NATIONAL TECHNICAL UNIVERSITY OF ATHENS

STUDY GUIDE

INTERINSTITUTIONAL PROGRAM OF POSTGRADUATE STUDIES (M.Sc) IN:

“SHIP AND MARINE TECHNOLOGY”

ACADEMIC YEAR: 2024 - 2025

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KEY ABBREVIATIONS

ASO	Administrative Services Organization
EU	European Union
FLC	NTUA Foreign Language Center
GA	General Assembly
GGI	Government Gazette Issue
HCMR	Hellenic Centre for Marine Research
HEI	Higher Education Institution
NKUA	National and Kapodistrian University of Athens
NSRF	National Strategic Reference Framework
NTUA	National Technical University of Athens
PDT	Postgraduate Diploma Thesis
PS	Postgraduate Student
PSC	Program of Studies Committee
PSD	Postgraduate Studies Diploma
SAMPS	School of Applied Mathematical and Physical Sciences
SC	Steering Committee
SCE	School of Civil Engineering
SECE	School of Electrical and Computer Engineering
SME	School of Mechanical Engineering
SNAME	School of Naval Architecture and Marine Engineering
SRSGE	School of Rural, Surveying and Geoinformatics Engineering
UCPS	University Committee on Postgraduate Studies

1. INTRODUCTION AND GENERAL PRINCIPLES

1.1. History and Mission of the National Technical University of Athens

The core mission of the National Technical University of Athens (NTUA) is to deliver internationally recognized higher education in engineering and related subjects and to promote the advancement of science and technology.

Founded in 1836 as a "School of Arts", the NTUA emerged almost concurrently with the creation of the modern Greek state. Adhering to the education standards of Continental Europe for engineering studies, it grew by offering, within the general framework of a five-year course of study, a combination of:

- a strong background in basic sciences,
- orientation towards modern trends in the technological field.

The NTUA graduates played a pivotal role in shaping both the public sector and private engineering firms as competent engineers. They served as the primary driving force behind Greece's pre-war development and post-war reconstruction. Furthermore, the NTUA graduates achieved recognition as distinguished members within both the Greek and international academic communities.

The NTUA's great national contribution and its distinguished position among national and international academic institutions is due to maintaining consistently high-standard in the offered programs of study, the high academic quality of its teaching staff and students and the satisfactory level of its material infrastructure and equipment.

The diploma awarded upon successful completion of the NTUA's undergraduate programs of study is characterized as an Integrated Master and is equivalent to the Master of Engineering (M.Eng.) and to the combination of Bachelor of Engineering (B.Eng) + Master of Science (M.Sc) of British universities.

In line with its position in the Greek and international scene as a leading public University, and towards fulfilling its national mission, the NTUA:

- continually upgrades its educational and research capabilities in order to offer competitive study programs for Greece and the surrounding Eurasian region (and even beyond it),
- supports the independent development of Greece through new initiatives in scientific and technological fields; and
- actively enhances Greece's presence and contribution in the international scientific and industrial scene.

In the NTUA's emblem appears Prometheus bringing the fire from the Olympian gods to mankind, symbolizing that education and research are human-centered, having as a priority the generation and dissemination of knowledge. In this regard, the main parameters include the quality of life and the protection of human rights. The NTUA fulfills its mission by fostering the development of both the broader personal and social virtues of the lecturers-researchers as well as the students by:

i. cultivating the skills that enable their self-reliant access to knowledge, synthesis, research, communication, collaboration and the administration of personnel and projects,

ii. developing integrated personalities, distinguished not only for their ability to continually advance their scientific and technological knowledge, but also for their character both as scientists and as conscious-responsible citizens,

iii. providing unwavering and effective contributions towards addressing the scientific and technological, social, cultural and broader developmental needs of Greece primarily as well as those of the international community.

1.2. Framework for Postgraduate Studies

To accomplish its mission and for creating rich sources in the fields of Science and Technology, the NTUA has established high-quality Programs of Postgraduate Studies. These are classified into two categories:

i. programs leading to the awarding of a Doctoral Degree, mainly within the framework of a single School, but also including the possibility of collaboration with schools from foreign institutions,

ii. Interdisciplinary (interdepartmental or interinstitutional) MSc Programs, in which various NTUA Schools and/or Departments of other HEIs and/or Research Centers may participate.

Programs falling under the second category lead to the awarding of a Postgraduate Studies Diploma (PSD). The Postgraduate Study Programs offered by the NTUA, along with the cutting-edge areas of Science and Technology to which they correspond, are presented at https://www.ntua.gr/en/school/postgraduate-studies.

The NTUA organizes and operates its Postgraduate Study Programs in compliance with the current legislative framework, setting in parallel the following specific objectives:

i. While running postgraduate programs, to ensure that the quality and the internationally-recognized value of the “Diplomas” awarded upon successful completion of the five-year Undergraduate Studies is preserved and enhanced, securing their recognition in the professional field as well. This prevents any possibility of substituting or downgrading the five-year undergraduate programs offered by the NTUA Schools.

ii. To monitor and evaluate the postgraduate courses, in order to ensure that the course content and the examination topics are up to the standard of the intended postgraduate level.

iii. To ensure the coherence of each postgraduate program and achieve scientific depth.

iv. To address both current and future developmental needs, promoting evidence-based research.

v. To take initiatives rendering the program appealing to students from other universities.

vi. To achieve an optimal study duration with regard to the learning outcome anticipated.

1.3. Administrative Support for Postgraduate Studies

In accordance with the University’s policy towards the decentralization of responsibilities and the strengthening of its Schools, the support for Postgraduate Studies is provided at the School level through the corresponding Secretariats, which have been upgraded to address the arising needs.

At the same time, at central administration level, within the Directorate of Studies has been created a dedicated Department overseeing the University’s Postgraduate Studies. This aligns with the guidelines of the NTUA’s Administrative Services Organization (ASO).

The support for the Postgraduate Studies of each School is computer-aided and involves the actions provided for by the ASO, placing emphasis on the following specific actions:

i. Preparing, uploading and circulating the announcement of postgraduate study openings.

ii. Collecting the applications and the supporting documents of candidate PS.
iii. Running the PS enrollment procedure (upon the completion of the candidate selection procedure).
iv. Preparing and updating the catalogs of the PS enrolled per Program and course.
v. Maintaining an electronic register to track the progress of each enrolled PS and updating it throughout the study period.
vi. Issuing grade sheets for the PS.
vii. Preparation of timetables and examination schedules.
viii. Issuing certificates and other documents, granted upon request of the PS and signed by the School's Secretary.
ix. Preparing procedures for granting loans and scholarships.
x. Maintaining a computerized record of the PS.
xi. Supporting the GAs of the Schools on affairs related to postgraduate studies.
xii. Providing all kinds of information and data concerning the School's postgraduate studies and uploading them to the world wide web.
xiii. Preparing procedures for the awarding of postgraduate and doctoral degrees.
xiv. Updating the records of PSD and Doctorate holders.

1.4. Presentation of the University and Research Units participating in the Program

In the Interinstitutional Postgraduate Program "Ship and Marine Technology" participate the NTUA Schools of:

(a) Naval Architecture and Marine Engineering.
(b) Mechanical Engineering.
(c) Rural, Surveying and Geoinformatics Engineering.
(d) Civil Engineering.
(e) Electrical and Computer Engineering.
(f) Applied Mathematical and Physical Sciences.

