, mangroves, sanctuaries and parks on the fisher communities. Role of extension in fisheries - mechanisms and modes of extension and their impact on capture fisheries and fisher's livelihood - alternative livelihood options.		
References and Text Books Bal, D.V., & Rao, K. V. (1990). <i>Marine Fishes of India (1st ed)</i> . Tata McGraw Hill. Chandra P. (2007). <i>Fishery Conservation, Management and Development</i> . SBS Publ. Dholakia, A. D. (2004). <i>Fisheries and Aquatic Resources of India, FAO, Technical Papers on Marine Fisheries</i> . Daya Publ. House. Hoar, W. S., & Randall, D. J. (1971). <i>Fish Physiology (Vol.1-11)</i> . New York: Academic Press. Kurian, C. V., & Sebastian, V. O. (1986). <i>Prawns and Prawn Fisheries of India</i> . Hindustan Publ. Corp.			

Margaret, E. Brown. (1957). *The Physiology of fishes (Vol. 1 & 2)*. New York: Academic Press.
 Peter, B. M., & Joseph, J. C. Jr. (2000). *Fishes - An Introduction to Ichthyology (4th ed)*. Prentice Hall.
 Samuel, C. T. (1968). *Marine Fisheries in India*. Narendra Publ. House.
 Shanbhogue, S. L. (2000). *Marine Fisheries of India*. ICAR.
 Yadav, B. N. (1997). *Fish and Fisheries (2nd ed)*. Daya Publ. House.

Outcome	<ul style="list-style-type: none"> ➤ Students able to classify the fishes. ➤ They obtain knowledge on the techniques of identifying fishes. ➤ They have sound knowledge on the conservation and management of marine fishery.
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Course Code:461302	AQUACULTURE	Credits: 5	Hours: 5
Objectives	<ul style="list-style-type: none"> ➤ The main objective of this course is to make students aware of the need for aquaculture, farm design and construction, nursery and hatchery management. ➤ To know the current status of aquaculture and socio-economic problems. ➤ Learn about brood stock rearing, induced breeding, hatchery production of fin and shell fish seeds and larval rearing. ➤ Aware about aquaculture extension, role of government and non-government organisation in fisheries and aquaculture extension activities. 		
Unit -I	Introduction: Significance of Coastal aquaculture and potential. Status of aquaculture and socio-economic problems.		
Unit-II	Farm design and construction: Site selection-Soil and water quality-Earthen pond design, construction, operation and maintenance- Open sea farming: cages and Raft - Pens and Race ways.		
Unit-III	Nursery and Farm management: stocking, feed and water quality management- predators and parasites control. Disease management - probiotics and prebiotics. Harvesting- economics of farming. Seaweed resources-Types of culture-Economical importance of seaweeds.		
Unit-IV	Hatchery Management: Fin fishes, crustaceans and molluscs-hatchery production: collection and maintenance of brood stock-induced breeding-mass production of seeds - Intensive Larval rearing.		
Unit -V	Aquaculture Extension: Principles and extension methods - Government and Non - Governmental Agencies in fisheries development - Role of Fisheries Extension in the development of aquaculture in India.		
References and Text Books:			
Bliss, D. (1983). <i>Biology of crustacean (Vol. I to 10)</i> . London: Academic Press.			
Bose. (1991). <i>Coastal aquaculture engineering</i> . Oxford: IBA Publishing Co. Pvt. Ltd.			
Chapman, V. J., & Chapman, D. J. (1980). <i>Seaweeds and their use</i> . London: Chapman and Hall.			
Fredrick W. Wheaton.(1977). <i>Aqua cultural engineering</i> . New York: Wiley Inter science.			
Hornell, J. (1984). <i>Marine fish farming for India</i> . Madras, India: Shanthy Books.			
Morton, J. E., (1979). <i>Molluscs</i> . London: Hutchinson Co. Ltd.			
Pillay,T.V.R. (1972). <i>Coastal aquaculture in the Indo. Pacific region</i> , London: Fishing News Ltd.			
Santhanam, R.,Ramanathan, N., &Jegadeesan, G. (1990). <i>Coastal Aquaculture in India</i> . India: CBS Pulation.			
Shigueno, K. (1976). <i>Shrimp culture in Japan</i> . Tokyo: Association for International Technical Promotion.			
Shigueno, K. (1978). <i>Problems in prawn culture</i> . New Delhi: Amerind Publishing Co, Pvt. Ltd.			
Outcome	<ul style="list-style-type: none"> ➤ Students were able to identify the potentials and socio-economic issues of aquaculture. ➤ They gain knowledge about selection of suitable site for fish farm, design and construction. ➤ Accomplish knowledge about water quality, stocking, feed and disease management in aquaculture. 		

Course Code: 461303	POST - HARVEST TECHNOLOGY	Credits: 5	Hours: 5
Objectives	<ul style="list-style-type: none"> ➤ The main objective of this course is to make the students to know the need of proper handling and processing of fisheries, which is important both for the fishing industry and for the consumers. ➤ To know the processing and handling of fishes in terms of quality, product range and volume, which results in increased economic activity and employment. 		
Unit -I	Handling and transportation - on board and on shore - manufacture, quality and uses of ice for handling, transportation and processing of fish - Refrigerated sea water for fish preservation. Insulated containers for fresh fish transportation.		
Unit-II	Fish processing - post mortem changes - chemical and structural. Chemical changes in lipids, proteins and nucleotides. Changes in pH, bacterial load, sensory changes, texture, taste and odour. Factors affecting quality of fish. Pre-treatment of fish washing, gutting, filleting, beheading, peeling, deveining. Steaming of crab.		
Unit-III	Methods of freezing - Processing and packaging, Chemical treatment, antioxidants, cryoprotectants and other additives. Temperature and duration of storage in quality and shelf life. Processing of crustaceans and cephalopods. Sanitation in processing plants and Quality control of fresh and processed fish and fishery products.		
Unit-IV	Packaging and packaging materials - Packaging materials; basic films and laminates - their manufacture and identification - resistance of packaging materials - development of protective packaging for fishery products. Packing of fresh and frozen fish - packaging for transport and shipping. packaging standards for domestic and international trade		
Unit -V	Seafood quality: Quality assessment in fish and fishery products - Physical, chemical organoleptic and microbiological quality standards - Good manufacturing practices - National and International standards - Codex alimentaris, USFDA and EU regulation for export trade		
<p>References and Text Books:</p> <p>Bardach, J. E., Ryther, J. H., & McLarney, W.O. (1972). <i>Aquaculture: Farming and husbandry of freshwater and marine organisms</i>. New York: Wiley Inter science.</p> <p>Beveridge, M. (1987). <i>Cage culture</i>. England: Fishing News Books.</p> <p>Bose. (1991). <i>Coastal Aquaculture Engineering</i>. Oxford: IBH Publishing Co. Pvt. Ltd.</p> <p>Chen, T. P. (1976). <i>Aquaculture practices in Taiwan</i>. London: Fishing News (Books) Ltd.</p> <p>K. K. Balachandran. (2002). <i>Post - Harvest Technology of Fish and Fish Products</i>. Daya Publishing House.</p> <p>Kutty, M. N. (1991). <i>Aquaculture</i>. FAO Publication</p> <p>Nowak, W. S. W. (1970). <i>The marketing of shell fish</i>. London: Fishing News (Books) Ltd.</p> <p>Setharaman, J. J. (1966). <i>A method for determination of suitability of coastal regions for construction of brackish water ponds</i>.</p>			

