

University of Mumbai



No. AAMS (UG) /140 of 2021

CIRCULAR:-


Attention of the Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science and Technology.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in **Maritime Studies** at its meeting held on 24th May, 2021 vide item No. 2 and subsequently passed by the Board of Deans at its meeting held on 11th June, 2021 vide item No. 6.27 have been accepted by the Academic Council at its meeting held on 29th June, 2021, vide item No. 6.27 and subsequently approved by the Management Council at its meeting held on 29th July, 2021 vide item No. 16 and that in accordance therewith, in exercise of the powers conferred upon the Management Council under Section 74(4) of the Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017) the Ordinance 6671 & 6672 Regulations 9414 & 9415 and the syllabus of **M.Sc. (Maritime Studies) (Sem. I to IV) (CBCS)** has been introduced and the same have been brought into force with effect from the academic year 2021-22, accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI - 400 032

25th October, 2021

To,


(Sudhir S. Puranik)
REGISTRAR

The Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science and Technology. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/6.27/29/06/2021

M.C/16/29/07/2021


No. AAMS (UG) /140-A of 2021

MUMBAI-400 032

25th October, 2021

Copy forwarded with Compliments for information to:-

- 1) The Chairman, Board of Deans
- 2) The Dean Faculty of Science and Technology,
- 3) The Chairman, Ad-hoc Board of Studies in Maritime Studies,
- 4) The Director, Board of Examinations and Evaluation,
- 5) The Director, Board of Students Development,
- 6) The Co-ordinator, University Computerization Centre,


(Sudhir S. Puranik)
REGISTRAR

Copy to :-

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

for information.

New ordinances 6671 & 6672 relating to the M.Sc (Maritime Studies).

i. Necessity of starting these Programmes/Courses:

In India, there are very few Universities that are offering programmes and research opportunities in Maritime Studies, which covers a wide span of marine and maritime subjects, including humanities, law, science & technology, and commerce & management. Maharashtra and Goa have a few institutions that cover some of these subjects, like Indian Maritime University (IMU), Mumbai & Navi Mumbai; Mumbai; Samudra Institute for Maritime Studies (SIMS), Lonavala; Maharashtra Academy of Naval Education and Training (MANET), Pune; Institute of Maritime Studies, Goa; and other institutes/bodies for the Indian Navy, like INS Hamla, Mumbai; INS Shivaji, Lonavala; Naval War College (NWC), Goa; and National Institute of Hydrography (NIH), Goa as well as Maritime History Society (MHS), Mumbai. The IMU also has campuses in Kochi, Chennai, Visakhapatnam and Kolkata. There is also an existing Centre of Excellence in Maritime and Shipbuilding (CEMS) at Mumbai & Visakhapatnam. The various civil institutions mostly run graduate and PG programmes for the Indian Merchant Marine, including Marine Engineering, Naval Architecture & Ocean Engineering, Shipbuilding & Repair, Shipping and Logistics Management, and Nautical Science. On the East Coast, Pondicherry University has a Centre for Maritime Studies (CMS), which conducts research and academic programmes in Maritime Studies, covering subjects of maritime security, connectivity and regional cooperation.

At the international level, in the Indian Ocean Region (IOR), there is a Centre for Maritime Studies at Maldives, which is also focused entirely on training for the merchant marine. There is also another Centre for Maritime Studies at Singapore, which conducts research in issues related to the maritime industry, including trade, ports and shipping, and offers PG programmes in Maritime Technology and Management. At the international level in the IOR, therefore, there is again a paucity of academic institutions with an interdisciplinary approach to maritime studies.

There is, evidently, a paucity of universities and research institutes that cater to the interests of academic and research aspects of Maritime Studies in the country and, especially, in Mumbai.

Apart from a glorious maritime legacy of yore, Maharashtra has about 720 km coastline, which is at the politico-economic heart of India's total 7,516 km coastline. Mumbai has two international seaports, the Mumbai Port Trust (MbPT) at Ballard Estate and the Jawaharlal Nehru Port Trust (JNPT) at Nhava-Sheva, and major Dockyards like the Mazagon Dock and also Naval Dockyard. Mumbai also has a ship breaking yard at Sewri. The ports at Mumbai directly connect to the Arabian Sea and cater for more than 18% of the traffic at India's Major Ports. There are also a number of Shipbuilding yards, both government and private, in the jurisdiction of University of Mumbai and its vicinity, such as those based in Ratnagiri and Ghodbundar in Maharashtra, and Dempo and Chowgule Shipyards in Goa. More importantly, Mumbai houses the Indian Navy's swordarm the Western Naval Command with a range of organisations such as the Western Fleet, the Maharashtra Naval Area and several key naval/maritime focussed entities.

The maritime jurisdiction of Maharashtra, and especially Mumbai, covers the vital energy, trade and commerce routes and centres of India, and is adjacent to the main arterial International Shipping Lanes across the Arabian Sea, which connects India and the strategic Persian Gulf and Gulf of Aden regions to the Indo-Pacific littoral.

Mumbai and Maharashtra/ Goa also have several historic forts, fortifications, coastal structures, architectural remnants, ancient ports and other structures that bear testimony to a long and deep maritime history, incorporating all elements of maritime canvas from war and trade to ship building and cultural connections.

The maritime strategic importance of Mumbai, and the wide spread of important subjects under the rubric of Maritime Studies that are pivotal to the growth and well-being of India, especially Mumbai and Maharashtra, merit reflection in a dedicated vehicle being provided for academic pursuits, education and

deeper understanding of these subjects.

ii) Whether UGC has recommended to start the said courses:

1. **Reference: F No. 2-1/2021 (QIP) from Chairman, UGC to Hon'ble Vice Chancellor, University of Mumbai, dated 19th July 2021 (Pertaining to Multidisciplinary and holistic programmes)**
2. **UGC notification on: University Grants Commission INNOVATIVE PROGRAMMES Teaching and Research in Interdisciplinary and Emerging Areas**
3. **New Education Policy NEP 2020 and thrust on interdisciplinary academic programmes.**

Initiative taken for implementing multidisciplinary and holistic education in CEMAS, University of Mumbai:

It is, thus, important that the **University of Mumbai** identifies **Maritime Studies** with Multidisciplinary and Holistic approaches as one of its thrust areas. The award of The University through **Centre of Excellence in Maritime Studies** has embarked towards bolstering higher education and research in **Maritime studies** by envisaging a **holistic and multidisciplinary education** that aims to develop all capacities of student as human beings.

The Centre has a **broad based and interdisciplinary** focus on Marine and Maritime studies, which will cover the entire gambit of **Maritime Laws, Trade, Commerce, Logistics, Science and Technology**.

CEMAS will provide a stimulating intellectual climate for academics and policymakers working on topics related to coasts and seas.

As the Centre highly focuses on holistic, multidisciplinary and interdisciplinary concepts, it not only is catering to develop the individual through Maritime laws, securities, transport, etc. The Centre has also introduced the concept of **BLUE ECONOMY** – which allows prioritizing **the sustainable use of ocean resources for economic growth, livelihoods and jobs, and ocean ecosystem health**.

Through the academic ride, an individual will be groomed to be utilizing the theoretical value by adding it to mini and minor projects, book review, field work, laboratory experiments which allows them to approach the world in real time.

CEMAS is offering internship embedded PG Diploma in Maritime Logistics, Masters programmes in M.A. (Maritime Studies), M.Sc. (Maritime Studies) and M.Com. (Maritime Studies). PhD programme (maritime Studies) will be initiated in the future course. The programmes are attributed with innovative approaches to curriculum development and delivery. Curriculum delivery will work on blended mode of Teaching and Learning, leveraging on the resource pools and expertise that are both, on site and off site for academics and research. This will help the centre to adapt to the very principles that are enshrined in the new National Education Policy (NEP) 2020. The Centre is expected to attract both Indian and foreign students in this domain.

CEMAS is having a broad based multi-disciplinary focus and will take cognizance of marine and maritime studies to cover the gamut of Maritime History, Security, Laws, Trade, Commerce, Logistics, Science and Technology. Centre will collaborate with other premium national and international organizations and institutes in the domain of marine and maritime to leverage on their strengths. The centre therefore, through the University of Mumbai will help develop maritime consciousness, boost higher education and recognize the centrality of Mumbai in national maritime growth.

CEMAS through its myriad courses will inculcate and develop the ability of the student to analyse problems, conduct research and propose solutions while making sound professional judgments with the

help of well-read and readily available human resources to meet the challenges of understanding, developing and conserving a benevolent marine ecosystem. As a student of CEMAS, the individual will benefit from this expertise and receive an education that is both, relevant and career enhancing in the existing and futuristic job scenarios. The endeavour of CEMAS programmes is to meet the students' career aspirations and employment opportunities, nationally and internationally, with emphasis on practical expertise application and specialization.