In the program participate also:

(g) The Physics Department of the National and Kapodistrian University of Athens.
(h) The Hellenic Centre for Marine Research.

The MSc Program "Ship and Marine Technology" originated from an initiative of the School of Naval Architecture and Marine Engineering of the NTUA. The particular School provides administrative support for the Program and it also assumes the role of the Program's coordinator.

The collaboration of the various Engineering Schools of the NTUA participating in the Postgraduate Program with the Physics Department of the National and Kapodistrian University of Athens and the Hellenic Centre for Marine Research (HCMR) offers postgraduate students access to high-quality scientific personnel and laboratory facilities of relevance to the field of Ship and Marine Technology.

Coordinator of the Postgraduate Program

<u>*School of Naval Architecture and Marine Engineering*</u>

The School of Naval Architecture and Marine Engineering (SNAME) started operating in the academic year 1969-70 as a Department within the School of Mechanical and Electrical Engineering. Its establishment was the result of the rising, since the 1950s, shipbuilding industry in Greece and the increasing needs of shipping and other technical companies (design offices, construction and repair units) in the maritime sector. The following three chairs were initially established:

i. Ship Theory,
ii. Ship Design and Construction; and
iii. Marine Engineering.

From the very beginning, the Department of Naval Architecture and Marine Engineering could admit its own students, starting with ten (10) in the first year of operation, while the first group of its Graduate Engineers completed their studies in 1974. In 1982, an independent Department of Naval Architecture and Marine Engineering was created within the NTUA, but the number of its Faculty Members was still limited (three professors and two lecturers) and its laboratory facilities had not yet been adequately developed, with the exception of the newly-established at the time 100m-long Towing Tank for model experiments. Today, there are 22 Faculty Members (plus two recently-elected members yet to assume office) while the laboratory infrastructure is considered as top-quality internationally. The educational program offered has also been significantly updated, in terms of both course content and academic disciplines, through the introduction of new courses. Since 2013, the NTUA Departments have been officially upgraded to Schools.

The School of Naval Architecture and Marine Engineering has developed vigorous and multifaceted research activity and its members have been awarded with the highest international distinctions for their research contribution. Furthermore, the School is one of the most active within the NTUA (and, more generally, within Greece), excelling in attracting grants for research projects funded by public and private institutions as well as by the EU. The School operates the following six officially established laboratories:

i. Naval and Marine Hydrodynamics,
ii. Marine Engineering,
iii. Ship Design,
iv. Shipbuilding Technology,
v. Floating Structures and Mooring Systems; and
vi. Maritime Transport.

There are unofficial laboratory units as well. The School is organized into the following four (4) Sections:

i. Section of Ship Design and Maritime Transport,
ii. Section of Naval and Marine Hydrodynamics,
iii. Section of Marine Engineering; and
iv. Section of Marine Structures.

Today, at the School of Naval Architecture and Marine Engineering there are 957 Undergraduate Students and 124 Postgraduate Students, of which 84 are PhD Students.

Collaborating Schools of the Postgraduate Program

School of Mechanical Engineering

In 1887, the specializations offered at the NTUA (at those times called in Greek “Metsovion Polytechnion”) were divided, leading to the creation of three separate four-year Schools.

These were the Schools of: Civil Engineers, Machinists and Foremen, which continued operating until 1914, when the University was given its present Greek name "Ethnikon Metsovion Polytechnion". At that point, the Machinists School underwent a name change to become the "School of Mechanical Engineering" and it was characterized as "Supreme". In 1917, the School of Mechanical Engineering was renamed the "Supreme School of Mechanical and Electrical Engineering". At the beginning of the 1975-76 academic year, the separation of the School of Mechanical-Electrical Engineering into two independent Schools was effected. The School of Mechanical Engineering incorporated the Department of Naval Architecture and Marine Engineering and included also the thematic area of Production Engineering.

In 1982, the School of Naval Architecture and Marine Engineering was separated from the School of Mechanical Engineering. At the same time, the staff and educational activities of the latter School were organized into six Sections:

i. Management and Operational Research,
ii. Thermal Engineering,
iii. Mechanical Design and Automatic Control,
iv. Nuclear Engineering,
v. Fluids; and
vi. Manufacturing Technology.

In 1986, two more course cycles were introduced at the School (one on Energy Mechanical Engineering and another on the Construction Mechanical Engineering), to which the Aeronautical Mechanical Engineering course was added in 1990.

Today, at the School of Mechanical Engineering there are 40 Faculty Members, 1621 Undergraduate Students and 184 Postgraduate Students, of which 124 are PhD Students. The students' practical training and the research activities of the Faculty Members take place in the School laboratories.

School of Electrical and Computer Engineering

As early as 1911, the "Electrical Laboratory" was established in the university with the aim of testing electricity supply and gas lighting meters. At the same time, exercises and experimental sessions were conducted for training the students of the School. Subsequently, the Laboratory was enriched with instruments and machines, taking on a more specialized electrical character. Naturally, it evolved into the basic laboratory from which all subsequent electrical laboratories were developed. These are the laboratories of: Electrotechnics, Electrical Machinery, High Voltage and Electrical Distance, Electronics and Telecommunication Systems.

All the courses offered by the School of Mechanical-Electrical Engineering were mandatory and mixed (encompassing a diverse range of subjects). In 1975, an independent School of Electrical Engineering was established accommodating two course streams (i.e., thematic areas), namely those of Electrical and Energy Engineering.

In 1982, the School was renamed the "Department of Electrical Engineering" and then, in 1991, the "Department of Electrical and Computer Engineering". Currently, it is the School of Electrical and Computer Engineering (SECE), organized into seven Sections:

i. Electromagnetics, Electrooptics and Electronic Materials,
ii. Information Transmission Systems and Material Technology,
iii. Signals, Control and Robotics,
iv. Computer Science,

v. Communication, Electronic and Information Engineering,
vi. Electric Power; and
vii. Industrial Electric Devices and Decision Systems.

Today, at the School of Electrical and Computer Engineering there are 57 Faculty Members, 5387 Undergraduate Students and 1411 Postgraduate Students, of which 933 are PhD Students.

School of Applied Mathematical and Physical Sciences (Formerly-known as "General Department")

In 1982, according to the Greek Law 1268/82, the so called "General Department" was established to offer courses on Physics, Mathematics, Engineering and Humanities, considered to be foundational to all NTUA specializations, as well as a selection of elective courses.

In response to the increasing needs of the research and technological sector for highly-qualified graduates in the basic sciences, a systematic discussion was initiated in the early 1990's. This discussion aimed at transforming the General Department into a Department that can admit its own students. The initiative was prompted by the systematic study and application of international standards and the practices for similar study programs abroad. Significant educational and research activities were developed in the Department, the number of teaching staff was increased and the Department's infrastructure in terms of material and equipment was improved. From these, and with the excellent cooperation with the rest of the NTUA Departments, the new (independent) Department dedicated to the basic sciences (Physics, Mathematics and Engineering with emphasis on applications) became fully functional. The School of Applied Mathematical and Physical Sciences (SAMPS) started operating in its current form in the academic year 1999-2000.

The SAMPS is organized into the following Sections:

i. Mathematics,
ii. Physics,
iii. Engineering; and
iv. Humanitarian Science.