Outcome	<ul style="list-style-type: none">➤ Students were able to handle and transport of fish from onboard and fresh fish preservation.➤ They get awareness about fish processing, chemical and microbial quality of seafood during processing and storage.➤ Acquire knowledge about methods of freezing and storage of processed fish. Know about seafood packaging materials and methods of packing and transport. Aware about seafood quality, national and international regulatory agencies for quality assurance and monitoring
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PRACTICALS – THIRD SEMESTER

Course Code: 461304	PRACTICAL - IV	Credits: 5	Hours: 10
FISH AND FISHERIES			
1. Marine fishery resources – visit to nearest marine landing center – length frequency analysis – catching method – catch data analysis on marine fishery resources of India– closed season studies – gear selectivity.			
2. Identification of Commercially important fin and shell fishes and study of their morphology and classification.			
3. Study on food and feeding habits on fishes.			
4. Observation of fish maturation cycle, larval and juveniles and adult development – a case study.			
5. Identification of Fish Parasite.			
6. Collection of eggs and larvae collection methods.			
7. Fish net making			
AQUACULTURE			
1. Identification of cultivable seaweeds, fin and shell fishes.			
2. Soil and water quality determination and fish farm equipment			
3. Technique of induced breeding and rearing techniques of fin fish and crustaceans in hatcheries.			
4. Observation and management practices of nursery and stocking ponds.			
5. Fields visits to observe fin fish, shell fish, sea cucumber and seaweed culture technique and harvest methods.			
POST HARVEST TECHNOLOGY			
1. Isolation and identification of pathogenic bacteria.			
2. Preparation of salted and cured fishery products and sensory evaluation of freshness.			
3. Estimation of moisture, salt content, protein, lipid, carbohydrates and TMA in dried and cured fishery products.			
4. Fish processing industrial visit.			

FOURTH SEMESTER

SEMESTER IV			
Course Code: 461401	RESEARCH METHODOLOGY	Credits: 8	Hours:8
Objectives	<ul style="list-style-type: none"> ➤ The primary objective is to develop a research orientation among the students and to familiarize them with the fundamentals of research methods. ➤ The course also aims to introduce the students to the basic concepts used in research. ➤ This is designed to impart education in the foundational methods and techniques of academic research. 		
Unit -I	Methods for assessing primary productivity in animals - laboratory culture of diatoms and dinoflagellates – culture systems – fin fishes, shell fishes and seaweeds. Morphometric and meristic character – methods for estimation reproduction and breeding periodicity in animals.		
Unit-II	Microscopy: Principles and applications of microscopy, light, phase contrast, fluorescence, scanning and transmission electron microscopes. Histology: Principles of microtechniques –fixing, embedding, sectioning, staining, differential. Histochemistry: Principles and practice. Methods employed in analysis of proximate composition.		
Unit-III	Spectroscopy: Principles of biophysical methods, X-ray diffraction, Spectrofluometer, flame photometer, UV-visible, atomic absorption and emission spectrophotometers, NMR and Mass spectrometer. Centrifuge: Principles and applications – Ultra centrifuge (velocity, buoyance and density, gradient centrifugation). pH: Buffers – pH meters – ion, selective electrodes. Chromatography: Principles and Application of Chromatography: Paper, Thin layer, column, Ion Exchange, Gel filtration, Gas Liquid, HPLC and affinity. Electrophoresis: Principles and Application of Electrophoresis: Paper, Agarose, PAGE, SDS PAGE and Iso-Electric focusing. Hybridization, sequencing, PCR, DNA finger printing, screening of genome and cDNA libraries.		
Unit-IV	Biostatistics: Collection and analysis of biological data - mean, median, mode Standard deviation, Standard error, Coefficient of variation, Student ‘t’ test, Skewness, Kurtosis, Chi - square, Correlation, Regression and ANOVA. Bioinformatics: Internet - Worldwide Web - Search Engines - their functions. Boolean searching - file formats. Biological data bases - sequence and structure - date retrieval - searching source data bases - sequence similarity searches - FASTA and BLAST, CLustalW and Phylip.		
Unit -V	Biological literature library research: Abstracting, searching for literature, indexing; manuscript preparation, organization of the paper – the art of writing –presentation of results – tables – graphs – histogram – relevant titles, etc. Internet and e-journals. Computer aided techniques for data analysis, data presentation and slide preparation.		
References and Text Books			
Bajpai, P. K. (2006). <i>Biological Instrumentation and Methodology</i> . New Delhi: S. Chand & Co. Ltd.			
Blum, Deborah.,& Mary Knudson.(1997). <i>A field guide for science writers: the official guide of the National Association of Science Writers</i> . New York: Oxford University Press.			
Comir.,& Peter Wood Ford. (1979). <i>Writing scientific papers in English</i> . London: Pitman Medical Publishing Co.			
Day, R.A. (1994). <i>How to write and publish a scientific paper</i> . London: Cambridge University Press.			

Ewing, G.W. (1988). *Instrumental methods of chemical analysis*. McGraw HillBook Company.

Gurumani, N. (2006). *Research Methodology for Biological Sciences*. Chennai: MJP Publishers.

Milton, J.S. (1992). *Statistical methods in Biological and Health Sciences*. New York: McGraw Hill Inc.

Skoog, A., Douglas, J.,& Leary, J. J. (1992). *Principles of Instrumental Analysis*. Philadelphia: Sanders Golden Sunberst Series.

Wilson and Walker. (2000). *Practical biochemistry - principles and techniques*. Cambridge University Press.