CEMAS will offer first respondent response to the direct needs of the maritime industry by virtue of it being in consonance with industry relevant curriculum development, focus on skill set acquisition and a high job readiness quotient of its students post programme completion. The experiential learning offered by CEMAS makes its programmes unique and distinguishes CEMAS from other university studies.

The centre has a panel of eminent and renowned members in the Board of Management and an eminent body of advisors from Navy, Mercantile Shipping and Commerce, Maritime Strategy, Maritime Law, Maritime History, Maritime and Marine Science and Technology to provide robust direction and pertinent mentoring. The programmes offered by the centre are to be initiated from the academic year 2021-22. The syllabi of the masters programmes has been developed by subject matter experts from academics, Indian Navy, Merchant/Mercantile Navy, Entrepreneurs from maritime logistics, warehousing and blue Economy. The curricula are contemporary with intent to make the post graduates industry ready. Each syllabus is based on UGC's **Outcomes Based Higher Education** framework with measurable deliverables. The advisors for the mini and major project would mainly be a mix of academicians and industry personnel to assign real life interdisciplinary projects to the students. The centre will work towards achieving the translatory provisions of **NEP 2020** with student flexibility being key to the specializations and projects. Soft skills development and sensitization to professional ethics will be covered as additional lectures and orientations at the centre.

CEMAS will aspire to excel in Maritime Commerce, Maritime Law, Maritime Science and Technology, Maritime Heritage and History. It will focus on maritime Security, sustainable ocean resource utilization, maritime conflicts, strategies and resolution, blue Economy, natural hazards and disaster, livelihood based on ocean and coastal areas, coastal habitats, island communities and regional maritime and coastal issues.

CEMAS will endeavour to focus on research related to open ocean. The centre will try to involve in the Deep Ocean Mission of the Ministry of Earth Sciences of India. Centre will undertake projects in oceanography, biotechnology, nanotechnology, material science, environment physics, hydrography, minerals, marine diversity, ocean engineering, instrumentation etc in collaboration with CSIR-NIO and other research organisations.

CEMAS has in its fold Sindhu Swadhyay Sanstha (SSS) that was established on September, 5th 2015. Sindhu Swadhyay Sanstha offers 2 years Masters degree programme in Zoology with specialization in Oceanography and Fishery Technology. Since its inception SSS is working diligently to accomplish its mission of achieving academic excellence and providing research and entrepreneurship opportunities to the young aspirants.

iii) Whether all the courses have commenced from the academic year 2021-22:

yes, all the three programmes namely Masters programmes in M.A. (Maritime Studies), M.Sc. (Maritime Studies) and M.Com. (Maritime Studies) will commence from the academic year 2021-22.

iv) The courses started by the University are self financed, whether adequate number of eligible permanent faculties are available:

Yes, all the three programmes are self-financed. The interdisciplinary programmes will be conducted on blended mode and faculty of University departments and affiliated colleges will be appointed as faculty on visiting or clock hour basis. Scientists and subject matter experts of top maritime organizations of India will be appointed as faculty for online delivery of lectures (upto 40% as permissible by UGC). MoUs are being signed by UoM for collaboration with CSIR-NIO, Goa, CIFE, Versova, Mumbai and other

government research organisations for faculty support and collaborative PG project research. Permanent faculty will be recruited in due course of time. Programme coordinator cum faculty is under process for recruitment.

v) To give details regarding duration of the course and is it possible to compress the course:

All the three programmes, viz. namely Masters programmes in M.A. (Maritime Studies), M.Sc. (Maritime Studies) and M.Com. (Maritime Studies) are masters (PG) programmes and is of two years duration covering four semesters as per UGC regulations.

vi) The intake capacity of each course and no. of admissions given in the current academic year (2021-22):

The approved intake for M.A. (Maritime Studies), M.Sc. (Maritime Studies) and M.Com. (Maritime Studies) is 20 students, each. Admissions will commence from the academic year 2021-22.

vii) Opportunities of Employability/Employment available after undertaking these courses:

Masters programmes in M.A. (Maritime Studies), M.Sc. (Maritime Studies) and M.Com. (Maritime Studies) will educate, train and groom graduates that are not only Industry ready but are also attuned to take on further higher education in research. The programme aims to create manpower to service the maritime/marine related industries and R & D, blue economy, maritime logistics, warehousing and allied Industries which is expected to witness an upward trajectory with the recent favorable government policies and schemes in this sector.

India is strategically located across the world's shipping routes, with maritime trade comprising about 95% of India's trade by volume and over 70% by value. The Government launched the ambitious Sagarmala Programme in March 2015. The programme envisions port led development and growth of logistics intensive industries. Under Sagarmala Programme, \$123 Billion is expected to be invested across 415 projects across the areas of Port Modernization and New Port Development; Port Connectivity Enhancement; Port-linked Industrialization; and Coastal Community Development. This programme is expected to create four million new direct and six million indirect jobs, and estimated to enhance India's GDP by upto 4%. The Inland Vessels Bill, 2021 has been passed by the Lok Sabha in July 2021. This will boost domestic cargo movement with potentially lower rates.

UNIVERSITY OF MUMBAI



Syllabus

for the

Programme: M.Sc. (Maritime Studies)

Syllabus for Semesters: I, II, III and IV

Course: Maritime Studies

(Choice Based and Credit System with effect from
the academic year 2021-22)

Cover Page

Item No. _____

UNIVERSITY OF MUMBAI



<u>Sr. No.</u>	<u>Heading</u>	<u>Particulars</u>
<u>1</u>	Title of the Programme O.6671	M. Sc. (Maritime Studies)
<u>2</u>	Eligibility for Admission O.6672	B.Sc., B.E., B.Tech., B Pharm. and Equivalent degrees (Details on page 4 under Programme Details)
<u>3</u>	Passing Marks R - 9414	As per University of Mumbai rules, statutes and ordinances
<u>4</u>	Ordinances / Regulations (if any)	As Applicable
<u>5</u>	No. of Years / Semesters R - 9415	2 Year, 4 Semesters
<u>6</u>	Level	PG
<u>7</u>	Pattern	Semester
<u>8</u>	Status	New
<u>9</u>	To be implemented from Academic Year	From Academic Year: 2021-2022

Date:

Signature:

Dr. Anuradha Majumdar
Chairperson, Adhoc BoS in Maritime Studies
Dean, Faculty of Science and Technology

PREAMBLE

Apart from a glorious maritime legacy of yore, Maharashtra has about 720 km coastline, which is at the politico-economic heart of India's total 7,516 km coastline. Mumbai has two international seaports, the Mumbai Port Trust (MbPT) at Ballard Estate and the Jawaharlal Nehru Port Trust (JNPT) at Nhava-Sheva, and major Dockyards like the Mazagon Dock and also Naval Dockyard. Mumbai also has a ship breaking yard at Sewri. The ports at Mumbai directly connect to the Arabian Sea and cater for more than 18% of the traffic at India's Major Ports. There are also a number of Shipbuilding yards, both government and private, in the jurisdiction of University of Mumbai and its vicinity, such as those based in Ratnagiri and Ghodbundar in Maharashtra, and Dempo and Chowgule Shipyards in Goa. More importantly, Mumbai houses the Indian Navy's swordarm the Western Naval Command with a range of organisations such as the Western Fleet, the Maharashtra Naval Area and several key naval/maritime focussed entities.

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The maritime strategic importance of Mumbai, and the wide spread of important subjects under the rubric of Maritime Studies are pivotal to the growth and well-being of India, especially Mumbai and Maharashtra, merit reflection in a dedicated vehicle being provided for academic pursuits, education and deeper understanding of these subjects.

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across 415 projects across the areas of Port Modernization and New Port Development; Port Connectivity Enhancement; Port-linked Industrialization; and Coastal Community Development. This programme is expected to create four million new direct and six million indirect jobs, and estimated to enhance India's GDP by upto 4%.

With nations committed to fulfilling the Sustainable Development Goals (SDGs), the role of oceans is significant. Addressing the strategic, environment and ocean ecosystem challenges are one of the greatest challenges for India and the world. India and the world maritime industries have to meet the environment, energy, safety and human factor challenges with extensive research and innovation.

The interdisciplinary industry relevant curriculum of the M.Sc. (Maritime Studies) is following choice based credit system. The programme is divided into four semesters in which the learner has to complete total 12 courses covering subjects related to maritime and marine sciences along with few interdisciplinary courses. In semester I, II and III, each, learners will have to complete 3 core courses and one elective course. The programme will provide quality education in subjects related to national maritime growth and development, observe an interdisciplinary approach across humanities, law, commerce, management, science and technology to empower students with knowledge, focus and critical thinking skills to address maritime challenges and harness the seas in an inclusive, integrated and holistic manner, now and in the future. The syllabus of these courses are designed to be dynamic and contemporary that will aid concept learning to synergise field work, research with data analysis in both the mini and major project in semester II and IV, respectively. Learner will have to undertake book review assignment in semester I as a prelude to the mini project of semester II. Similarly learner will undertake the second book review in semester III as a literature survey ground work for the project and dissertation of semester IV. Learners are expected to undertake case study, field work or laboratory experimentation to address contemporary problems and challenges associated with marine and maritime sciences. Learners will be encouraged to select projects related to regional and country relevant topics addressing current challenges, problems and provide analyses, find relevant new knowledge and solutions. Learners will be encouraged to select interdisciplinary projects. This will help learners to attain hands-on skills and experiential learning.