Today, at the School of Applied Mathematical and Physical Sciences there are 68 Faculty Members, 2193 Undergraduate Students and 774 Postgraduate Students, of which 376 are PhD Students.

School of Rural, Surveying and Geoinformatics Engineering

The School of Rural and Surveying Engineering (SRSE) was founded in 1917 under the name "Supreme School of Surveying Engineering". In 1930, the (by that time) three-year program of studies turned into a four-year one and the School was renamed the "Supreme School of Rural and Surveying Engineering".

In 1974, the duration of the program of studies offered by the School was increased to five years and, in 1982, the School was renamed the "Department of Rural and Surveying Engineering". In 1983, the Department was organized into three Sections:

i. Section of Topography, focused on the development of methods and techniques for measurements and their processing for Topographic, Photogrammetric, Hydrographic, Geodetic and Geophysical Surveys,

ii. Section of Geography and Regional Planning, focused on the analysis, processing and mapping of quantitative and qualitative attributes of the Geographical Space, their interdependence relationships and changes through time, aimed at investigating the problems of Regional Planning; and
iii. Section of Infrastructure and Rural Development Scope, focused on the study and construction of rural projects that contribute to the development of the Rural Space.

The NTUA Departments were later upgraded to Schools and, in July 2020, the NTUA Senate, responding to a detailed proposal from the School, approved the change of its name to the "School of Rural, Surveying and Geoinformatics Engineering". This adjustment aimed to align the School's name more accurately with the contemporary content of its academic disciplines.

Today, at the School there are 33 Faculty Members, 842 Undergraduate Students and 321 Postgraduate Students, of which 139 are PhD Students.

School of Civil Engineering

The School of Civil Engineering of the National Technical University of Athens is the oldest engineering School of Greece. Its Faculty Members and students actively contribute to the generation of new knowledge internationally. As a result of the high-quality work produced by its Faculty Members and students (both undergraduate and postgraduate), in recent years the School enjoys a very high ranking in recognized international lists - for example, it is ranked eighth among European Civil Engineering Schools according to the QS Organization.

The School comprises five Sections, each of them being a unit for the generation and dissemination of science and technology.

The activities of the Structural Engineering Section span the areas of theoretical and experimental statics, dynamics, structural stability analysis, formation and calculation of metal structures, reinforced concrete structures, prestressed concrete, concrete technology, earthquake engineering and computer applications. The Section operates four laboratories being: the Laboratory of Reinforced Concrete, the Laboratory of Steel Structures, the Laboratory for Earthquake Engineering and the Laboratory of Structural Analysis and Antiseismic Research.

The Section of Water Resources and Environmental Engineering focuses on the study, from both the qualitative and quantitative perspective, of the aquatic environment and the related Civil Engineering works. In terms of educational and research work, it spans the following areas: Hydraulics, Hydrology and Water Resources, Hydraulic Engineering, Environmental and Sanitary Engineering, Marine Hydraulics and Harbor Engineering, Energy and Hydroelectric Works. The Section operates four laboratories being: the Laboratory of Applied Hydraulics, the Laboratory of Harbor Works, the Laboratory of Sanitary Engineering and the Laboratory of Hydrology and Water Resources Development.

The Section of Transportation Planning and Engineering covers, in terms of education and research activity, the transport of people and goods, from the stages of research, general planning and feasibility studies to implementation studies, the construction and operation. It also covers the design of road material mixtures and the construction and maintenance of road and airport pavements. The Section operates three laboratories: the Laboratory of Traffic Engineering, the Laboratory of Road Works Engineering and the Laboratory of Railways and Transport.

The Section of Geotechnical Engineering covers a wide range of subjects including the study of soil behavior under static and dynamic loading conditions, the behavior of rocks and geological formations and the seismic behavior of underground structures, harbor quay walls and bridge foundations. It also covers the calculation, design and construction of foundations for civil engineering works and the protection and restoration of the geo-environment. The Section operates two laboratories being: the Laboratory of Soil Mechanics and the Laboratory of Foundations Engineering.

Finally, the Section of Construction Engineering and Management is responsible for the training of students in the management of technical works production for their entire life cycle, i.e., from the conception of their construction necessity to their delivery, operation and maintenance. The Section operates the Laboratory of Construction Equipment and Project Management.

The School is also equipped with a Personal Computer Laboratory which includes two computer labs for undergraduate students and another two for the postgraduate students. The School participates in various postgraduate programs co-organized by the nine NTUA Schools. Two of these programs operate under the administrative responsibility of the School of Civil Engineering in the fields of: Analysis and Design of Structures and Water Recourses Science and Technology.

Today, at the School of Civil Engineering there are 39 Faculty Members, assisted by members of laboratory, technical and administrative staff. In addition, there are 1800 Undergraduate Students and 450 Postgraduate Students enrolled, of which 230 are PhD Students.

Physics Department of the National and Kapodistrian University of Athens

The Physics Department of the National and Kapodistrian University of Athens belongs to the School of Sciences. The Department's academic function, encompassing the educational and research activities of its members, is organized into 5 Sections. In addition, there are Educational Laboratories that are either directly under the Department itself or under the individual Sections of the Department. Of these, the first three Sections were created and have been operating since 1983, while the last two were established in 2007, after the division of the fourth (by that time) Section being the one of Physics of Applications. The current Sections are of:

i. Condensed Matter Physics,
ii. Nuclear and Particle Physics,
iii. Astrophysics, Astronomy, and Mechanics,
iv. Environmental Physics – Meteorology; and
v. Electronic Physics and Systems.

Mainly responsible for the education of both the undergraduate and postgraduate students are the Sections. Traditionally, the various courses composing the (undergraduate and postgraduate) curricula are offered by the Sections while the teaching of each course is assigned to the Faculty Member(s) of the corresponding Section, without necessarily implying that Faculty Members cannot teach courses offered by other Sections. Furthermore, the Sections are responsible for the courses corresponding to the scientific direction of study they represent. By "scientific direction" is meant the specific course cycle that each student must choose for the completion of the undergraduate studies. The Sections are also responsible for the courses offered by postgraduate programs in which Faculty Members of the Section participate.

The Department's officially established laboratories for specialized educational and research activities, in which undergraduate and postgraduate students are trained, are also under the responsibility of the Sections. These laboratories are listed next: Laboratory of Solid-State Physics (Section A'), Laboratory of Nuclear and Particle Physics (Section B'), Laboratory of Astronomy and Astrophysics (Section C'), Laboratory of Environmental Physics - Meteorology (Section D'), Laboratory of Electronic Physics (Section E').

In addition to the above, there are also officially established laboratories with a wider scope operated directly by the Physics Department. These are: 1. the Laboratory of Physics "Caesar Alexopoulos", which includes the "Machine Shop", 2. the Laboratory of Mechanical Engineering and Design, 3. the Laboratory (Center) of Computers and Informatics; and 4. the Gerostathopoulion University Observatory.

The facilities of the Physics Department are located in the Zografou Campus and include two main three-story buildings, the observatory and a ground floor laboratory area between the two main buildings.

Information regarding the teaching staff and the academic programs (undergraduate, postgraduate, doctoral) offered by the Department of Physics are listed on the Department's website at: https://www.phys.uoa.gr/.