Outcome	<ul style="list-style-type: none"> ➤ Learns to develop an understanding of the basic frame work of research process, various research designs and techniques. ➤ Recognizing the various source of information for literature review and data collection. ➤ Understands the ethical dimensions of conducting research.
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Course Code: 461999	Project Work	Credits:10	Hours:20
<p>Project Dissertation: Project Dissertation will be carried out by the student themselves with the interest of the student as well as the interest of the faculty with mutual understanding, expertise and interest. The students continuously evaluated the work carried out day to day for further events. Finally, the faculty will be given instruction how to write the dissertation with different components, topics and the material, text, problems to be addressed in each assignment title. The dissertation will consist of Introduction, Materials and Methods, Results and Discussion, Summary and Conclusion, References/Bibliography. Of course, appropriate statistical tools must be followed for the assessment of data. A proper preparation of graphs, diagrams and flow charts must be included in the dissertation. Appendix may also be taken into consideration if necessary.</p>			

ELECTIVE PAPERS

S.No	ELECTIVE PAPERS
1	MARINE BIODIVERSITY AND CONSERVATION
2	COASTAL ZONE MANAGEMENT
3	MARINE RESOURCES
4	COASTAL DISASTER MANAGEMENT
5	MARINE BIOFOULING, PREVENTION AND MANAGEMENT

Course Code: 461E101	MARINE BIODIVERSITY AND CONSERVATION	Credits: 2	Hours: 2
Objectives	<ul style="list-style-type: none"> ➤ Protect and restore marine and estuarine ecosystems. Control invasive species, mitigate dry land salinity, Promote ecologically sustainable grazing ➤ Minimize impacts of climate change on biodiversity, Maintain and record indigenous peoples' ethnobiological knowledge, Improve scientific knowledge and access to information. 		
Unit -I	Introduction - Marine Biodiversity - Importance - levels of biodiversity - biodiversity indices. Definition of extinction of marine bio-resources - rate of extinction – causes of extinction - island / intertidal biogeography - vulnerability to extinction.		
Unit-II	Conservation - essential concepts for small populations - problems of small population - applied population biology - establishment of new populations - ex-situ conservation strategies - conservation categories of species - legal protection of species.		
Unit-III	Marine protected areas - designing of protected areas - managing protected areas - restoration ecology.		
Unit-IV	Impediments to marine biodiversity conservation - insufficient scientific information inadequate transfer of information - cultural and biological diversity - differing benefits and costs harming aquatic life - jurisdictional gaps and overlaps - use of marine environment - immunity from public scrutiny - fragmented decision making.		
Unit -V	Conservation and sustainable development - traditional societies - Government action local legislation - national laws - National Biodiversity Act and National Biodiversity Authority. International approaches to conservation and sustainable development -On going problems - possible responses - role of conservation biologists.		
References and Text Books: Heywood, V., & Watson, R. (1995). <i>Global Biodiversity Assessment</i> . Cambridge University Press. Kannaiyan, S.,& Venkatraman, K. (2011). <i>Marine Biodiversity in India</i> . Associated Publishing Company. Kumar, S. (2009). <i>Biodiversity, Environment and Sustainable Management (1st ed)</i> . A. K. Publications. Sinha, P. (1998). <i>Biodiversity Depletion</i> . Anmol Publications Pvt. Ltd.			
Outcome	<ul style="list-style-type: none"> ➤ They gain knowledge on scientific information and knowledge regarding the current status of marine biodiversity, various values associated with it and the necessity for its conservation. ➤ They can promote conservation of marine biodiversity and its sustainable use appropriately. 		

Course Code: 461E102	COASTAL ZONE MANAGEMENT	Credits: 2	Hours: 2
Objectives	<ul style="list-style-type: none"> ➤ To coordinate the initiatives of the various coastal economic sectors (e.g., shipping, agriculture, fisheries) toward long-term optimal socio- economic outcomes, including resolution of conflicts between sectors and arranging beneficial trade-offs. ➤ Integrated in this way, a multi-sector approach could jointly guide the activities of the key economic sectors under an effective coastal planning and management system. 		
Unit -I	Definition and Concept: Introduction to Coastal Zone: Environment status of the coastal and marine ecosystems: Estuaries, mangroves, coral reef, lagoon, and wetland-Major threats to coastal ecosystem-Scientific expeditions for ascertaining the wealth of the sea-Five major Oceans and their relative importance-law of the sea-UNESCO, UNEP, IMO, regional seas programme- Antarctic expedition convention		
Unit-II	Protected Area Management: Marine biosphere reserves, marine park, biosphere reserve and Sanctuaries-Categories background and basic concepts and applications-strict nature-reserve, national park, natural monument-Habitat/species management areas-Protected landscape/seascape-managed resource protected area-Coastal ecosystem-use of Coastal resources-Conservation issue and problems-Species of conservation concern – Recommendation and management practices for future action.		
Unit-III	Natural Hazards and mitigation: Natural hazards, volcanoes, tides, tsunamis, cyclones, storm, Global warming and sea level rise, erosion, emergence and submergence and sub-emergence of coastline-Mitigation. Monitoring strategies of marine pollution: Mitigation - Global warming and Climate change. Role of international and national organizations and role of NGO.		
Unit-IV	Coastal Protection Structures: Bio shields and their impact on coasts, beach stability, ocean and sea beach nourishment; interaction of waves with structures like seawalls, groins, breakwaters, revetments and replantation. Implementation of CRZ regulation and their Protection		
Unit -V	Managerial organization: Role of national and international agencies and organizations in ocean management. UNESCO, FAO, IMCO, UNEP, UNDP, NIOT, NIO, MOEFs and CPCB, MPEDA.		
References and Text books: Beatley. (1994). <i>Introduction to Coastal Zone Management</i> . Island Press. Edward. D. Goldberg. (1976). <i>The Health of the Oceans</i> . Paris: The Unesco Press. Parimal Sharma. (2008). <i>Coastal Zone Management</i> . Global India Publications. Pilarczyk, K. (1990). <i>Coastal Protection</i> . A. A. Balkema Publishers. Platzoder, R. (1995). <i>The 1994 United Nations Convention on the Law of the Sea</i> . Martinus Nijhoff Publishers. Trives, T., & Pineschi, L. (1997). <i>The Law of the Sea</i> . Martinus Nijhoff Publications. Valiela, I. (2006). <i>Global Coastal Change</i> . Blackwell Science Ltd.			
Outcome	<ul style="list-style-type: none"> ➤ Students able to manage coastal areas to balance environmental, economic, human health, and human activities. ➤ Coastal management encourages the students about habitat protection through land-use planning, habitat restoration, and state and local permitting programs that regulate development impacts to coastal habitats. 		