The book reviews, mini term project and major project with dissertation will enable experiential learning through literature survey, field work, data collection, data analysis and laboratory experimentations. This programme will educate, train and groom graduates that are not only Industry ready but are also attuned to take on further higher education in research. The programme aims to create manpower to service the maritime and allied Industry which is expected to witness an upward trajectory with the recent favorable government policies and schemes in this sector. The USP of the programme is that the curriculum has been made comprising of interdisciplinary subjects from Humanities, Science and Commerce in addition to core domain subjects, synergizing and blending learning and training comprising of core and elective subjects. The programme can be executed in blended mode of teaching and learning.

From,

Dr. Anuradha Majumdar, Chairperson (Adhoc BoS of Maritime Studies)

Members of Syllabus Committee:

- 1) Dr Deepak Apte, (Convener, Syllabus Committee in Science and Technology, Member Adhoc BoS)
- 2) Rear Admiral (IN) Sai Venkat Raman, VSM, (Member, Adhoc BoS)
- 3) Dr. Madhav Rajwade, (Member, Adhoc BoS)
- 4) Col AN Rayarikar, (Member, Adhoc BoS)
- 5) Dr. Mohandass C (Member, Adhoc BoS)
- 6) Mr. Vardhan Patankar (Member, Adhoc BoS)
- 7) Mr. David Birwadkar (Member, Adhoc BoS)
- 8) Capt (IN) Rikeesh Sharma, (Invited Subject Matter Expert)
- 9) Cdr (IN) Manoj K, (Invited Subject Matter Expert)

Programme: Master of Science (Maritime Studies)

1. Programme Objectives: To impart fundamental knowledge on the science and technology involved in the maritime environment.

2. Eligibility for Admission.

- I. B.Sc degree from UGC recognized University, (Physics, Chemistry, Mathematics, Statistics, biological sciences and any other allied subjects)
- II. B.E. degree from UGC recognized University
- III. B.Tech degree from UGC recognized University
- IV. B Pharm. Degree from UGC recognized University
- V. Or Equivalent Qualification
- VI. Candidates must have secured minimum 50% marks at bachelor's degree. Examination and as per rules of University of Mumbai and Govt. of Maharashtra
- VII. Foreign candidates should have equivalent degrees from foreign Universities recognized by Association of Indian Universities (AIU)
- VIII. Selection of candidates can be made on the basis of merit and personal interview/Written Aptitude Test (WAT)

3. Intake Capacity.

Maximum intake 20

4. Course Structure & Distribution of Credits:

	<u>Paper 1</u>	<u>Paper 2</u>	<u>Paper 3</u>	<u>Elective 1</u>	<u>Elective 2</u>
Semester I	Overview of Maritime History Security and Laws	Introduction to Maritime Sciences – Oceanography, Meteorology, Climatology and Ocean Chemistry	Research Methodology	Fisheries Management System and Technology	Artificial Intelligence and Monitoring
Semester II	Overview of International Maritime Trade	Marine Ecology, & Environment, Laws and Legislations	Maritime Science - Marine Geography, Hydrology and	Maintenance of Marine Electrical System and Troubleshooti	Ship Construction

			Climatology	ng	
Semester III	Marine Pollution	Climate Change, Coastal Hazard, Maritime Sectoral Impacts and Sustainable Development Goals	Waves & Tides, and Dynamics of North Indian Ocean	Marine Electrical System	Marine Engineering
Semester IV	Submission of Dissertation on research topic followed by Viva-Voce (24 Credits)				

Book Review/Mini Term Project:

Semester-I	One Book review	08 Credits
Semester-II	One Book Review	08 Credits
Semester-III	One Mini Term Project	08 Credits

One Semester Dissertation based Project:

Semester-IV	Dissertation based R&D Project 24 Credits
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Semester I

M.Sc. (Maritime Studies) Program for Semester-I consists of four theory courses (3 core and one elective) and one Book Review Assignment. The details are as follows:

Theory Courses (4): 16 hours per week (Each subject will have 4 hours of lecture per week)

Theory Paper	Subject	Lectures (Hrs)	Credits
MMS101	Overview of Maritime History Security and Laws	60	04
MMS102	Introduction to Maritime Sciences – Oceanography, Meteorology, Climatology and Ocean Chemistry	60	04
MMS103	Research Methodology	60	04
MSCMS104E	Fisheries Management System and Technology	60	04
MSCMS105E	Artificial Intelligence and Monitoring		
Total		240	16

Book Review term assignment:

Paper Code	Subject	Credits
MSCMSBR1	Book Review of one book relevant to the course leading to the final year Dissertation Based R&D Project Work. 16 hours per week library or engagement and mentoring by advisor with end semester report and presentation.	08

Semester II

M.Sc. (Maritime Studies) Program for Semester-II consists of four theory courses (3 core and one elective) and one Mini Term Project. The details are as follows:

Theory Courses (4): 16 hours per week (Each subject will have 4 hours of lecture per week)

<u>Paper Code</u>	<u>Subject</u>	<u>Lectures (Hours)</u>	<u>Credits</u>
MMS201	Overview of International Maritime Trade	60	04
MSCMS202	Marine Ecology, & Environment, Laws and Legislations	60	04
MSCMS203	Maritime Science - Marine Geography, Hydrography and Climatology	60	04
MSCMS204E	Maintenance of Marine Electrical System and Troubleshooting	60	04
MSCMS205E	Ship Construction		
Total		240	16

Mini Term Project:

<u>Paper Code</u>	<u>Subject</u>	<u>Credits</u>
MSCMSMP	Mini Term Project. 16 hours per week either of case study, field work, data collection, data analysis, laboratory experimentation leading to Dissertation Based R&D Project Work with end semester report and presentation. Mentor/advisor should facilitate field work and laboratory experimental work related projects across domains of science and technology. Projects with interdisciplinary objectives will also be encouraged.	08

Semester III

M.Sc. (Maritime Studies) Program for Semester-III consists of four theory courses (3 core and one elective) and one Book Review Assignment. The details are as follows:

Theory Courses (4): 16 hours per week (Each subject will have 4 hours of lecture per week)

Paper Code	Subject	Lectures (Hours)	Credits
MSCMS301	Marine Pollution	60	04
MSCMS302	Climate Change, Coastal Hazard, Maritime Sectoral Impacts and Sustainable Development Goals	60	04
MSCMS303	Waves & Tides, and Dynamics of North Indian Ocean	60	04
MSCMS304E	Marine Electrical System	60	04
MSCMS305E	Marine Engineering		
Total		240	16

Book Review term assignment:

Paper Code	Subject	Credits
MSCMSBR2	Book Review of one book relevant to the course leading to the final year Dissertation Based R&D Project Work. 16 hours per week library or engagement and mentoring by advisor with end semester report and presentation.	08

Semester IV: MSCMSDP M.Sc. Dissertation Based Project Work

M.Sc. (Maritime Studies) for Semester-IV consists of a full-term Dissertation Based Research Project of 24 credits. Every student will have to complete a separate project in Semester IV with twenty four credits (600 marks). Students have to prepare and submit a Master level thesis and the final evaluation will be done by an external expert and Guide on the basis of the quality of the thesis and Viva-Voce examination. Mentor/advisor should facilitate field work and laboratory experimental work related projects across domains of science and technology. Projects with interdisciplinary objectives will also be encouraged.

The candidate shall be awarded the degree of Master of Science (Maritime Studies) after completing the course and meeting all the evaluation criteria.

5. Scheme of Examination and Passing:

- a) This course will have 40% Internal Assessment (IA) and 60% end semester examination
- b) Written examination of 2.5 Hours duration for each course paper at the end of each semester, end semester examinations (ESE) will be conducted by the University as per the existing norms, statutes and ordinances.
- c) Internal Assessment - IA (40%) and End Semester Examination (ESE) (60%)- shall have separate heads of passing. For Theory courses, internal assessment shall carry 40 marks and Semester-end examination shall carry 60 marks for each Theory Course.
- d) To pass, a student has to obtain minimum 40% marks and above, separately in the IA and end semester examination.
- e) The University (external) examination for Theory and term assignments shall be conducted at the end of each Semester and the evaluation of Project work i.e. Mini project and Dissertation, at the end of the forth Semester will be by the external expert and Guide.
- f) The candidates shall appear for external examination of 4 theory courses each carrying 60 marks of 2.5 hours duration and each term assignment (Book Review/Mini Term Project) comprising of report and presentation will carry 200 marks at the end of each semester.
- g) The candidate shall prepare report and give presentation both book review and mini term project under the guidance of a faculty.
- h) Every student will have to complete a separate dissertation based project in Semester IV with twenty four credits (600 marks). Students have to prepare and submit a Master level thesis and the final evaluation will be done by external expert and Guide on the bases of the quality of the thesis and Viva-Voce examination.