Hellenic Centre for Marine Research (HCMR)

The Hellenic Centre for Marine Research (HCMR) is a Legal Entity of Public Law, a research organization of the public sector operating under a status of administrative and financial independence. It operates under the supervision of the Ministry of Development and Investment and the General Secretariat for Research and Innovation. It is the national entity for marine research and technology and is located in the municipality of Anavyssos, Attica.

The HCMR owns and operates:

- Large-scale land, floating and underwater research and technology infrastructure.
- Research vessels, watercraft and remotely operated vehicles (ROVs).
- Internationally renowned Laboratories for Research and Technological Development.

Three (3) scientific Institutes have been established at the HCMR, focusing on Research, Technological Development and Innovation (RTDI) activities. These activities include: the study of the marine and submarine environment and inland waters and their relationship with the atmosphere, geosphere and biosphere; the sustainable use of marine and aquatic bio-resources (blue growth); the development and exploitation of innovative products and services; the dissemination of produced results to society; and the contribution to the training of young scientists, in accordance with the objectives and mission of the Centre. More specifically:

- The Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC) is based in Gournes Pediados of the Municipality of Hersonissos, Crete (HCMR-Thalassocosmos) with facilities in Anavissos (Attica) and Souda (Chania, Crete) which include Aquaculture units.
- The Institute of Marine Biological Resources and Inland Waters (IMBRIW) is based in Anavissos (Attica) with facilities in the Attica Region and in Gournes Pediados of the Municipality of Hersonissos (HCMR-Thalassocosmos, Crete).
- The Institute of Oceanography (IO) is based in Anavissos (Attica) with facilities in Gournes Pediados of the Municipality of Hersonissos (HCMR-Thalassocosmos, Crete) and in Rhodes.
- The Institutes are supported by: a) the Directorate of Administrative Services, b) the Directorate of Financial Services, c) the Directorate of Infrastructure; and d) the Directorate of Research Support. Additional support is provided by two independent Units being: a) the Administrative and Financial Support Unit; and b) the Maritime Service Unit.

The Institute of Oceanography (IO) participates in the present Interinstitutional Postgraduate Program "Ship and Marine Technology". The mission of the IO is the long-term recording, monitoring and understanding of the physical, chemical, biological and geological processes governing the structure, function and evolution of coastal, marine and submarine systems.

In this context, the Institute of Oceanography:

i. investigates the dynamics of water masses, evaluates the potential of marine renewable energy sources and develops marine technology,
ii. supports, develops and implements procedures for the systematic monitoring of the marine environment, maintains oceanographic databases and develops appropriate forecasting systems and data assimilation schemes,
iii. studies the biodiversity of marine, coastal and transitional ecosystems, develops and applies ecological quality assessment techniques and is actively involved in their sustainable management, restoration and conservation of ecosystem services,
iv. studies the biogeochemical cycles of chemical elements, marine pollution, paleoclimatic changes as well as the effects of human activities and climate change on ecosystem functioning; and
v. evaluates the geomorphological, geophysical and geodynamical processes governing the submarine geosphere and producing geohazards. Additionally, the Institute participates in geoarchaeological investigations.

The Institute of Oceanography currently employs approximately 185 individuals, including researchers, special operational scientists, PhD students and post-doctoral researchers, special technical and scientific staff, technicians as well as administrative staff.

Collaboration

The collaboration of the various Engineering Schools of the NTUA, mentioned in the above, with the Physics Department of the National and Kapodistrian University of Athens (NKUA) and the Hellenic Centre for Marine Research (HCMR) allows to utilize, for the benefit of the postgraduate students, the active scientific expertise in the areas covered by the offered postgraduate program as well as the available high-quality laboratory facilities. The expertise needed for conducting the program is comprehensively addressed, with the NTUA Schools covering topics related to marine systems technology and waves; and the Department of Physics covering marine meteorology and oceanography topics. Alongside, the HCMR, with its ocean surveillance vessel and its experience in in-situ measurements and operational oceanography matters, supplements the infrastructure required for the study of the marine environment.

2. GENERAL FRAMEWORK FOR INTERDEPARTMENTAL/INTERINSTITUTIONAL PROGRAMS OF POSTGRADUATE STUDIES (MSc PROGRAMS) AT THE NTUA

2.1. Administration of the MSc Programs

Responsible for the organization and operation of the Interdepartmental Programs of Postgraduate Studies are the following bodies: the NTUA Senate, the Program of Studies Committee (PSC) of the MSc Program, the Steering Committee (SC) and the Director of the MSc Program. The responsibilities of these bodies are specified in Article 82 of the Greek Law 4957/2022.

In addition to the general legal framework of Greece, the operation of all the MSc Programs of the NTUA is governed by the NTUA's Bylaws (cf. Article 7, "Postgraduate Studies").

The PSC is the primarily responsible body for the organization and operation of a MSc Program. The PSC is formed in compliance with the Greek Law 4957/2022 (Article 81, par. 5). The interdisciplinary particularities of the MSc Programs require continuous assessment of the quality of the education they provide as well as of their longer-term economic viability.

More specifically:

i. The Departments and Schools participating in the MSc Program contribute to the educational activities and provide lecturers.

ii. The University Committee on Postgraduate Studies (UCPS) of the NTUA is the statutory body coordinating and overseeing the MSc Programs offered by the NTUA (see Article 79, par. 1 of the Greek Law 4957/2022).

The NTUA Senate is the supreme approving body, the decisions of which regulate matters of administrative and organizational nature. The responsibilities of the NTUA Senate are specified in Article 82, par. 1 of the Greek Law 4957/2022.

2.2. Eligibility of Postgraduate Students (PS)

In all the MSc Programs of the NTUA are eligible for acceptance by the corresponding PSCs, after an open call for applications, graduates from the following categories:

i. Graduates of the NTUA Schools and other Greek Engineering Departments/Schools.

ii. Graduates of Greek HEIs, mainly orientated towards Physics, Mathematics and related subjects.

iii. Graduates of foreign universities, accredited as equivalent to the Greek HEIs and mainly orientated towards Physics, Mathematics and related subjects, holding a degree of level 6 (at least) according to the National Qualifications Framework (B.Sc, B.Eng degrees of British universities or equivalent). Holders of a level 7 degree (M.Eng, B.Sc + M.Sc, Dipl.Ing or equivalent) are preferred.

iv. Final-year students of the NTUA or other HEI from the above categories, as long as they provide evidence that they will be awarded a diploma/degree prior to the beginning of the MSc Program.

v. Graduates of other Departments, in accordance with the applicable provisions.

2.3. Entry Requirements and Postgraduate Student Selection Criteria

The general entry requirement for postgraduate students who wish to be enrolled in the program is to have the necessary scientific background. This is specified by the PSC and may include the attendance of a number of prerequisite undergraduate courses which provide fundamental knowledge in the broader interdisciplinary field of the Schools (Departments for Interinstitutional Postgraduate Programs) participating in the MSc Program.