Course Code: 461E103	MARINE RESOURCES	Credits: 2	Hours: 2
Objectives	<ul style="list-style-type: none"> ➤ The students get knowledge on Marine resources, which are not only used by commercial fishers but are also used by recreational fishers, marine tourism, mining and transportation industries. ➤ They get idea about biological diversity, fish and seafood supplies, oil and gas, minerals, sand and gravel, renewable energy resources, tourism potential, and unique ecosystems like coral reefs. 		
Unit -I	Non-living resources- Ocean resources in coast, shelf, slope and abyssal - Distribution of various kinds particularly in India ocean- Their forms, grade and potentiality- Coastal aquifer its nature, form, migration - Integrated resource management-Preservation and conservation of non-living resources including water-Renewable & non-renewable resources. Resources originated -terrigenous, chemogenous, biogenous, allogenic and antigenic.		
Unit-II	Marine minerals - Potential in east and west coasts of India-Mineral resources - Mineral enrichment in the Black sea-Marine phosphorites-Placer minerals-Marine sulfides-Manganese nodules and crusts-Methods in the exploration of seafloor minerals deposits-Methods of exploration in manganese nodules, phosphorite and polymetallic sulfides-Sea baulk (non-living resources)		
Unit-III	Fishery resources management and deep-sea fishery potential - Resource potential - Resource estimates-Fish resources of Indian EEZ-Reasons for decline in fish production-Profitable vessel management and requirement - Exploitation of marine fisheries resources and exports-Export management. Living resources – Captures - Sardines, Mackerels, Bombay Duck and Prawn fisheries - Principle methods of exploitation of sea fishes - Indigenous and modern Crafts and Gears.		
Unit-IV	Drugs - Marine drugs – Importance – Sources-Carbohydrate and derivatives-Nitrogenous compounds-Antibiotic compound from marine animals - Bioactive compound – Sources- Natural function -Ecological and distribution in the marine environment.		
Unit -V	Toxin from marine animals - Type of toxins- Functional properties – toxin- Venoms-Venom in marine animals - sea snake, fish and mollusks -Pharmacological and toxicological properties- Marine steroids - Types- Marine cartenoids- Sterols of marine invertebrate.		
Text Books and Reference Books			
Gautam, A. (1998). <i>Conservation & Management of Aquatic Resources</i> . Daya Publishing House.			
Madhu, M., Jakhar, P.,& Adhikary, P. (2013). <i>Natural Resource Conservation</i> . Satish Serial Publishing House.			
Singh, R. (2013). <i>Fishery Resources</i> . Pearl Books Publishing.			
Teleki, P., Dobson,& M., Moore, R. (1987). <i>Marine Minerals</i> . Reidel Publishing Company.			
Thompson, M., Sarojini, R.,& Nagabushanam, R. (1991). <i>Bioactive Compounds from Marine Organisms</i> . Oxford & IBH Publishing Co. Pvt. Ltd.			
Yadav, B. N. (1997). <i>Fish & Fisheries</i> . Daya Publishing House.			
Outcome	<ul style="list-style-type: none"> ➤ Students get idea on fisheries resource management and EEZ. ➤ They get awareness about drugs from the marine based organisms. 		

Course Code: 461E104	COASTAL DISASTER MANAGEMENT	Credits: 2	Hours: 2
Objectives	<ul style="list-style-type: none"> ➤ This course is intended to develop the basic understanding of the natural Disaster and gets the understanding of the basic concepts in Coastal Disaster Management and its mitigations. ➤ They get idea about the long-term disasters of climate change and sea level rise and manmade disasters like nuclear, epidemic and air pollution. 		
Unit -I	Definition –Hazards as natural process - Benefits and importance of disasters Nature disaster- creeping disaster- creeping disaster- Death and Damage - Evaluating hazards - Human response to hazards.		
Unit-II	Major threats to coastal ecosystem- Habitat loss- Landslides -Sea level change, Degradation of water quality, Fisheries resource depletion, Earthquakes, Tsunami, Volcanic activity, Coastal flooding, Cyclones, Erosion, Sea water intrusion, Cause and preventive measures - Hazards Relief and management		
Unit-III	Disaster mitigation, actions to reduce risks, the menu of mitigation actions, classification of mitigation measures, Environmental hazards, typology, assessment and response, the strategies, the scale of disaster, vulnerability, disaster trends.		
Unit-IV	Nature, humanity and development, disruption of development by disasters, loss of resources, interruption of programs, impact on investment and climate, impact on non- formal sector, socio- political destabilization, development as causes of disaster, fundamentals of disaster, causal factor of disasters, characteristics of particular hazards in disaster.		
Unit -V	Geohazards, international decade for natural disaster reduction, problems of financing and insurance, trends in climatology, meteorology and hydrology, trends in seismic activities, training of emergency management personnel.		
References and Text Books:			
Harsh K Gupta. (2013). <i>Disaster Management</i> . Universities Press (India) Pvt. Ltd. Pp. 185.			
Haruyama, S & Sugai, T. (2016). <i>Natural Disaster and Coastal Geomorphology</i> . Springer. Pp. 165.			
Miguel Esteban, Hiroshi Takagi., & Tomoya Shibayama. (2015). <i>Handbook of Coastal Disaster Mitigation for Engineers and Planners</i> . Butterworth-Heinemann. Pp. 788.			
Pranam Dhar. (2011). <i>Disaster Management and Preventions</i> . LAP Lambert Academic Publication.			
Sinha, P. C. (1998). <i>Encyclopaedia of Disaster Management (Vol. 1- 4)</i> . Anmol Publications Pvt. Ltd.			
Vidyanathan, S. (2011). <i>An Introduction to Disaster Management</i> . IKON Books. Pp. 401.			
Outcome	<ul style="list-style-type: none"> ➤ They get awareness of various types of Disasters and the Challenges posed by Disasters. ➤ They able to understand the Impacts of Disasters and Risk Management strategies. 		

Course Code: 461E105	MARINE BIOFOULING, PREVENTION AND MANAGEMENT	Credits: 2	Hours: 2
Objectives	<ul style="list-style-type: none"> ➤ The students get idea about microbially-influenced corrosion. ➤ They get knowledge on Biofouling management. 		
Unit -I	Fundamentals of Corrosion: Basic aspects of Corrosion – Types of Corrosion – Mechanisms of Corrosions – Factors influencing corrosion – Corrosion testing and monitoring – Electrochemical methods, surface analysis		
Unit-II	Marine Biofouling Basics: Principle fouling organisms - Micro-fouling - Mechanisms of biofilm formation - Properties of a biofilm -Characteristics of the macro-organisms - Factors influencing biofouling growth - Geographical location - Distance from shore – Depth - Temperature and season - Water current and tidal conditions - Water quality - Other factors.		
Unit-III	Biofouling Communities: Biofilms – attached macro-fouling communities – mobile communities – Commensals – Parasites and pathogens.Activities of microorganisms as the driving force for biocorrosion - Sulfate-Reducing Bacteria (SRB)- Metal-Reducing Bacteria (MRB)- Metal-Depositing Bacteria (MDB)- Slime-producing bacteria-Acid-Producing Bacteria (APB)- Fungi.		
Unit-IV	Biofouling as a Pathway: Hull fouling and other ship components – Ports – harbors and marinas - Mariculture – fisheries/fishing and diving equipment – marine debris – Primary and Secondary pathways. Economic losses caused by biocorrosion.		
Unit -V	Biofouling Management: Anti-fouling strategies – anti-fouling systems – Cleaning Programs in the Shipping and aquaculture Industries – Current practice – natural and non-toxic antifoulants – risk analysis – education and training.		
Text Books and Reference Books			
Alexander I. Railkin. (2005). <i>Marine biofouling: Colonization Processes and Defenses</i> . Taylor & Francis.			
Drane, C.W. (1963). <i>Chapter on natural waters. “Corrosion”, Vol (1)</i> . London: George Newness Limited.			
Lynn Jackson. (2008). <i>Marine Biofouling and Invasive species: Guideline for Prevention and Management</i> . Compiled by Lynn Jackson on behalf of The Global Invasive programme and The UNEP Regional Seas Programme.			
Peter Maaß.,& Peter Peißker. (2011). <i>Handbook of Hot-dip Galvanization</i> . WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.			
Volkan Cicek.,& Bayan Al-Numan. (2011). <i>Corrosion Chemistry</i> . New Jersey, Massachusetts: Co-published by John Wiley & Sons, Inc. Hoboken and Scrivener Publishing LLC.			
Outcome	<ul style="list-style-type: none"> ➤ Students get idea on biofouling and corrosion mitigation techniques. ➤ They get sound knowledge on macro and micro fouling organisms and its consequences. 		