6. Standard of Passing for University Examinations:

As per ordinances and regulations prescribed by the University for semester based credit and grading systems.

7. Standard point scale for grading:

Grade	Marks	Grade Points
O	80 & above	10
A+	70 to 79.99	9
A	60 to 69.99	8
B+	55 to 59.99	7

B	50 to 54.99	6
C	45 to 49 .99	5
D	40 to 44 .99	4
F (Fail)	39.99 & below	0

Semester I: Theory Courses

MMS101: Overview of Maritime History, Security and Laws (60 Hours, 04 Credits)

Course Objectives.

1. Acquaint learners about Indian Maritime History from Ancient times till contemporary period.
2. Impart knowledge of Prevailing Maritime Security Scenario in the Indo-Pacific and Indian Ocean Region.
3. Impart knowledge of Geo-Political environment in the Indo-Pacific and IOR.
4. Familiarize learners to the prevailing important International and National Laws and Legislations with respect to Maritime and Marine ecosystem.

Syllabus.

Unit	Course Content	Hours
1	Ancient India: Indus Valley Civilisation and trade links with Greeks, Egyptians and other countries. Maritime activity between Indian and Arabian Nations, West and East Asian Countries.	06
2	Medieval Period: Maritime Trade and diplomacy during Mauryan Period Expansion of Buddhism through Sea Pandiyam Navy: Sea borne trade and expeditions Chola Navy: Expeditions and relation with Sri Lanka and Southeast Asia Chera Period: Trade and Maritime Activities Gupta Navy	10
3	Trade Between the Arab Counties and the Malabar Coast, religious and cultural influence.	04
4	British, Portuguese, Dutch, French Naval Presence and influence in the Indian Ocean	04

5	The Mughal Navy The Zamorin Navy History of Marakkars, The Maratha Navy: Shivaji, Kanhoji, Sambaji, Mysore Navy	04
6	Contemporary International Relations: Cold war – rise of super powers, Ideological Bipolarity Military Alliances Arms Race and Nuclear Threat'	04
7	India and her Neighbours: Forms of Government, Executive, Legislature and Judicial System Neighbouring Countries and their relationship with India Indian Ocean Region Indo-Pacific Areas of Dispute with particular reference to South Asia International and Regional Organisations like the UNO, OPEC, NAM, EU, League of Arab States, WARSAW Pact, NATO, SAARC, BRICS, ASEAN, SAGAR, FOIP and IPOI. China Strategy of 21 st Century Maritime Silk Road.	10
8	India Foreign Policy and Maritime Diplomacy UNCLOS Coastal Security, Piracy. Leadership Challenges of Maritime Forces in 21 st Century	06
9	An Overview of Maritime Laws: Law of Contract The Indian Ports Act, 1908 The Major Port Trust Act, 1963 Carriage of Good by Sea Act, 1925 Merchant Shipping Act, 1958 Customs Act, 1962 Maritime Arbitration and Alternative Dispute Resolution Modes Salvage, International Salvage Convention 1989, of 2000, SCOPIC MARPOL SOLAS and ISPS Code Maritime Labour Convention 2006 Hongkong Convention 2009	12

Recommended Books (Latest Editions):

1. The Timeless Wake by Cmde Odakkal Jonson
2. A World of Nations: The International Order Since 1945 by William R Kaylor
3. Transition to Triumph: History of Indian Navy by VAdm G H Hiranandani
4. Rulers of the Indian Ocean by G A Ballard
5. A Maritime History of India Adm K Sridharan
6. Coastal Security: Maritime Dimensions of India's Homeland Security by Kunwar Rajendra Singh
7. Coastal Security: The Indian Experience by Pushpita Das
8. Role of Coast Guard in the Maritime Security of Indian by Prabhakaran Paleri
9. An Integrated Approach to Coastal and Offshore Defence: Leveraging the Coastal Security by Capt Himadri Das
10. Armed Robbery in Sea in India: Trends and Imperatives by Capt Himadri Das.
11. Coastal Security, Challenges, Concerns and Wayahead by Brig Hemant Mahajan

Course Outcomes:

The learner will be able to acquire knowledge on the following:-

1. Vibrant Maritime History of India from Ancient, Medieval, Colonial, Contemporary Period.
2. Prevailing Security Scenario and Geo-Politics in the Indo-Pacific and Indian Ocean Region.
3. To familiarise and gain basic knowledge on critical International and National Maritime Laws.
4. Would have gained basic knowledge on strategic importance of the Indo-Pacific and IOR.

MMS102: Introduction to Maritime Sciences – Oceanography, Meteorology, Climatology and Ocean Chemistry (60 Hours, 04 Credits)

Course Objectives:

1. To impart basic knowledge and understanding of the Oceanography.
2. To impart knowledge on the Geological characteristics of the Ocean.
3. To acquaint the learner with Ocean Climatology.
4. To familiarise the learner with knowledge on Ocean Chemistry.

Unit	Course Content	Hours
1	<p>Introduction to Oceanography</p> <ul style="list-style-type: none"> a) Geological time scale and major physico-chemical and biological events in Earth's history b) Plate Tectonics and Seafloor Spreading c) Ocean floor morphology d) Introduction to Paleoclimatic studies e) Marine Sediment distribution, classification, sources and dispersal pathways f) Introductory Marine Geochemistry g) Marine Minerals h) Applications of isotopes for geoscientific studies i) Marine microfossils and their applications with special reference to Quaternary climatology 	15
2	<p>Physical Oceanography and Meteorology:</p> <ul style="list-style-type: none"> a) Structure and composition of the atmosphere b) Atmospheric circulation, Asian Monsoon and tropical cyclone c) Surface heat budget of the ocean d) Physical properties of sea water and their distribution, light and sound propagation in sea water e) Water masses and thermohaline circulation f) Indian Ocean circulation g) Oceanic processes: Upwelling/sinking and meso-scale eddies h) Oceanic processes: ENSO and IOD i) Wave generation, growth and decay j) Generation of tides, Semi-diurnal and diurnal tides, tidal constituents 	15
3	<p>Biological Oceanography:</p> <ul style="list-style-type: none"> a) General microbial ecology b) Measurement of primary production c) Benthic-Pelagic coupling , Benthic ecology, Benthic biomass structure and production d) Fisheries oceanography e) Plankton carbon cycling f) Introduction to suboxic and anoxic oceanography, Dynamics of DOM under anoxic conditions 	12

	<ul style="list-style-type: none"> g) Food web dynamics and climate change h) Biofouling/Bioinvasion i) Zooplankton and phytoplankton j) Fishery biology 	
4	<p>Ocean Chemistry:</p> <ul style="list-style-type: none"> a) Elemental composition of seawater and behaviour of substances b) Chemical speciation in seawater c) Major marine biogeochemical cycles d) Marine biogenic gases of climatic importance e) Global Climate Change and ecosystem impacts f) Exchange of materials across marine interfaces g) Sampling and analytical tools in chemical oceanography 	06
5	<p>Ocean Climatology</p> <ul style="list-style-type: none"> a) Climate classification b) Greenhouse gases: Introduction, causes of changing concentration, role in climate change c) Cryosphere and its role in climate change d) Energy Balance of the Earth and atmosphere e) Ocean-climate linkage 	06
		60

Recommended Books (Latest Editions)

1. Essential of Oceanography, by Trujillo/ Thurman (6 January 2015)
2. Oceanography: An Invitation to Marine Science, by Tom Garrison (31 July 2012)
3. Essentials of Meteorology: An Invitation to the Atmosphere by C. Donald Ahrens
4. Meteorology Today: An Introduction to Weather, Climate, and the Environment by Robert Henson, C. Donald Ahrens

Course Outcome:

The learner will be able to acquire knowledge on the following:-

1. Understand the Topography and Oceanography.
2. Effective Ocean influence on the climate.
3. Understand and acquire knowledge on Ocean Chemistry
4. Understand the various dynamics of Ocean Meteorology.

MMS103: Research Methodology (60 Hours, 04 Credits)

Course Objectives:

1. To impart knowledge on the process of Research Paper Writing.
2. To acquaint the learner with the in-depth knowledge on the various methods involved in carrying out research.
3. The learner will be imparted knowledge on the steps of carrying out focused research.