As evidence of the above-mentioned background knowledge, candidates must submit, together with their resume, the syllabus of each relevant course attended during their previous academic studies. Else, they are required to pre-enroll and attend (with successful examination) the NTUA (prerequisite) courses specified by the PSC. In particular, during the student selection process, certain criteria (listed next) are taken into account by the PSC, upon the recommendation of the Selection Committee. If the prerequisite courses are less than three (3), the PSC decides on whether the postgraduate student can be allowed to attend them in parallel with the regular program of study. This applies under the condition that the student will have passed the examinations of these courses prior to the beginning of the particular postgraduate courses to which the prerequisites refer and, in any case, prior to the time when the Postgraduate Diploma Thesis (PDT) is assigned.

As selection criteria are considered the following:

i. the diploma/degree grade,
ii. the ranking of the diploma/degree grade in relation to the grades of the other graduates in the same School/Department and academic year,
iii. the grades in undergraduate courses which are of relevance to the postgraduate program,
iv. the candidates' performance and the subject of their final-year thesis, if the writing of such a thesis was formally required for successfully completing their undergraduate studies,
v. any other postgraduate qualifications being of relevance to the thematic area of the MSc Program,
vi. the research, professional and/or technological activity of the candidate,
vii. the proficiency in foreign languages, particularly English, and for non-Greek candidates, proficiency in the Greek language as well,
viii. the computer literacy,
ix. the letters of recommendation; and
x. for candidates who are employees, the needs and prospects of their employer company or organization.

The PSC shall specify the details for applying the postgraduate student selection criteria presented in the above. This includes specifying the language proficiency level and any additional criteria, conducting examinations or interviews, the results of all of which shall be taken into account in the selection process. In the case of interviews, these are arranged by the PSC and conducted by a three-member Selection Committee (designated by the PSC), which is composed of Faculty Members, being lecturers in the MSc Program, one of whom is PSC member.

Former postgraduate students who did not complete their studies in the Postgraduate Program are also considered eligible. For these students, the following apply:

i. Provided that they have been accepted for re-enrolment, they cannot retain credits corresponding to courses they had previously attended and successfully completed if more than four (4) years have elapsed since their official withdrawal from the Postgraduate Program.
ii. Applications for re-enrollment from these students are assessed separately from all other applications (i.e., those concerning enrolment in the program for the first time).

The number of such admissions is decided on an annual basis by the PSC and cannot exceed 10% of the total number of students admitted.

2.4. Preparation of the MSc Program Curricula, Monitoring and Evaluation

The background knowledge required for enrolment in the MSc Programs is specified by the corresponding PSC, which is the body determining the prerequisite courses that individual students should attend and any other possible requirements. Taking into account the programs' content, as approved by the Ministry of Education and published in the GGI, the PSC of each MSc Program must decide on the following specific elements of the curriculum by mid-April every year:

i. The titles and detailed contents of the prerequisite courses, along with the bibliography and supporting teaching material.

ii. The titles and detailed contents of all MSc Program courses (required and elective).

iii. The weekly teaching hours for each course, in which all teaching activities shall be included.

iv. The chronological sequence or interdependence of the courses.

v. The credits of each course.

vi. The course characteristics in terms of technical support.

vii. The overlaps with other undergraduate and postgraduate courses offered.

viii. The course grading system.

ix. The continuous monitoring and objective evaluation of all the courses offered in a MSc Program in terms of their postgraduate academic level, the interdepartmental and interdisciplinary nature of the syllabus and examination topics. The aforementioned procedures may be carried out not only internally, by means of questionnaires filled in and delivered by the responsible lecturers to the PSC of the MSc Program and to the UCPS of the NTUA, but also externally, by internationally renowned evaluators. These evaluators are proposed by the PSC and then approved by the Senate based on the recommendation of the UCPS of the NTUA.

The MSc Programs are evaluated by the Quality Assurance Unit (QAU) of the NTUA and are subject to an accreditation process conducted by the Hellenic Authority for Higher Education (HAHE).

2.5. Interconnection between the MSc Programs and Programs of Doctoral Studies

The awarding of the PSD through study in a MSc Program of the NTUA provides graduates with the opportunity to proceed, if they wish and meet certain conditions, to a cycle of studies towards a Doctoral Degree.

Upon recommendation of the PSC, individuals holding another PSD, which is recognized as equivalent in a scientific area that is relevant to the thematic area of the proposed Doctorate, may apply to the coordinating School or to one of the collaborating Schools in order for the Advisory Committee to be designated. Then, they may proceed to the preparation and writing of the Doctoral Thesis alongside with which they may have to attend postgraduate courses recommended by the Advisory Committee. In other words, such cases essentially fall within the provisions of Article 7 par. 4.7 of the NTUA's Bylaws for single-department postgraduate programs, with the remark that a NTUA doctoral degree is awarded in the end.

The minimum duration of doctoral studies, starting from the time when the PSD is awarded, is two (2) academic years. The studies should comply with the statutory procedures specified by the Greek Law 4957/2022 (Article 95). Additionally, to be awarded the Doctoral degree, students should successfully defend their Doctoral Thesis before an examination committee and an audience of interested individuals.

2.6. Structure of Studies

The structure of postgraduate studies is organized into groups of required and elective courses. In the group of required courses, prerequisite basic (also called "core") courses and specialization courses may be included. The PSC has the authority to decide whether courses can be offered by other Schools of the NTUA or of another HEI. Also, the PSC decides on whether courses may be offered as electives in other MSc Programs of the NTUA. Obviously, many of the various MSc Program courses appear as elective in Doctoral Studies Programs.

Covering the prerequisites involves pre-enrolment of the PS candidates, which is allowed after a decision of the PSC. Then, those PS who pass the prerequisite courses are enrolled in the MSc Program to pursue the PSD.

In the MSc Programs, the lectures are delivered to relatively small-sized audiences (up to 40 PS). The exact size of these classes will be decided by the PSC, taking into account the restrictions set in the relevant Ministerial Decisions.

The maximum time period within which students can pursue the PSD, measured from the official time of enrollment in the MSc Program, is two (2) years. By exception, in special cases, a short-period extension of up to one (1) additional year may be granted, upon a reasoned PSC decision. On completion of the second year, the PSC shall decide on whether the student's period of study should be discontinued, in which case a certificate with the courses passed and corresponding grades should be issued.

In exceptional cases in which a postgraduate student successfully completes the obligations for the PSD to be awarded in a period shorter than the minimum duration of the MSc Program provided for and, in all cases, in a period of not less than one (1) year, the Senate may approve, upon the recommendation of the PSC to the UCPS, the awarding of the PSD.

Courses requiring laboratory practice or computer use aim to provide, as far as possible, individualized training for the postgraduate students. The introduction of new teaching methods that will enhance active participation of students is pursued. Particular emphasis will also be placed on the training of postgraduate students in groups, with distinctive role for each group member, in order to enhance their teamwork skills and synthetic ability.

All the MSc Programs coordinated by a School of the NTUA follow the "Unified Academic Calendar of Postgraduate Studies", which is prepared by the UCPS and approved by the University's Senate on an annual basis.

In the case of an Inter-University or part-time MSc Programs, the duration of studies is specified by the PSC and then finally approved by the Senate, in the framework of the procedures for the preparation and approval of the MSc Program curricula, while the academic calendar is adjusted accordingly. For part-time programs, the academic semesters that add up to the total number of credits of a full program cannot exceed twice the duration of the full-time MSc Programs, i.e., four (4) years.

By a written request, postgraduate students of the MSc Programs may temporarily suspend their studies for a period not exceeding two (2) consecutive semesters. The semesters of student status suspension shall not be counted towards the maximum duration of regular study.