CURRICULUM VITAE

Name : **Dr.C.Stella**
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Educational qualification:

Course	Board/University	Subject	Division/Grade
Ph. D	Annamalai University	Marine Biology	Highly Commended
M.Phil.	Annamalai University	Marine Biology	First Class
M.Sc.,	Annamalai University	Marine Biology	First Class
B.Sc.,	Annamalai University	Marine Biology	First Class

Professional experience:

Teaching Experience: 20 years

Research Experience: 25 years

Honours and Awards:

1. Received Cash award for Novel Idea Scheme, Central Electrochemical Research Institute, Karaikudi 1996 – DST, CSIR, and CECRI.
2. Received Second Prize for Young Scientist Award for best paper presentation competition, CSIR Foundation day celebrations on 26.9.1997, CECRI, Karaikudi
3. Received Best Research Advisor Award in Marine science, 7-8th Feb 2013.
4. Received Distinguished Faculty Award for the Contribution and Achievement in the Field of Marine Biology- 9th July 2016.

Recent publications:

- P De los Ríos, M Kalaiarasi, P Paul, C Lathasumathi, C Stella(2019), Crustaceana Monthly variations in crustacean zooplankton abundances in Sundarapandian Pattinam and Manamelkudi in the Palk Strait, India (9-10° N, Arabian Sea). 92 (3), 295-306.
- P De los Ríos, L Kanagu, C Lathasumathi, C Stella(2019) Age and growth of two populations of Pugilinochlidium (Gastropoda: Melongenidae), from Thondi coast-Palk Bay in Tamil Nadu-South East coast of India.. Brazilian Journal of Biology.
- P De los Ríos, L Kanagu, C Lathasumathi, C Stella(2019). Age and growth of two populations of Pugilinochlidium (Gastropoda: Melongenidae) from Thondi coast-Palk Bay on the Tamil Nadu-Southeast India coast. Brazilian Journal of Biology
- Mariadoss Kalaiarasi, and Chelladurai Stella (2017), Zooplankton in Arabian Sea, India. *Sustainability Agri, Food and Environmental Research* 4(4), 1-12.
- Mariadoss Kalaiarasi, Chelladurai Stella. (2017). Key for Microzooplankton Species found in Sundarapandian Pattinam and Manamelkudi, Tamil Nadu, India (9-10° N, Arabian Sea). *Sustainability Agri, Food and Environmental Research* 4(4), 2017: 45-49.
- Chokkalingam Lathasumathi, Patricio De Los Ríos Escalante, Mariadoss Kalaiarasi & Chelladurai Stella* (2017). Seasonal variation of community composition of zooplankton in the Palk strait, (9-10 °N, Arabian sea, India). *Bulletin de la Société Royale des Sciences de Liège*, Vol.86, articles, 2017, p.78 - 87.

Total Citations	:	682
h-index	:	15
i10 index	:	31

CURRICULUM VITAE

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Educational qualification:

Course	Board/University	Subject	Year	Division/Grade
Ph. D	Auburn University	Anatomy and Physiology	2006	Highly Commended
M.Sc.,	Annamalai University	Marine Biology	1990	First Class
B.Sc.,	Madras University	Zoology	1988	First Class

Professional experience:

Teaching Experience: 19 years

Research Experience: 17 years

Honours and Awards:

1. Presidential Graduate Fellowship at Auburn University 2001-2005
2. People's Choice Poster Award at Phi Zeta Honor Society Research Forum 2005
3. Outstanding International Graduate Student Award at Auburn University 2005
4. Marshal representing the Veterinary medical school, Auburn University at graduation 2006

Recent publications:

- Kuppurangan, G., Karuppasamy, B., Nagarajan, K., Sekar, R. K., **Viswaprakash, N.**, & Ramasamy, T. (2016) Biogenic synthesis and spectroscopic characterization of silver nanoparticles using leaf extract of *Indoneesiellaechioides*: in vitro assessment on antioxidant, antimicrobial and cytotoxicity potential *Applied Nanoscience* 6: 973.
- Karuppiah, P., Venkatasamy, V., **Viswaprakash, N.**, & Ramasamy, T. (2015) A statistical approach on optimization of exopolymeric substance production by *Halomonas* sp. S19 and its emulsification activity *Bioresources. Bioprocessing* 2: 48.
- **Viswaprakash, N.**, Vaithianathan, T., Viswaprakash, A., Judd, R., Parameshwaran, K. & Suppiramaniam, V. (2015) Insulin treatment restores glutamate (α -amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid) receptor function in the hippocampus of diabetic rats. *Journal of Neuroscience Research*, 93: 1442-1450.
- Geetha, T., Zheng, C., **Vishwaprakash, N.**, Broderick, T. L., & Babu, J. R. (2012) Sequestosome 1/p62, a Scaffolding Protein, Is a Newly Identified Partner of IRS-1 Protein. *The Journal of Biological Chemistry*, 287(35), 29672–29678.
- **Viswaprakash, N.**, Josephson E. M, Dennis J. C, Yilma S., Morrison E. E, Vodyanoy V. J. (2010) Odorant Response Kinetics from Cultured Mouse Olfactory Epithelium at Different Ages in vitro. *Cells Tissues Organs*; 192:361-373.
- **Viswaprakash, N.**, Dennis, J. C., Globa, L., Pustovyy, O., Josephson, E. M., Kanju, P., Morrison, E. E., Vodyanoy V. J. (2009) Enhancement of Odorant-Induced Responses in Olfactory Receptor Neurons by Zinc Nanoparticles. *Chemical Senses*, Volume 34, Issue 7, Pages 547–557.

CURRICULUM VITAE

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Phone : (+91) 9434289298
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Educational qualification:



Course	Board/University	Subject	Year	Division/Grade
Ph. D	Annamalai University	Marine Biology	1997	Awarded
M.Sc.	Annamalai University	Marine Biology and Oceanography	1990	First Class
B.Sc.	Aditanar College, Madurai Kamaraj University	Zoology	1988	First Class

Professional experience:

Research Experience: 25 years

Honours and Awards:

- Received 'HIGH PERFORMANCE SCIENTIST OF ZSI – 2011' AWARD conferred by ZSI, HQs, Kolkata on 26th January 2012.
- Received 'HIGH PERFORMANCE SCIENTIST OF ZSI – 2012' AWARD conferred by ZSI, HQs, Kolkata on 26th January 2013.
- Received a 'CERTIFICATE OF APPRECIATION' from Central Agricultural Research Institute (CARI), ICAR, Port Blair on 23rd June 2013 for the meritorious services
- Received a 'CERTIFICATE OF APPRECIATION' from Central Island Agricultural Research Institute (CIARI), ICAR, Port Blair on 23rd June 2014 for the constant support and cooperation for strengthening research, extension and development activities of the institute.
- Received an award 'FELLOW OF ANDAMAN SCIENCE ASSOCIATION' conferred by Andaman Science Association, Port Blair on 17th April 2015.