Unit	Course Content	Hours
1	Research Methodology: An Introduction Meaning of Research Objectives of Research Motivation in Research Types of Research Research Approaches Significance of Research Research Methods versus Methodology Research and Scientific Method Importance of Knowing How Research is Done Research Process Criteria of Good Research Problems Encountered by Researchers in India	08
2	Defining the Research Problem What is a Research Problem? Selecting the Problem Necessity of Defining the Problem Technique Involved in Defining a Problem	06
3	Research Design Meaning of Research Design Need for Research Design Features of a Good Design Important Concepts Relating to Research Design Different Research Designs	06

	Basic Principles of Experimental Designs	
4	<p>Methods of Data Collection</p> <p>Collection of Primary Data</p> <p>Observation Method96</p> <p>Interview Method</p> <p>Collection of Data through Questionnaires</p> <p>Collection of Data through Schedules</p> <p>Difference between Questionnaires and Schedules</p> <p>Some Other Methods of Data Collection</p> <p>Collection of Secondary Data</p>	08
5	<p>Processing and Analysis of Data</p> <p>Processing Operations</p> <p>Some Problems in Processing</p> <p>Elements/Types of Analysis</p> <p>Statistics in Research</p> <p>Measures of Central Tendency</p> <p>Measures of Dispersion</p> <p>Measures of Asymmetry (Skewness)</p> <p>Measures of Relationship</p> <p>Simple Regression Analysis</p> <p>Multiple Correlation and Regression</p> <p>Partial Correlation</p> <p>Association in Case of Attributes</p>	08
6	<p>Sampling Fundamentals</p> <p>Need for Sampling</p> <p>Some Fundamental Definitions</p> <p>Important Sampling Distributions</p> <p>Central Limit Theorem</p> <p>Sampling Theory</p> <p>Sandler's A-test</p> <p>Concept of Standard Error</p> <p>Estimation</p> <p>Estimating the Population Mean (μ)</p> <p>Estimating Population Proportion</p> <p>Sample Size and its Determination</p>	08

	Determination of Sample Size through the Approach Based on Precision Rate and Confidence Level Bayesian Statistics	
7	<p>Testing of Hypotheses</p> <p>What is a Hypothesis?</p> <p>Basic Concepts Concerning Testing of Hypotheses</p> <p>Procedure for Hypothesis Testing</p> <p>Flow Diagram for Hypothesis Testing</p> <p>Measuring the Power of a Hypothesis Test</p> <p>Tests of Hypotheses</p> <p>Important Parametric Tests</p> <p>Hypothesis Testing of Means</p> <p>Hypothesis Testing for Differences between Means</p> <p>Hypothesis Testing for Comparing Two Related Samples</p> <p>Hypothesis Testing of Proportions</p> <p>Hypothesis Testing for Difference between Proportions</p> <p>Hypothesis Testing for Comparing a Variance to Some Hypothesized Population Variance</p> <p>Testing the Equality of Variances of Two Normal Populations</p> <p>Hypothesis Testing of Correlation Coefficients</p> <p>Limitations of the Tests of Hypotheses</p> <p>Important Nonparametric or Distribution-free Test</p> <p>Relationship between Spearman's r_s and Kendall's W</p> <p>Characteristics of Distribution-free or Non-parametric Tests</p>	08
8	<p>Interpretation and Report Writing</p> <p>Meaning of Interpretation</p> <p>Why Interpretation?</p> <p>Technique of Interpretation</p> <p>Precaution in Interpretation</p> <p>Significance of Report Writing</p> <p>Different Steps in Writing Report</p> <p>Layout of the Research Report</p> <p>Types of Reports</p> <p>Oral Presentation</p> <p>Mechanics of Writing a Research Report</p> <p>Precautions for Writing Research Reports</p>	08

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Recommended Books (Latest Editions):

1. Research Methodology Methods and Techniques by C.R. Kothari, Gaurav Garg, New Age International Publishers
Methodology of Research in Social Science by O.R. Krishnaswami and M. Ranganatham, Himalaya Publishing House

Course Outcomes:

The learner will be able to understand and carry out the following:-

1. Identify the research problem, formulation of hypothesis, carryout data analysis using systematic and scientific methods.
2. Formulate the Research Process and arrive at the conclusion and recommendations in a logical manner.
3. Understand the need of Proper Research Writing.
4. Carryout a systematic and logical Research towards writing the term mini project conduct and report, Book review and Dissertation.

MSCMS104E – Fisheries Management System and Technology (60 Hours, 04 Credits)

Course Objectives

To impart knowledge on Fisheries Management System and Technologies

Unit	Course Contents	Hours
1	<p>Marine Fisheries resource management</p> <p>a) Important finfish and shellfish resources of India b) Issues and challenges of managing multi-species fishery c) Fisheries co-management</p> <p>Inshore, offshore and high seas fishery</p>	10
2	<p>Tropical Fish stock assessment</p> <p>a) Fish stock concept and assessment b) Eco path and Ecosystem models</p> <p>Stock recruitment relationships</p>	5
3	<p>Remote sensing and GIS for fishery management</p> <p>a) Sensor platforms</p> <p>Environmental satellites</p>	15
4	<p>Fishing and allied technologies</p> <p>a) Inland & Estuarine Fishery resources of India b) Commercially important fisheries in India</p>	10

	c) Hygienic Handling of fish d) Traditional & Modern fish processing e) Quality assurance norms and methods	
5	Coastal resource management a) Renewable resources; Tidal energy, biological resources (finfish, shellfish, mangroves, sea grass, sea weed) b) Mangrove and mudflat ecosystem c) Coral reef and sea grass ecosystem d) Coastal tourism e) Coastal aquaculture f) Ornamental fishery g) Climate resilient coastal agriculture Identification ecologically sensitive sites – Using Ecologically and Biologically Significant Areas tool	20
		60

Recommended Books (Latest Editions)

1. Conservation of Fish and Shellfish Resources- By J. Thorpe, Graham Gall, 2007.
2. Aquaculture, Resource Use, and the Environment- By Claude E., Boyd Aaron A., and McNevin. 2014.
3. Introduction to tropical fish stock assessment- By Per Sparre and Siebren C. Venema. 1998
4. Marine and Coastal Resource Management: Principles and Practice (Earthscan Oceans)- By David R. Green, and Jeffrey L. Payne. 2017.
5. Remote Sensing and GIS for Fisheries Management- By Mogalekar H S, and Johnson Canciyal. 2015
6. The book of Indian shells- by Deepak Apte (Bombay Natural History Society ; Calcutta : Oxford University Press, ©1998).
7. Fisheries biology Assessment and management – by Michael King (Oxford ; Ames, Iowa : Blackwell Pub., ©2007.)

Course Outcomes:

The learner will be able to understand and carry out the following:-

- Fisheries resource management and fish stock assessment using remote sensing and GIS
- Coastal resource management

MSCMS105E - Artificial Intelligence and Monitoring (60 Hours, 04 Credits)

Course Objectives

To impart fundamental knowledge on Artificial Intelligence and Monitoring.

Unit	Course Contents	Hours
1	Introduction What is AI? The Foundations of Artificial Intelligence The History of Artificial Intelligence The State of the Art	05
2	Intelligent Agents Agents and Environments Good Behavior: The Concept of Rationality The Nature of Environments The Structure of Agents	05
3	Problem Solving Solving Problems by Searching Beyond Classical Search Adversarial Search Constraint Satisfaction Problems	06
4	Knowledge, Reasoning, and Planning Logical Agents First-Order Logic Inference in First-Order Logic Classical Planning Planning and Acting in the Real World Knowledge Representation	10
5	Uncertain Knowledge and Reasoning Quantifying Uncertainty Probabilistic Reasoning Probabilistic Reasoning over Time Making Simple Decisions Making Complex Decisions	10
6	Learning Learning from Examples Knowledge in Learning Learning Probabilistic Models Reinforcement Learning	06
7	Communicating, Perceiving, and Acting	08

	Natural Language Processing Natural Language for Communication Perception Robotics	
8	Philosophical Foundations Weak AI: Can Machines Act Intelligently? Strong AI: Can Machines Really Think? The Ethics and Risks of Developing Artificial Intelligence	06
9	AI: The Present and Future Agent Components Agent Architectures Are We Going in the Right Direction? What If AI Does Succeed?	04
		60

Recommended Books (Latest Editions)

1. Artificial Intelligence: Modern Approach by Stuart Russel

Course Outcomes

The learner should be able to:

1. What is AI?
2. Robotics
3. Uses and Advantages of AI and Robotics.

Semester II

MMS201– Overview of International Maritime Trade (60 Hours, 04 Credits)

Course Objectives:

1. Educate learners about the concept and structure of Maritime Trade and its importance.
2. Impart learners about how Maritime Trade is based around Geographic availability of resources and consumers.

3. Impart knowledge to the learner on the various types of handling and transporting Commodities depending on its category.