2.7. Language of Instruction

The language of instruction in the MSc Programs offered by the NTUA, that are not identified as “foreign-language” ones, is Greek. The language to be used for the writing of the PDT is Greek or English and is specified by decision of the PSC. The PDT must include an extensive abstract in both Greek and English.

Regarding the MSc Programs offered in languages other than Greek, as is the MSc Program “Ship and Marine Technology”, the language of instruction and writing of the PDT is English.

2.8. Attendance, Examination and Course Grading System

Students are required to attend the courses and participate in the related educational activities and coursework. If there are extremely serious and documented reasons justifying a postgraduate student’s inability to attend, the PSC may excuse a certain number of absences which cannot exceed a maximum of 1/3 of the total number of lectures delivered. Postgraduate students who have not reached the required number of attendances in a course are entitled to repeat the course (or an equivalent one designated by the PSC) in the next, being also the final, academic year of study.

The course grading system is on a 0-10 scale, without involving fractional units, with the grade 5 representing the lowest pass. A course grade has to be derived not only from the final examination, but also (with non-negligible weight) from the performance of the students in the applied teaching methods (laboratories, personal computer labs, study labs, design labs, fieldwork, thematic studies, group work with individual presentations of the group members) carried out during the course, with a relative weighting that is determined in each course by the responsible lecturer, approved by the PSC and which cannot be less than 30% of the total course grade. It is also clarified that only the PSD grade, which is the average of grades awarded by the individual examiners, may be expressed in a form including the half of a fractional unit.

The final examination is held after the end of the teaching period, within a two-week examination period, in accordance with the University’s Unified Academic Calendar of Postgraduate Studies and relevant PSC decisions.

The results are issued by the responsible lecturers within two weeks from the date that the final examination was held.

There is no provision for repeating the examination period. In exceptional circumstances, the PSC may accept, by a documented decision, a special additional examination for a maximum number of two (2) courses per postgraduate student and academic year, provided that the postgraduate student was unable to take the examination due to force majeure events. Also in exceptional cases, the PSC may set re-examination.

Students failing the examinations have the option to re-enroll the following year in the same courses or, if these courses are elective, select other. In cases of two-year programs in which re-enrolling is not possible in the following year, only one additional examination period (set at a suitable time by the PSC) is allowed as an exception.

Postgraduate students who fail examinations in up to two courses, in which case they cannot successfully complete the program according to the provisions of the present Guide, are entitled to be examined, upon their request and a reasoned PSC decision, by a three-member committee of Faculty Members of the School. This applies exclusively to the PS who failed examinations in up to 2 postgraduate courses (at most) and one prerequisite course. Regarding the members of the examination committee, they are designated by the PSC of the MSc Program and should have expertise in the same or, at least, a closely related subject as the examined courses. Lecturers of the courses in question are exempt from this committee.

It is possible for postgraduate students who have attended courses of another recognized postgraduate program and have successfully passed the associated examinations to be exempted from the corresponding courses of the MSc Program upon a submitted written request, receiving the positive recommendation of the responsible lecturers and the decision of the PSC.

Lectures not given have to be re-scheduled in order to reach the number of 13 teaching weeks, required for all the Program courses. Re-scheduling is decided and announced by the PSC of the MSc Program, which takes care of complying with the academic calendar to the greatest extent possible.

2.9. Postgraduate Diploma Thesis – PSD Awarding and Grade

After completing the second semester of the first year of studies, postgraduate students can select the subject and supervisor for their Postgraduate Diploma Thesis (PDT), provided that, by that time, they have fulfilled all requirements for at least half of the MSc Program courses. For postgraduate students who re-enroll in the following year in order to attend first or second semester courses, the PSC decides on whether they can be allowed to start working on their PDT from the beginning of the second academic year of study.

Postgraduate students are required to submit an application in which shall be indicated the proposed title and supervisor of the PDT, with an abstract of the proposed thesis attached. Then, the PSC designates the supervisor and establishes the three-member Examination Committee. This Committee consists of the supervisor and other Faculty Members or Professors Emeriti or members of the teaching staff or researchers of ranks A, B, C that hold a PhD degree. The scientific expertise of the examination committee members must be the same with, or relevant to, the thematic area of the MSc Program. By their supervisor's proposal, postgraduate students may be scientifically assisted in the preparation of their PDT by PhD holders, PhD students or postgraduate students and other scientific collaborators of the NTUA or invited external lecturers. In addition, support for the preparation of the PDT in terms of laboratory equipment may be provided by the technical staff (STS, STLS, LTS, and others), whenever such a need arises.

It is important for the PDT to be a high-quality investigation on a scientific or technological problem, to be distinguished by originality and to leverage knowledge acquired in the context of the MSc Program.

The grade of the PDT is calculated as the average of the grades received from the three examiners on a 1-10 scale, rounded to the nearest half fractional unit, with the minimum pass mark being 5.5 (five and 50%). The PSC is responsible for setting uniform evaluation criteria through rotation of the Examination Committee members.

The text of the PDT is composed by using a suitable text compiler, following a template approved by the PSC. On the cover page should appear: the University's logo, the title of the MSc Program and the title of the PDT, the name of the PS, the names of the supervisor and of the rest Examination Committee members as also the examination period. In the text are included: 300- to 500-word abstract (in Greek and in English), introduction, thesis objectives, critical review of the literature, description of the methodology used, results, discussion on the results, conclusions and future directions for further investigation, bibliographical references and possibly appendices. The list of references should follow one of the internationally-accepted citation systems. The thesis should be submitted electronically and in hard copy. After the approval of the PDT, postgraduate students are required to deposit an electronic file of their thesis at the NTUA Central Library and to electronically submit the file to the NTUA Institutional Repository (DSpace@NTUA).

If the PDT is not successfully completed within the 3rd semester of the program, it can be continued for one more academic semester.

In all cases, successful completion of the postgraduate courses and the PDT is required in order for the PSD to be awarded. If this is not achieved within the maximum prescribed period of study, the postgraduate student receives a simple certificate of attendance for the courses passed and withdraws.

The total PSD grade is calculated as the weighted average of the grades received in the postgraduate courses and the PDT. The PDT can be considered to correspond to one (1) semester of courses.

Once a year, specifically in November, the Secretariat of the coordinating School compiles a list of postgraduate students graduating, in which are included those who have successfully completed their obligations in the MSc Program during the previous academic year. The degrees are awarded annually, at a special ceremony organized by the coordinating School, by the corresponding Dean and the Director of the MSc Program.

2.10. The Academic Advisor

Immediately after the student admission process, the PSC designates an Academic Advisor for each postgraduate student individually, based on the particular thematic area in which the student has selected to specialize.

Throughout the study period, the advisor collaborates with and provides guidance to the postgraduate student in selecting the courses - other than the required - that best align with their interests and personal goals. Furthermore, the advisor endorses the list of courses in which the postgraduate student is enrolled at the beginning of each academic period (semester). The advisor also oversees the overall progress of the postgraduate student in the MSc Program, including the fulfilment of prerequisites when necessary.

The advisor does not necessarily have to be the supervisor of the PDT. In principle, all the Faculty Members teaching in the MSc Program may serve as advisors.