Recent publications:

- Dixit, S., Raghunathan, C. and Chandra, K., 2017. New records of sea slugs (Heterobranchia: Opisthobranchia) from India. *Proceedings of the International Academy of Ecology and Environmental Sciences*, 7(3): 47
- Rajeshkumar, S., Raghunathan, C. and Chandra, K., 2016. Additional records of Odonata from Andaman & Nicobar Islands, India. *Biosystematica*, 10(1&2): 39-46.
- Dixit, S., Raghunathan, C. and Chandra, K., 2017. Two new Pseudoceros (Polycladida: Pseudocerotidae) and a Prostheceraeus (Polycladida: Euryleptidae) from Andaman and Nicobar Islands, India. *Zootaxa*, 4269(4): 495-512.
- Mondal, J., Raghunathan, C. and Venkataraman, K., 2017. New records of Aplousobranch ascidians to Indian waters from Andaman Islands. *Threatened Taxa*, 9(2): 9874-9880.
- TamalMondal, Raghunathan, C. and Venkataraman, K., 2016. Diversity of Scleractinian Corals in Great Nicobar Island, Andaman and Nicobar Islands, India. *Proc. Zool. Soc.*, 69(2): 205-2016. DOI 10.1007/s12595-015-0145-8.

CURRICULUM VITAE

Name : **Dr. G. Khedkar**
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Studies,
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Academic qualification: Ph.D.



Professional experience:

Teaching Experience: 20 years

Research Experience: 27 years

Area of Research: Molecular genetics and genomics.

Recent publications:

1. Vikram Khilare, Anita Tiknaik, Bharathi Prakash, Balasaheb Ughade, Ganesh Korhale, Dinesh Nalage, Nadeem Ahmed, Chandraprakash Khedkar, Gulab Khedkar (2019). Multiple tests on saffron find new adulterant materials and reveal that 1st grade saffron is rare in the market. *Food chemistry* 272, 635-642.
2. Anita Tiknaik, Amol Kalyankar, Mahesh Shingare, Rahul Suryawanshi, Bharathi Prakash, Tejswini A Sontakke, Dinesh Nalage, Raveendranathanpillai Sanil, Gulab Khedkar (2019). Refutation of media reports on introduction of the red bellied piranha and potential impacts on aquatic biodiversity in India. *Mitochondrial DNA Part A* 30 (4), 643-650.
3. B Prakash, I Karunasagar, I Karunasagar, GD Khedkar (2019). Denture wearers show more diversity of lactobacillus spp. Than lebsiella spp. Compared to non-denture wearers. *International Journal of Scientific Research* 8 (10).
4. G Khedkar, C Khedkar, B Prakash, A Khedkar, D Haymer (2019) DNA barcode-based identification of a suspected tiger skin: A case to resolve mimicry. *Forensic Science International: Reports* 1, 1000272019.
5. S Abhyankar, K Khobragade, G Khanwelkar, A Tiknaik, G Khedkar (2019). Evidence for a species complex in *Indialonaganapati* (Chydoridae). *Mitochondrial DNA Part A* 30 (3), 457-4652019.
6. BR Ughade, VC Khilare, DM Sangale, GA Korhale, P Ingle, AE Tathe, R Patil, GD Khedkar (2019). A definitive method for distinguishing cultivated onion from its weedy mimic, *Asphodelus fistulosus*, at multiple developmental stages. *Weed Research* 59 (1), 39-482019.
7. B Prakash, GD Khedkar, SP Akshay R Patil, GD Khedkar I (2019). Newer Aspects of Diagnosis and Treatment of Human Fungal Infection. *nt. J. Curr. Microbiol. App. Sci* 8 (6), 1873-1876.
8. V Iswarya Deepti, S Kandula, GD Khedkar (2019). DNA barcoding of five species of groupers (Pisces: Serranidae) off Visakhapatnam, central eastern coast of India. *Mitochondrial DNA Part A* 29 (5), 659-663.
9. Nadeem Ahmed, Deepali Sangale, Anita Tiknaik, Bharathi Prakash, Raituja Hange, Ravindranathanpillai Sanil, Sajid Khan, Gulab Khedkar (2019). Authentication of origin of meat species processed under various Indian culinary procedures using DNA barcoding. *Food control* 90, 259-265.

Total Citations	:	302
h-index	:	11
i10 index	:	13

CURRICULUM VITAE

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Resources, CMFRI Campus, Post Box No- 1603,
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Email : nbfgrocochin@gmail.com



Educational qualification: M. Sc., Ph. D., in Marine Biology

Professional experience: 24 years

Current area of Research: Aquaculture for conservation and livelihood development.

Expertise: Livelihood development to coastal & island community.

Honours and Awards:

- Best Researcher- Annamalai University 2008 – 2009.
- INSA Fellow – 2009.
- K. Chidambaram memorial annual award for the contribution to marine ornamental fish breeding – 2011.
- Prof. M. Aruchami award for the contribution to aquaculture, Clownfish - Kongu Nadu Arts and Science college, Bharathiar University, Coimbatore – 2016.
- Member - Expert committees on Invasive Alien Species and Normally Traded Commodities, N. B. A. 2017 – 2019.

Recent publications:

- J. Balamurugan, T. T. Ajith Kumar, S. Prakash, B. Meenakumari, C. Balasundaram, R. Harikrishnan. 2016. Clove extract: A potential source for stress free transport of fish, *Aquaculture*, 454: 171-175.
- Prakash, S., T. T. Ajith Kumar, R. Bauer, M. Thiel and T. Subramoniam. 2016. Reproductive morphology and mating behavior in the coral reef shrimp *Rhynchocinetes durbanensis* Gordon, 1936 (Decapoda: Caridea: Rhynchocinetidae) in India. *Journal of Marine Biological Association, UK*, 96(6): 1331-1440.
- Prakash, S., T. T. Ajith Kumar, T. Subramoniam. 2016. New records of marine ornamental shrimps (Decapoda: Stenopodidea and Caridea) from the Gulf of Mannar, Tamil Nadu, India. *Check List*, 12(6): 1-6.
- Prakash, S., T. T. Ajith Kumar, R. Raghavan, A. Rhyne, M. F. Tlusty and T. Subramoniam. 2017. Marine aquarium trade in India: Challenges and opportunity for conservation and policy. *Marine Policy*, 77: 120-129.
- Marudhupandi, T., T. T. Ajith Kumar, S. Prakash, J. Balamurugan and N. B. Dhayanithi. 2017. *Vibrio parahaemolyticus* a causative bacterium for tail rot disease in ornamental fish, *Amphiprion sebae*. *Aquaculture reports*, 8: 39-44.