Unit	Course Content	Hours
1	History of Maritime Trade	04
2	Basic Concepts and Geographies of Maritime Trade	05
3	Basics Concepts & Principles of Seaborne Trade	04
4	Types of Commodities Internationally Traded	04
5	Commercial Origins	04
6	Trades due to differences in Natural Resources	04
7	Trade Theory & Principle Drivers of Trade a. Demand and Supply	06
8	Types of Cargoes and their means of carriage	09
9	Ship Design & Technical Parameters - Bulk / Liquid Bulk / Gas (LPG, LNG, Ammonia) / Crude & CPP - Break Bulk :Types of Break Bulk Cargoes and their Characteristic - Automobiles / Project Cargoes - Cruise and Passenger	14
10	Maritime Vocabulary – On board and in Business	02
11	Commodity Trade Cycles & Trends	04
		60

Recommended Books (Latest Editions).

1. Maritime Economics, By Martin Stopford (3rd Edition)
2. Port Economics (Routledge Maritime Masters), By Wayne K. Talley
3. The Handbook of Maritime Economics and Business, By Costas Grammenos

4. The Business of Shipping, By Ira Breskin

Course Outcomes.

The learner would have gained knowledge towards implementing the following with indepth understanding of the following:-

1. Describe what Maritime Trade is
2. Demonstrate how it is governed by geographical distribution of resources and consumers
3. Differentiate types of marine transport crafts based on commodity
4. Construct and explain a trade cycle and its importance.

MSCMS202 - Marine Ecology & Environment and laws and legislations (60 Hours, 04 hours)

Course Objectives

To impart fundamental knowledge on marine ecology and related legislation.

No.	Details	Hours
1	Marine and Coastal Ecosystems <ol style="list-style-type: none"> a. Key marine and coastal habitats (Coral reefs, Mangroves, Sea Grass, Sandy shores, Rocky Shores, Sand dunes and mudflats, pelagic and deep sea) b. Trophic structure and energy transfer at various trophic levels c. Benthic ecosystem (Components, functioning and interactions) d. Ecosystem functioning e. Population connectivity in marine systems and biogeography f. Carbon and nutrient cycles g. Biological productivity h. Nutrient cycles i. Processes across land-ocean interface j. Processes in the marine boundary layer 	15
2	Coastal marine flora and fauna <ol style="list-style-type: none"> a. Coastal and Marine biodiversity – Overview b. Major marine invertebrate fauna c. Major marine vertebrate fauna d. Major marine flora e. Endangered species – Dugong, Whale Shark, Giant Clam, sea horse, sharks and skates f. Monitoring marine flora and fauna 	15
3	International & National Law, Maritime Law & Conventions <ol style="list-style-type: none"> a. UN Convention Territorial Waters, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976. b. Indian Ports Act, 1908 c. Major Ports Authority Act, 2021 d. Maharashtra Maritime Board Act, 1996 	30

	<ul style="list-style-type: none"> e. Indian Port Health & Indian Port Health Rules 1955 f. Oilfields (Regulation and Development) Act, 1948 g. Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008 h. Offshore Wind Policy, 2015 i. Marine Products Exports Development Act, 1972 j. State Marine Fisheries Regulation Act (MFRA)/ Maharashtra Marine k. Fishing Regulation Act, 1981 l. Coastal Aquaculture Authority Act, 2005 m. Marine Environmental and Biodiversity Protection: <ul style="list-style-type: none"> Air (Prevention and Control of Pollution) Act, 1981 Environment Protection Act, 1986 Wildlife (Protection) Act, 1972 Biodiversity Act, 2002 Environmental Impact Assessment notification 2006 Forest Conservation Act 1980 Marine and Coastal Protected Areas Management framework for MPAs n. Coastal Regulation Zone Notification, 2019 o. Integrated Coastal Zone Management p. MARPOL q. UNCLOS 	
Total		60

Recommended Books (Latest Editions)

1. Levinton, J. S. 2001. Marine Biology: Functions, biodiversity, ecology. Oxford Univ. Press. (2nd Edition)
2. Castro, P., Huber, M. E., 2003. Marine Biology. McGraw Hill Science. (4th Edition)
3. Jones, C. G., Lawton, J. H., 1995. Linking species and ecosystem. Springer.
4. Takahashi, M., Hargrave, B., Parsons, T.R., 1984. Biological oceanographic processes. Pergamon Press. (3rd Edn)
5. Gray, J. S., Elliot, M., 2009. Ecology of marine sediments. Oxford Univ. Press.
6. Maritime Law -- C. Hill, 2nd Ed. 1985 (LLP).
7. Maritime Law of India -- Dr. Nagendra Singh, 1st Ed. 1979 (Bhandarkar)
8. The Indian Ports Act, 1908 -- (Government of India).
9. Major Port Trusts Act, 1963 -- A.B. Gandhi, 1st Ed. 1982 (Milan)

Course Outcomes

The learner should be able to:

1. Understand nuances of marine ecology.
2. Learn various laws and policies that govern maritime sector.
3. Learn the existence of National and International Regulations governing Maritime environment

MSCMS203- Maritime Sciences – Hydrology, Climatology, Geography- (60 Hours, 04 Hours)

Course Objectives

To impart advanced knowledge on Maritime science.

Unit	Course Content	Hours
1	<p>Geography</p> <ul style="list-style-type: none"> a) Definition and basics of topography in general and, oceanic, in particular Topographic differences among various oceans on Earth b) Zonation and its significance c) Oceans, Seas and other water bodies in saline environments d) Topological studies with respect to advances in computational geography e) Zonation and its significance in Oceanography using various modern techniques and applying different computational models Climate classification 	11
2	<p>Quaternary climatology</p> <ul style="list-style-type: none"> f) Climate classification g) Greenhouse gases: Introduction, causes of changing concentration, role in climate change h) Cryosphere and its role in climate change i) Energy Balance of the Earth and atmosphere j) Ocean-climate linkage k) Role of ENSO, IOD, MJO, Walker Circulation in climate l) Causes and scale of climate variability; Milankovitch orbital cycles with respect to Ice Age climate variability m) Thermohaline circulation and climate n) Time-series measurements to develop paleoclimatic proxies. Calibration of paleoclimatic proxies o) Quaternary dating methods p) Isotope ratio mass-spectrometry q) Sea-level: factors affecting sea-level changes, Short and long-term sealevel variability r) Organic carbon, Inorganic carbon and Grain-size Analysis s) Activities and findings of IPCC 	20
3	<p>Hydrology Set I</p> <ul style="list-style-type: none"> a) The global hydrological cycle <ul style="list-style-type: none"> o the global system, fluxes, reservoirs, and residence times o evaporation, condensation, precipitation o regional water balances and resources o hydrological effects of climate change b) Land-atmosphere interactions <ul style="list-style-type: none"> o precipitation o interception o evapotranspiration c) Water and energy balance d) Structure and Properties of Water e) Principles of fluid dynamics <ul style="list-style-type: none"> o forces on fluids o fluid statics/dynamics o laminar and turbulent flow 	6

	<p>f) Monitoring and assessing processes</p> <ul style="list-style-type: none"> ○ remote sensing and hydrological networks ○ Measuring precipitation, evaporation, evapotranspiration, runoff, subsurface water. <p>g) Hydrology of coastal and estuarine areas</p> <ul style="list-style-type: none"> ○ Coastal morphology. Sources of salt. Measures to combat salt intrusion. Reservoirs in coastal areas; water and salt balance. Estuarine morphology. Mixing of fresh and salt water. Tidal effects. Water quality aspects of estuarine mixing. Siltation in coastal and estuarine areas. <p>Set II</p> <p>a) Introduction</p> <p>Introduction to Hydrologic Science: Hydrology, a distinct geoscience. The global hydrologic cycle. Multidisciplinary hydrology and its relation to other geosciences</p> <p>b) Earth's Energy Budget</p> <p>Surface radiation distribution. Elementary radiation physics. Short wave radiation. Long wave radiation.</p> <p>c) Earth-Atmosphere System</p> <p>Atmospheric composition and structure. Pressure, temperature, moisture distributions. Principles of atmospheric thermodynamics. Principles of atmospheric stability.</p> <p>d) Precipitation</p> <p>Rainfall generating mechanisms. Cloud physics. Storm structure. Precipitation modelling. Applications.</p> <p>e) Evaporation and Transpiration</p> <p>The lower atmosphere and the atmospheric boundary layer (ABL). Mean profiles and similarity in a stationary and horizontally-uniform ABL. Evaporation process. Water and energy balance methods. Mass transfer method. Penman equation. Transpiration. Evapotranspiration. Modified Penman equation.</p> <p>f) Advanced Topics</p> <p>Global hydrology and climate change. Regional hydrology and climate change.</p>	5
4	<p>Oceanographic observations and sampling</p> <p>a) Introduction to research vessels, deck gear, and sampling equipment</p> <p>b) Introduction to geological and geophysical survey equipment</p> <p>c) Introduction to biological sampling equipment and techniques</p> <p>d) Sea temperature and Salinity measurements</p> <p>e) Introduction to CTD data collection and processing techniques</p> <p>f) Introduction to basic statistical techniques in Oceanography</p>	6

5	Case Study – Oceanography – Mapping of resources (Visit to NIO (Goa) or/ and NIOT (Chennai))	12
		60

Recommended Books (Latest Editions)