2.11. Prize for Best Postgraduate Diploma Theses (PDT) Awarded by the NTUA

The NTUA may award prizes to the best PDTs written for the University postgraduate programs by exploiting endowment resources. The procedure for the evaluation of the theses is described below.

A thesis is nominated for a prize by the thesis supervisor who submits a written recommendation concisely stating the reasons why the specific PDT is recommended for a prize. The recommendation is accompanied by:

i. a duly filled submission form in which the thesis author declares that an electronic file of the PDT is submitted in order to be evaluated for winning the prize corresponding to a specific endowment,
ii. abstract of the PDT; and
iii. an electronic file of the PDT.

Following the selection criteria applied for prize awards at the NTUA, the PSC compiles a list of the PDTs nominated. The number of PDTs included in this list should correspond to the number of the prizes awarded. The list needs to be approved by the GA.

In the selection criteria should be included the following:

i. the originality and novelty of the PDT; and
ii. the papers in high-quality journals and conferences that have been published based on material produced for the PDT.

The UCPS establishes an Evaluation Committee, consisted of three (3) or four (4) Faculty Members from different Schools, in which supervisors of evaluated papers cannot participate.

The Evaluation Committee takes into account the evaluations of the Schools and submits its recommendation to the UCPS, which reaches a decision that is subsequently announced to the Senate.

The prizes are awarded in a ceremony featuring short presentations of the top three PDTs.

2.12. Scholarships

Scholarships may be granted to PS in compliance with the University Scholarship Rules. The number of scholarships available each year depends on the active agreements of the SNAME and the MSc Program with entities providing scholarships.

2.13. Sources of Funding

The funding and longer-term economic viability of the MSc Programs are ensured by resources raised from:

i. Entities of either the broader public or the private sector, under the terms and conditions set by the NTUA.
ii. The NSRF and the NTUA Special Account, in accordance with the NTUA's policy for postgraduate studies and research support.
iii. Tuition fees for non-EU students.

3. POSTGRADUATE STUDIES IN THE MSc PROGRAM: "SHIP AND MARINE TECHNOLOGY"

3.1. The Content, Importance and Objectives of the MSc Program

The content of the Postgraduate Program "Ship and Marine Technology" is primarily intended to meet the need for specialized, advanced-level studies in this scientific/technological field, which is of vital importance to Greece. In addition, the program aims to strengthen the country's scientific and technological research activity and the generation of new knowledge. It comprises three specialization directions in: (a) Maritime Technology, (b) Marine Structures and Exploitation of Hydrocarbons and (c) Marine Environment and Renewable Energy Resources.

The objectives of the MSc Program are:

- To offer education for the specialization of engineers and scientists with background in Physics, Mathematics and related subjects in the methods and techniques of integrated interdisciplinary approach, cooperation and research so that they can successfully meet the high technical requirements of employment in the ship and marine technology sector. To contribute to the competitiveness of the Greek economy through the production of competent and qualified executives in the field of Ship and Marine Technology.
- To develop the relevant scientific knowledge of engineers and other graduates and to improve their research skills so that they are rendered capable of generating new knowledge in the field of Ship and Marine Technology.
- To promote, through education, the interplay between science and technology within the maritime engineering sector, with a view to a balanced education of young engineers and scientists.

Given the objectives and the scientific areas it promotes, the MSc Program primarily contributes to the academic aspect of the technical scientific education in the field of Maritime Technology, in order to address the contemporary needs of the Greek and international shipping.

Apart from addressing the needs of Ship Technology, which are intertwined with the design and operation of ships, the current MSc Program aims to encompass cutting-edge technological and research developments in the field of Marine Technology, connected with a wide range of modern economic activities, such as:

- the exploitation of marine and sub-sea resources (extraction of hydrocarbons and minerals from the marine environment, energy harvesting from marine renewable sources (wave, hydrokinetic), fisheries, offshore and coastal fish farming, etc.),
- marine tourism and nautical sports (e.g., marinas, sailing boats, etc.),
- the protection and monitoring of the marine environment and coastal zones (e.g., properties and characteristics of the Greek seas, problems of pollution transport and diffusion, means of protection, etc.).

The MSc Program "Ship and Marine Technology" provides engineers and other graduates with the opportunity to pursue a career in the above-mentioned fields. The anticipated learning outcomes of the program relate to the following skills of the graduates:

i. to understand the operation principles of ship and marine technology systems, combining knowledge and information from different technological and scientific fields,
ii. to analyze these systems by considering their individual components and assess their performance,

iii. to contribute to the design and proper functioning of these systems,
iv. to revise and improve them on the basis of new ideas and methods,
v. to develop innovative solutions, using advanced computational tools; and
vi. to contribute to research efforts in the specific scientific/technological field.

3.2. Administrative Bodies

The MSc Program "Ship and Marine Technology" is administered by an eleven-member Program of Studies Committee (PSC), in which all the Schools, Departments and Research Centers participating in the MSc Program are represented according to the provisions of a Cooperation Protocol. The members representing a University School or Department are Faculty Members of the corresponding University, while the Research Centre is represented by one of its Researchers. Each PSC member is designated by decision of the Administrative Body having this authority (e.g., the GA for Schools and Departments) to serve a two-year term. Four of the PSC members come from the School coordinating the MSc Program, which is the School of Naval Architecture and Marine Engineering of the NTUA. Each of the rest participating entities shall designate one representative as a Member of the PSC. Each PSC member shall be required to provide teaching work to the MSc Program.

The PSC assembles with chairman the most senior member participating from the coordinating School among the School members holding the highest academic rank. Then, the PSC elects the Director and the Deputy Director of the MSc Program to serve a two-year term that is renewable without limitation. Both the Director and the Deputy Director are members of the PSC and come from the School of Naval Architecture and Marine Engineering of the NTUA.

The Steering Committee (SC) is established by decision of the PSC of the MSc Program to serve a two-year term. It consists of the Director of the MSc Program and four members of the PSC with scientific expertise of relevance to the thematic area of the Program. In the SC participate two (2) Faculty Members from the School of Naval Architecture and Marine Engineering of the NTUA and two (2) Faculty Members from the collaborating Schools/Departments. The Director of the MSc Program is the chair of the SC. The SC is responsible for overseeing and coordinating the operation of the Program.

The Director of the MSc Program is a Faculty Member of the rank of Professor or Associate Professor. The scientific expertise of the Director of the MSc Program is the same with, or relevant to, the thematic area of the MSc Program. According to the Greek Law 4957/2022, the Director exercises the duties specified in the postgraduate program Bylaws and recommends to the competent bodies of the MSc Program agenda items concerning the effective operation of the Program.

The PSC and the SC are responsible for the administration and management of the MSc Program, the PS selection process, the preparation of the curriculum, the recommendation for the designation of advisory committee members, the designation of examination committee members, the awarding of postgraduate studies diplomas and, in general, for the monitoring, coordination, support and control of the MSc Program operation as well as for the development of the educational and research activities approved by the UCPS and the Senate of the NTUA.

The PSC and the SC reach decisions by majority vote. In the case of the PSC, the presence of at least six (6) of its members is required in order for a decision to be made. In the event of a tie vote, the opinion of the Director of the MSc Program shall prevail.