Books : 10
Book Chapters: 25
Popular articles : 30

CURRICULUM VITAE

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Educational qualification:

Course	Board/University	Subject	Year	Division/Grade
Ph. D	Annamalai University	Marine Biology and Oceanography	2015	Highly Commended
M.Phil.	Annamalai University	Marine Biology and Oceanography	1986	First Class
M.Sc.,	Annamalai University	Marine Biology and Oceanography	1984	First Class

Employment Records:

1. Scientist G, Coordination of Seawater Quality Monitoring (SWQM), National Centre for Coastal Research (NCCR), Ministry of Earth Sciences, Government of India, 2018- till today
2. Scientist-F, Coordination of Seawater Quality Monitoring (SWQM) Programme – National Centre for Coastal Research (NCCR), Ministry of Earth Sciences, Government of India, 2014-18
3. Director & Scientist-F, Coordination and Implementation of R&D programme towards conservation and management of marine living resources in Indian Exclusive Economic Zone (EEZ) including maintenance and management of Fishery and Oceanographic Research Vessel (FORV) - SagarSampada. Also represented India in Commission for Conservation of Antarctic Marine Living Resources (CCAMLR), Centre for Marine Living Resources and Ecology (CMLRE), Ministry of Earth Sciences, Kochi, 2013-14
4. Scientist-F, Coordination of research programmes on (i) Integrated Coastal and Marine Area Management (ICMAM); (ii) Coastal Ocean Monitoring and Prediction System (COMAPS); (iii) Marine Living Resources (MLR); and (iv) Development of potential Drugs from Ocean (Drugs from Sea). In addition to the above, coordination of international programmes on (i) South Asia Cooperative Environment Programme (SACEP), Colombo, Sri Lanka; and (ii) Commission for Conservation of Antarctic Marine Living Resources (CCAMLR), Hobart, Australia. Ministry of Earth Sciences, New Delhi, 2008- 2009

Major Programs & Achievements:

- Seawater Quality Programme (SWQM) / Coastal Ocean Monitoring and Prediction System.
- Marine Research and Development Fund (MRDF)
- Marine Manpower Development Programme (MMDP)
- Assessment of Marine Living Resources in Indian EEZ (MLR)
- Development of potential Drugs from Ocean (Drugs from Sea)
- Outreach programme – seminar, symposia and conference
- National Ocean Information System (NOIS)

Publications:

- 5 publications in national and international referred journals.
- A status report on, “Seawater quality at selected locations along Indian coast has been released based on the data collected under COMAPS / SWQM programme on the occasion of celebration of Foundation Day of Ministry of Earth Sciences on 27th July, 2018 in New Delhi.

CURRICULUM VITAE

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Educational qualification:

Course	Board/University	Subject	Year	Division/Grade
Ph. D	Andhra University, Visakhapatnam	Marine Biology	2009	Highly Commended
M.Sc.,	Alagappa University	Marine Biology	2002	First Class
B.Sc.,	University of Madras	Microbiology	2000	First Class

Professional experience:

At present working as a Field Scientist in Sea 6 Energy, Pvt Ltd Bangalore Located in GKVK Campus, DBT - CCAMP Incubator, NCBS –TIFR, Bengaluru. from (August 2015 to till date); Main responsibilities: Field observation on marine studies and developing technologies that allow us to grow seaweed in rougher ocean waters and fisheries.

Worked as a Project Scientist in the division of Ecotoxicology at ICMAM, Ministry of Earth Sciences, Government of India from (November 2012 to July 2015); Main responsibilities: Development of marine water quality criteria for heavy metals by conducting bioassay experiments.

Worked as a Scientist at Aquaculture Foundation of India, Chennai from (February 2010 to November 2012); Main responsibilities: Transfer of knowledge on new fishing technologies to the fishermen population of Tamil Nadu, empowerment of fisherwomen by training them on seaweed cultivation at Palk Bay and Mandapam, Tamil Nadu.

Senior Project Assistant at Institute for Ocean Management, Anna University, Chennai from (May 2002 to March 2003); Main responsibilities: Digitizing of CRZ Maps.

Recent publications:

- P. Karthikeyan, D. Mohan, M. Jaikumar (2015). Growth Inhibition Effect of Organophosphate Pesticide, Monocrotophos on Marine Diatoms. Indian Journal of Geo-Marine Sciences 44(10):516-1520.
- M. Jaikumar, C. Suresh Kumar, Robin. RS, P. Karthikeyan, A. Nagarjuna (2013). Milkfish culture: Alternative revenue for Mandapam fisherfolk, Palk Bay, southeast coast of India. International Journal of Fisheries and Aquaculture Sciences 3(1): 31-43.
- P. Karthikeyan, K. Manimaran, P. Sampathkumar, M. Jaikumar, RS. Robin, C. Saravana Kumar, C. Suresh Kumar (2013). In vitro antioxidant activity of marine diatoms. Journal of Environmental Science, Toxicology and Food Technology 5(2): 32-37.
- C. Sureshkumar, M. Jaikumar, RS. Robin, P. Karthikeyan, C. Saravana Kumar (2013). Heavy metal concentration of seawater and marine organisms in Ennore creek, southeast coast of India. The Journal of Toxicology and Health 103: 192-201.
- Robin RS, Vishnu Vardhan Kanuri, Pradipta R. Muduli, M.Jaikumar, P. Karthikeyan, C. Suresh Kumar, C. Saravana Kumar (2013). Influence of coastal and backwaters coupling on sustenance of high nutrients and organic production along the southeast Arabian Sea. Marine Science, 3(3): 79-90.

CURRICULUM VITAE

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Educational qualification:

Course	Board/University	Subject	Year	Division/Grade
Ph. D	University of Madras	Zoology	2005	Highly Commended
M.Phil.	University of Madras	Zoology	2001	First Class (Outstanding)
M.Sc.	University of Madras	Zoology	2000	First Class
B.Sc.	University of Madras	Zoology	1998	First Class

Professional experience:

Teaching Experience: 11 years

Research Experience: 14 years

Honours and Awards:

1. Recipient of **Dr. (Mrs) Sudha Varadharajan Memorial Endowment Gold Medal** from Thiru. Surjit Singh Barnala, Governor of Tamil Nadu, for the **“Best Thesis 2005”**.
2. **Awarded Research Fellowship** – Department of Ocean Development, Government of India.
3. **Awarded DST – FAST TRACK for Young Scientist**, Government of India.

Recent publications:

- Paneerselvam, R., Anandhan, N., Sivakumar, G., Ganesan, K.P., Marimuthu, T and **Sugumar, V. (2019)**. Role of annealing temperatures on mechanical, optical, electrical and magnetic properties of nanohydroxyapatite biomaterial. *Journal of Nanoscience and Nanotechnology* [American Scientific Publishers, USA], 19: 4366-4376.
- Beema Mahin, M. I., Saravanan, R. and **Sugumar, V. (2018)**. Isolation, identification and characterization of the bioluminescent bacteria isolated from the blue swimmer crab *Portunus pelagicus* along Thondi Coast and virulence studies at high temperatures. *Microbial Pathogenesis* [Elsevier, USA], 117: 232-236.
- Saravanan, R. and **Sugumar, V. (2018)**. Heavy metal stress induced hyperglycemia in blue swimmer crab, *Portunus pelagicus*. *Acta Oceanologica Sinica* [Springer, USA], 37 (5); 1-7.