1. D.T. Pugh, (1987) Tides, surges and sea level: A handbook for engineers and scientists. John Wiley & Sons.
2. Joseph (2011) Tsunamis: Detection, monitoring and early warning technologies. Elsevier.
3. W.J. Emery and R.E. Thomson, (1997) Data analysis methods in physical oceanography.
4. Pergamon Strangeways, (2000) Measuring the natural environment. Cambridge University Press.
5. H. Myers and Mc Alister, (1969) Handbook of ocean and underwater engineering. McGraw & Hill. Product Manuals of ADCP, Current Meters, Sediment Trap, CTD etc.
6. Haslett, S.K., 2002. Quaternary Environmental Micropalaeontology, Oxford University Press, New York.
7. Bradley, R.S., Paleoclimatology: Reconstructing Climates of the Quaternary, Academic Press.
8. Haq and Boersma, 1978. Introduction to Marine Micropaleontology, Elsevier.
9. Fischer, G. and Wefer, G., 1999. Use of Proxies in Paleoceanography: Examples from the South Atlantic, Springer.
10. Jones, R.W., 1996. Micropaleontology in Petroleum exploration, Clarendon Press Oxford.
11. North, G.R. and Crowley, T.J., 1995. Paleoclimatology, Oxford University Press

Course Outcomes

The learner should be able to understand in more depth:

1. Maritime Geography,
2. Hydrography,
3. Meteorology, Marine Geology, Seabed Resources

MSCMS204E: Maintenance of Marine Electrical System & Troubleshooting (60 Hour, 04 Credits)

Course Objectives

To impart knowledge on the Maintenance of Marine Electrical System & Trouble shooting.

Unit	Course Content	Hours
1	Essentials of Electrical Safety	02
2	Generic Guidelines for Maintenance	02
3	Maintenance of Low Voltage Equipment	02
4	Maintenance of High Voltage Equipment	02

5	Test Equipment and Component Testing	02
6	Earth Fault Monitors	02
7	Guidelines for Troubleshooting	02
8	Introduction to Alarm and Monitoring Systems	02
9	MSBs, ACB, GSP	03
10	Integrated Monitoring and Control System	03
11	Main Engine Alarm and Safety System	02
12	M.E. Engine Alarms Handling and References	02
13	Electronic Governor	02
14	Viscosity Controller	01
15	Heaters and Coolers	02
16	Air Conditioning System	03
17	Axial Flow Fan	01
18	Magnetic and Gyro Compasses	03
19	Global Positioning System	02
20	ECDIS	02
21	Echo Sounder and Electro Magnetic Log	02
22	Anemometer and Anemoscope	02
23	BNWAS and Master Clock	02
24	VHF Communication Set	02
25	Weather Facsimile	02
26	Tank Radar	02
27	Gas Detection System	02
28	Fire Detection Systems	02
29	Internal Communication Systems	02
		60

Recommended Books (Latest Editions)

1. Maintenance and Troubleshooting of Marine Electrical Systems Volume 1 by Harbhajan Singh, Elstan A. Fernandez and Lakshman Singh Yadav

2. Maintenance and Troubleshooting of Marine Electrical Systems Volume 2 by Harbhajan Singh, Elstan A. Fernandez and Lakshman Singh Yadav

Course Outcomes

The learner should be able to understand:

1. Maintenance of Instrumentation and Electrical System
2. Trouble Shooting of faults in Ship Systems

MSCMS205E : Ship Construction (60 Hours, 04 Credits)

Course Objective:

To impart Knowledge on the basics of ship's construction and laws

Unit	Course Content	Hours
1	Introduction to shipbuilding; Purchase and Basic Design of the Ship; Ship Dimensions and Form; Development of Ship Types.	08
2	Materials and Strength of ships: Classification societies; Steels; Aluminum Alloy; Testing of Materials; Stresses to which a Ship is Subject.	06
3	Welding and Cutting: Welding and Cutting Processes used in Shipbuilding; Welding Practice and Testing Welds.	06
4	Shipyards Practice: Shipyards layout; Computer aided Design and Manufacture; Plate and Section Preparation and Machining; Prefabrication; Launching.	12

5	<p>Ship Structure:</p> <p>Bottom Structure;</p> <p>Shell Plating and Framing;</p> <p>Bulkheads and Pillars;</p> <p>Decks, Hatches and Superstructures;</p> <p>Fore End Structure;</p> <p>Aft End Structure;</p> <p>Tanker Construction;</p> <p>Liquefied Gas Carriers.</p>	12
6	<p>Outfit:</p> <p>Derricks,</p> <p>Masts and Rigging;</p> <p>Cargo Access, Handling and Restraint;</p> <p>Pumping and Pipe Arrangements;</p> <p>Corrosion Control and Paint systems;</p> <p>Ventilation, Refrigeration and Insulation.</p>	10
7	<p>International Regulations:</p> <p>International Maritime Organization;</p> <p>Tonnage;</p> <p>Load Line Rules;</p> <p>Structural Fire Protection.</p>	06
		60

Recommended Books (Latest Editions)

1. Ship Construction by D J Eyres

Course Outcomes

The learner should be able to understand:

1. Basics of Ship Building and Construction
2. Layout of Ship Building and Repair Yard
3. Laws and Regulations

MSCMSMP - M.Sc. Mini Project Work (8 Credits)

Course Objectives: Mini Term Project. 16 hours per week either of case study, field work, data collection, data analysis, laboratory experimentation leading to end semester report and presentation. Mentor/advisor should facilitate field work and laboratory experimental work related projects across domains of science and technology. Projects with interdisciplinary objectives will also be encouraged.

Course Outcome – After successful completion of the Mini Term Project the learner can demonstrate, analyse, compare, evaluate subject data and can develop aptitude in field work, data collection, laboratory experimentation, problem analysis and solving using technical and statistical concepts.

Journals and related latest editions of books have to be referred.

Semester III

MSCMS301 - Marine Pollution (60 Hours, 04 Credits)

Course Objectives

To understand and enumerate impacts of pollution due to maritime sectoral development on coastal and marine ecology.

Unit	Course Contents	Hours
1	Marine Pollution overview <ul style="list-style-type: none">a. Types of pollutionb. Response of benthic communities to the physical disturbancec. Organic and inorganic pollutiond. Toxic metals in marine environmente. Harmful Algal Bloomsf. Coastal pollution: Industrial; sewage; microbial pollution; eutrophication; water quality; microbial indicators; bioremediation	10
2	Marine pollution hazard management and mitigation <ul style="list-style-type: none">a. Evaluation and monitoring of pollutionb. Evaluation of toxicity in marine biotac. Managing Oil spills and Oil spill mitigationd. Incursion managemente. Solid-waste discharge and managementf. Marine pollution bioremediation – Fungal and microbial	10
3	Marine litter and impacts <ul style="list-style-type: none">a. Plastic and Micro-plastic pollution and impactsb. Impacts on benthic and pelagic fauna and flora	10
4	Marine Noise and light pollution <ul style="list-style-type: none">a. Sea-bed mining and oil and gas infrastructureb. Impact of underwater noise on cetaceansc. Impact of coastal illumination on marine fauna	15
5	Site Visits to Port to understand marine pollution, sample collection (hydrocarbon and eutrophication and pollution prevention and management	15
		60

Recommended Books (Latest Editions)

1. Basudeb Bhatta : 'Remote Sensing and GIS' (Second Edition) – Oxford University Press, New Delhi pp 418 - 437
2. Richard T Wright and Bernard J. Nebel : 'Environmental Science – Towards a Sustainable Future' (Eighth Edition) – Prentice-Hall of India Pvt. Ltd, New Delhi pp 213 – 237, 439 - 459
3. Savindra Singh : 'Physical Geography' – Prayag Pustak Bhavan, Allahabad pp 388 - 407
4. Asthana D K and Meera : 'A Textbook of Environmental Studies' – S. Chand and Company Pvt. Ltd, New Delhi pp 177 – 224
5. Savindra Singh : 'Environmental Geography' – Prayag Pustak Bhavan, New Delhi pp 414 – 541
6. Karlekar Shrikant : 'Coastal Geomorphology of India' – Diamond Publication, Pune
7. Bhakhtaver Mahajan and Suma Nair : 'Health and Environment – Action Based Learning (HEAL), HBCSE, TIFR, Mumbai pp 36 – 98
8. Botkin and Keller : 'Environmental Science – Earth as a Living Planet' (Fifth Edition), John Wiley and Sons pp 262 – 293, 435 – 465
9. Vivek Sharma and Deepika Singla : 'NTA, UGC – NET/JRF/SLET Geography' – Arihant Publication, New Delhi pp 202 – 204, 238 – 241
10. Doney, S. C., Lima, I., Feely, R. A., Glover, D. M., Lindsay, K., Mahowald, N., Moore, J.K. & Wanninkhof, R. (2009). Mechanisms governing internal variability in upper-ocean inorganic carbon system and air–sea CO₂ fluxes: Physical climate and atmospheric dust. Deep Sea Research Part II: Topical Studies in Oceanography, 56(8-10), 640-655
11. Valsala, V., & Maksyutov, S. (2013). Interannual variability of the air–sea CO₂ flux in the north Indian Ocean. Ocean Dynamics, 63(2-3), 165-178
12. Doney, S. C., Lima, I., Feely, R. A., Glover, D. M., Lindsay, K., Mahowald, N., Moore, J.K. & Wanninkhof, R. (2009). Mechanisms governing interannual variability in upper-ocean inorganic carbon system and air–sea CO₂ fluxes: Physical climate and atmospheric dust. Deep Sea Research Part II: Topical Studies in Oceanography, 56(8-10), 640-655
13. Stock, C. A., Dunne, J. P., Fan, S., Ginoux, P., John, J., Krasting, J. P., Laufkötter, C., Paulot, F. & Zadeh, N. (2020). Ocean biogeochemistry in GFDL's earth system model 4.1 and its response to increasing atmospheric CO₂. Journal of Advances in Modeling Earth Systems, e2019MS002043
14. Senthil Kumar : Modern Treatment Strategies for Marine Pollution (First Edition) - Elsevier

Course Outcomes

The learner should be able to:

1. Understand types of pollution.
2. Marine pollution hazard management and mitigation.
3. Marine litter and impacts.
4. Marine Noise pollution

MSCMS302 - Climate Change, Coastal Hazard, Maritime sectoral impacts and Sustainable Development Goals (60 Hours, 04 Credits)

Course Objectives

To understand implications of climate change and maritime infrastructure in ports

Unit	Course Contents	Hours
1	Climate Change – Global perspective a) Ocean acidification b) Chemical equilibria c) Carbon dioxide system d) Nutrient cycling e) Isotopic anomalies	10
2	Coastal hazard – trends, predictions and mitigation a) Cyclones and storm surges b) Tsunami c) Sea level rise, coastal inundation and impact on coastal agriculture d) Beach response to waves and currents e) Shoreline change analysis and modelling f) Introduction to shoreline management g) Planning and design aspects shore protection measures -Soft and hard infrastructure h) Beach nourishment i) Artificial reefs j) Mangrove restoration	15
3	Mitigating climate change impacts a) Coastal engineering b) Carbon sequestration c) Building community resilience d) Technology innovations in agriculture, engineering and prediction	10
4	Sustainable Development Goals a) Overview of SDG b) Goal 14 c) SDG and Post 2020 d) India's achievements towards SDGs e) Convention on Biological Diversity	10
5	Case Study -Climate Change and predicted impacts on existing port infrastructure	15
		60

Recommended Books (Latest Editions)

1. Savindra Singh : 'Physical Geography' – Prayag Pustak Bhavan, Allahabad
2. Asthana D K and Meera : 'A Textbook of Environmental Studies' – S. Chand and Company Pvt. Ltd, New Delhi
3. Botkin and Keller : 'Environmental Science – Earth as a Living Planet' (Fifth Edition), John Wiley and Sons

Course Outcomes

The learner should be able to understand:

1. Global climate change scenario
2. Coastal hazards – recent trends
3. Impacts of climate change on sectoral development
4. Sustainable Development Goals and policy interventions to mitigate climate change related impacts

MSCMS303– Waves, Tides and dynamics of the North Indian Ocean (60 Hours, 04 Credits)

Course Objectives

To impart fundamental knowledge on Waves and Tides and the weather dynamics in the North Indian Ocean.

Unit	Course Content	Hours
1	Waves: What are waves? Wave-forms. Wave dispersion and group speed. Wave energy. Waves of unusual character. Measurement of waves. Sediments.	06
2	Tides: Tide producing forces - the Earth-Moon system. Tide producing forces - the Earth-Sun system. The dynamic theory of tides. Types of tide.	06
3	Shallow-water Environments and their Sediments: The supply of sediments to shallow-water environments. Variations in the supply and distribution of shallow-water sediments. The relationship between shallow-water environments and their changes with time.	06
4	Sediment Movement with Waves and Currents: Fluid flow. Sediment erosion. The rate of sediment transport. The deposition of sediment. Bedforms.	05
5	Beaches and the Littoral Zone: The divisions of the littoral zone. Sediment movement in the littoral zone. Beach profiles. Beach materials and sediment structures.	06
6	Tidal Flats and Estuaries: Sediment transport and deposition on tidal flats. Estuaries.	05
7	Deltas: The structure of a delta. Mixing and sediment deposition at distributary mouths.	05

8	Shelf Seas: Shelf sediments. Shelf processes. Bedforms on the continental shelf. Shelf processes and resources.	05
9	Dynamics of the North Indian Ocean Introduction Observations Surface Mixed layer Mid-latitude Dynamics Equatorial Dynamics Review of Coastal dynamics Undercurrents and beams Interannual Variability Interseasonal Variability Application: Overturning Cells & Climate Application : Biophysical process	16
		60

Recommended Books (Latest Editions)

1. Open University Course Team (1999) Waves, Tides and Shallow water Process.
2. Lecture Notes from National Institute of Oceanography, Goa
3. S.R. Massel Ocean Surface Wave: Their Physics and Prediction.

Course Outcomes

The learner should be able to:

1. Understand what are Waves and Tides and how they affect the movement of sediments.
2. Understand the Dynamics of North Indian Ocean.

MSCMS304E - Marine Electrical System (60 Hours, 04 Credits)

Course Objectives

To impart practical knowledge on various onboard ship electrical systems and their operational usage.

Unit	Course Content	Hours
1	Overview of a Ship's Electrical System	04
2	Electrical Safety	04

3	Electrical Equipment for Hazardous Areas	04
4	AC Distribution Systems	02
5	Emergency Power and Shore Supply	04
6	Isolated and Earthed Neutral Systems	02
7	Alternators	02
8	Automatic Voltage Regulators and Exciters	02
9	Fixed and Portable Instrumentation	02
10	Paralleling of Alternators	02
11	Switchboards and Switchgear	02
12	Starters for Alternating Current Motors	02
13	Fault Protection Devices	02
14	Electric Cables	01
15	Insulation and Ingress Protection	02
16	Electrical Propulsion Systems	03
17	Steering Systems	02
18	Deck Machinery	04
19	Batteries and Battery Charging	04
20	Lighting Systems	04
21	Gas Analysers	02
22	Alarm Indication Systems	02
23	Miscellaneous Systems	02
		60

Recommended Books (Latest Editions)

1. Marine Electrical Technology – Elstan A Fernandez

Course Outcomes

The learner should be able to understand:

1. The Various Electrical Systems Installed onboard a Ship

2. Functioning and Operations of the Installed Electrical Systems

MSCMS305E – Marine Engineering (60 Hours, 04 Credits)

Course Objectives

To impart advanced knowledge on Marine Engineering.

Unit	Details	Hours
1	Ships and machinery	05
2	Diesel engines	05
3	Steam turbines and gearing	05
4	Boilers	05
5	Feed systems	05
6	Pumps and pumping systems	05
7	Auxiliaries	05
8	Fuel oils, lubricating oils, and their treatment	05
9	Refrigeration, air conditioning, and ventilation	05
10	Deck machinery and hull equipment	05
11	Shafting and propellers	05
12	Steering gear	05
		60

Recommended Books (Latest Editions)

1. Introduction to Marine Engineering 2nd Edition by D. A. Taylor

Course Outcomes

The learner should be able to understand :

1. Engineering Systems Installed on board a ship
2. Its Functioning and Operational Capabilities
3. Efficient ship management

MSCMSBR2 - Book Review term assignment (08 Credits)

Course Objectives - Book Review of one book relevant to the programme leading to the final year Dissertation Based R&D Project Work. 16 hours per week library or engagement and mentoring by advisor with end semester report and presentation.

Course Outcome - Book review with report and presentation will assist learner to gain in depth knowledge on specific topic and gain understanding of research undertaken in that area with an overview on the new knowledge generated.

Semester IV

MSCMSDP - M.Sc. Dissertation Based Project Work (24 Credits)

Course Objectives

M.Sc. (Maritime Studies) for Semester-IV consists of full term Dissertation Based Research Project of 24 credits. Every student will have to complete a separate project in Semester IV with twenty four credits (600 marks). Mentor/advisor should facilitate field work and laboratory experimental work related projects across domains of science and technology. Projects with interdisciplinary objectives will also be encouraged. Students have to prepare and submit a Master level thesis and the final evaluation will be done by external expert and Guide on the bases of the quality of the thesis and Viva-Voce examination.

Project Outcome: After the successful completion of **MSCMSDP - M.Sc. Dissertation Based Project Work** the learner can demonstrate, analyse, compare, evaluate subject data and can develop aptitude in field work, data collection, laboratory experimental skills, problem analysis and solving using technical and statistical concepts.

Journals and related latest editions of books have to be referred.