Total Citations : 136
h-index : 8
i10 index : 7

CURRICULUM VITAE

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Educational qualification:

Course	Board/University	Subject	Year	Division/Grade
B. Sc.	Barathidasan University	Zoology	1994	First Class
M. Sc.	Annamalai University	Coastal Aquaculture	1996	First Class
Ph.D	Annamalai University	Marine Biology	2003	By thesis

Professional experience:Teaching experience: 11 years; Research experience: 17 years

Honours and Awards:DST-SERB Young Scientist award : 2012

Recent publications:

- Rosemary, T.; Arulkumar, A.; **Paramasivam, S.**; Mondragon-Portocarrero, A.; Miranda, J.M. **2019**. Biochemical, Micronutrient and Physicochemical Properties of the Dried Red Seaweeds *Gracilaria edulis* and *Gracilariacorticata*. *Molecules*. 24, 2225. (doi:10.3390/molecules24122225). **Impact Factor: 3.060**.
- Arulkumar, A., P. Nigariga, S. Paramasivam and R. Rajaram. **2019**. Metals accumulation in edible marine algae collected from Thondi coast of Palk Bay, Southeastern India. *Chemosphere*. 221:856-862. (doi.org/10.1016/j.chemosphere.2019.01.007). ISSN: 0045-6535, **IF: 5.108**.
- Arulkumar A, Paramasivam S, Rameshthangam P, Paramithiotis S. **2019**. Evaluation of psychrophilic, mesophilic, histamine forming bacteria and biogenic amine content in the muscle of mud spiny lobster, *Panulirus polyphagus* (HERBST, 1793) during ice storage. *J. Food Saf.* 39 (1):e12582 (doi.org/10.1111/jfs.12582). **IF: 1.665**.
- Arulkumar, A., Paramasivam, S. & Miranda, J.M. **2018**. Combined Effect of Icing Medium and Red Alga *Gracilariaverrucosa* on Shelf Life Extension of Indian Mackerel (*Rastrelligerkanagurta*). *Food Bioprocess Technol.* (doi.org/10.1007/s11947-018-2154-x). pp 1-12. ISSN :1935-5149. **IF- 3.032**.
- AbimannanArulkumar, Thomas Rosemary, SadayanParamasivam&RamaswamyBabuRajendran. **2018**. Phytochemical composition, *in vitro* antioxidant, antibacterial potential and GC-MS analysis of red seaweeds (*Gracilariacorticata*and *Gracilaria edulis*) from Palk Bay, India. *Journal of Biocatalysis and Agricultural Biotechnology*. (doi.org/10.1016/j.bcab.2018.05.008). 15:63-71. ISSN:1878-8181.
- AbimannanArulkumar, AlagusundaramBalamurugan, SadayanParamasivam, PalanivelRameshthangam& Spiros Paramithiotis. **2017**. Physicochemical and Microbiological Changes During Drying of Wolf Herring (*Chirocentrusdorab*) and Coastal Trevally (*Carangoidescoeruleopinnatus*), *Journal of Aquatic Food Product Technology*, 26:8, 929-939, (doi: 10.1080/10498850.2017.1362683). **IF: 0.682**.
- AbimannanArulkumar, SadayanParamasivam, PalanivelRameshthangam and Mohamed A Rabie. **2017**. Changes on biogenic, volatile amines and microbial quality of the blue swimmer crab (*Portunuspelagicus*) muscle during storage. *Journal of Food Science and Technology*. (doi: 10.1007/s13197-017-2694-5). 54 (8), 2503-2511. **IF- 1.797**.
- AbimannanArulkumar, SadayanParamasivam and RajendiranRajaram. **2017**.Toxic heavy metals in commercially important food fishes collected from Palk Bay, Southeastern India. *Marine Pollution Bulletin*. (doi: 10.1016/j.marpolbul.2017.03.045). 119, 454–459. **IF: 3.782**.
- AbimannanArulkumar, KaliyanRamachandiran, SadayanParamasivam, PalanivelRameshthangam, Jose Manuel Miranda. **2017**. Effects of turmeric (*Curcuma longa*) on shelf life extension and biogenic amine control of cuttlefish (*Sepiabrevimana*) during chilled storage. *CyTA-Journal of Food*. (doi: 10.1080/19476337.2017.1296495). 15 (3): 441-447. **IF: 1.371**
- AbimannanArulkumar, Gunasekaran Karthik, SadayanParamasivam and Mohamed A Rabie. **2017**. Histamine levels in Indian Fish via Enzymatic, TLC and HPLC methods during storage. *Journal of Food*

Measurement and Characterization.(doi:10.1007/s11694-016-9395-z). 11 (1):281-289. ISSN-2193-4126.

IF: 1.415.

Cumulative Impact Factor	:	21.912
Total Citations	:	221
h-index:		6
i10 index	:	4

CURRICULUM VITAE

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Academic qualification: Ph.D.



Professional experience:

Teaching Experience: 08 years

Research Experience: 08 years

Membership in Professional and Academic Bodies:

- Life Member: Indian Science Congress
- Life Member: PAGES (Past Global Changes) Society , Switzerland
- Asia Oceania Geosciences Society, Singapore
- Member of Board of Studies for M.Sc.Marine Science programme
- Department Research Committee member For Ph.D. programme

Recent publications:

A. Sivachandiran, **V. Yoganandan**, K. Selvaraj (2018) Benthic foraminiferal faunal record indicated Paleoclimatic variation in the Southeastern Arabian Sea for 14,430 years B.P. Journal of Coastal Sciences. V. 5, pp 37-45.

K. Selvaraj, J. Pandiyan, **V. Yoganandan**, G. Agoramoorthy (2016). India contemplates climate change concerns after floods ravaged the coastal city of Chennai. Ocean & Coastal Management V. 129, pp 10-14.

A. Sivachandiran, **V. Yoganandan**, K. Selvaraj (2016) Microfossils Records of Decadal Climate Variability from the Southeastern Arabian Sea” International workshop on “Connecting Paleo and Modern Oceanographic Data to Understand AMOC over Decades to Centuries” held at boulder, Colorado, USA, During May 23- 25, 2016.

A. Sivachandran **V. Yoganandan** and K. Selvaraj, (2015) A High Resolution Planktonic Foraminifer Records of Indian Summer Monsoon Variability from Southeastern Arabian Sea. Proceeding volume of the CLIVAR-ICTP workshop on Decadal Climate Variability and Pridictability held at Trieste, Italy during 16-24 November 2015.

Total Citations	:	84
h-index	:	05
i10 index	:	04