The Director of the MSc Program chairs the PSC and the SC, convenes their meetings, prepares the agenda and oversees the implementation of their decisions. The Director is also responsible for the effective collaboration among the Schools participating in the MSc Program and the collaboration between teachers and students. By their decision, the two bodies (PSC and SC) may entrust other responsibilities to the Director of the MSc Program.

The administrative bodies of the MSc Program operate and exercise their responsibilities in accordance with the provisions of the Greek Law, the NTUA's Bylaws and the MSc Program Bylaws.

3.3. Members of the Program of Studies Committee (PSC)

By decision of the competent bodies of the collaborating entities, the members of the Program of Studies Committee (PSC) are:

1. From the National Technical University of Athens (NTUA):

a. School of Naval Architecture and Marine Engineering (coordinating School)

- Professor K. Spyrou, Director of the MSc Program, Section of Ship Design and Maritime Transport
- Professor K. Belibassakis, Deputy Director of the MSc Program, Section of Naval and Marine Hydrodynamics
- Professor N. Tsouvalis, Section of Marine Structures
- Associate Professor G. Dimopoulos, Section of Marine Engineering

b. School of Mechanical Engineering

- Professor M. Anagnostakis, Section of Nuclear Engineering

c. School of Rural, Surveying and Geoinformatics Engineering

- Professor V. Karathanassi, Section of Topography

d. School of Civil Engineering

- Professor Ch. Gantes, Section of Structural Engineering

e. School of Electrical and Computer Engineering

- Professor M. Anagnostou, Section of Communication, Electronic and Information Engineering

f. School of Applied Mathematical and Physical Sciences

- Professor K. Chrysafinos, Section of Mathematics

2. From the National and Kapodistrian University of Athens (NKUA):

- Professor H. Floca, Section of Environmental Physics - Meteorology

3. From the Hellenic Centre for Marine Research (HCMR):

- Dr. T. Soukissian, Institute of Oceanography, Research Director

3.4. Members of the Steering Committee (SC)

By decision of the PSC, the members of the Steering Committee (SC) of the MSc Program "Ship and Marine Technology" are:

1. From the National Technical University of Athens (NTUA):

a. School of Naval Architecture and Marine Engineering (coordinating School)

- Professor K. Spyrou, Director of the MSc Program, Section of Ship Design and Maritime Transport
- Professor K. Belibassakis, Deputy Director of the MSc Program, Section of Naval and Marine Hydrodynamics
- Professor N. Tsouvalis, Section of Marine Structures

b. School of Mechanical Engineering

- Professor M. Anagnostakis, Section of Nuclear Engineering

2. From the National and Kapodistrian University of Athens (NKUA):
   - Professor H. Floca, Section of Environmental Physics - Meteorology

3.5. Program Secretariat

Ms. A. Tsoni, Head of the Secretariat of the School of Naval Architecture and Marine Engineering NTUA

Tel. (+30) 210 7721938

Postal address:
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Ms. I. Kanta, Secretariat Officer responsible for the MSc Program "Ship and Marine Technology"

Tel. (+30) 210 7724147, Fax. (+30) 210 772-1887, email: secrmet@mail.ntua.gr

3.6. Prerequisite Courses

The prerequisite academic disciplines for the enrolment of postgraduate students in the MSc Program "Ship and Marine Technology" are classified into general prerequisites and prerequisites related to the specialization directions.

The general prerequisites for all the specialization directions of the MSc Program are:

- Mathematics (multivariable functions, differential equations)
- Fluid mechanics (general equations, Navier-Stokes equations, boundary layer, potential flows)
- Computer programming (Fortran or C programming languages)

The prerequisites for the specialization direction "Maritime Technology" (Direction I) are:

- Mechanics (of rigid and deformable bodies)
- Hydrostatics and ship stability
- Ship resistance and propulsion
- Applied Thermodynamics (laws of thermodynamics, operating cycles of thermal systems, refrigeration cycles, heat transfer, combustion)

The prerequisites for the specialization direction "Marine Structures and Exploitation of Hydrocarbons" (Direction II) are:

- Mechanics (of rigid and deformable bodies)
- Probability theory
- Strength of Structures (preferably of marine origin)
- Hydrostatics and ship stability

The prerequisites for the specialization direction “Marine Environment and Renewable Energy Resources” (Direction III) are:

- Probability theory
- Mathematical methods applied to physics problems (mathematical physics equations-Laplace, heat, wave, methods for solving partial differential equations, Sturm-Liouville problems)
- Mechanics (oscillations/wave mechanics, analytical mechanics)
- Marine Environment (oceanography or atmospheric physics or marine geology or a relevant course)

Eligible PS candidates are considered only those whose undergraduate studies cover all the general prerequisites of the MSc Program. Candidates not meeting this requirement for some of the prerequisites in the specialization area they have selected in their application must attend and pass the corresponding undergraduate courses determined by the PSC in order for the requirement to be fulfilled.

If the total number of the prerequisite courses is less than three (3), the PSC decides on whether the PS can be allowed to attend them in parallel with the regular program of study. This applies under the condition that the student will have passed the examinations of these courses within the first two semesters of the MSc Program and, in any case, prior to the beginning of the particular postgraduate courses to which the prerequisites refer. If the prerequisite courses are more than two (2), candidates who have been selected for the MSc Program have to pre-enroll in order to cover the necessary background knowledge before their admission. Then, admission will be granted in the following academic year, provided that the candidates have succeeded in maintaining less than two prerequisite courses. The maximum duration allowed for attending additional courses is two academic semesters.

Consequently, the period of study of a student will be discontinued in the following cases: (a) in the case of pre-enrolment, if the prerequisite courses have not been successfully completed within one academic year, except for a maximum of two (2); (b) in the case of enrolment with prerequisite courses, if these courses have not been successfully completed within one academic year.

In the academic year 2023-2024, an optional course called “Internship” is introduced as a pilot course. The grade received in this course will be counted towards the student’s PSD grade. On the other hand, taking the specific course does not count towards the 12 taught courses that students have to successfully complete in order to be awarded the PSD. Therefore, the content of the Internship course does not correspond to credits. As regards the conditions and the procedure for participating, as well as the students’ obligations with respect to the specific course, they are all described in the “Rules for Internship in the MSc Program “Ship and Marine Technology”, which is approved by the PSC.

Aiming at minimizing the need for assigning prerequisites to students admitted to the MSc Program, especially to those coming from higher engineering schools, for the academic year

2024-2025 the intention is to include, in the first semester, an additional course that will serve as an introduction to the basic scientific subjects of ship and marine technology (hydrostatics, propulsion, strength and design of ships and marine structures).

3.7. The Postgraduate Courses: Contents and Lecturers

In order for the PSD to be awarded, postgraduate students are required to succeed in examinations in at least twelve (12) MSc Program courses as well as in the examination of the PDT.

Out of the twelve MSc Program courses, a maximum of eight (8) are from the group of required and a minimum of four (4) from the group of elective courses. Regarding the required ones, at least two (2) are core courses, i.e., foundational to all PS regardless of the specialization area they have selected, while the specialization courses are at most six (6). Regarding the remaining four (4) (at minimum) elective courses, at least two belong to the specialization direction followed by the PS, while the rest two may be selected, with the agreement of the Academic Advisor, from the groups of required or elective courses corresponding to other specialization directions of the program.

The attendance of these courses and the preparation of the PDT are extended over a period of three academic semesters. In the first two semesters are included all the required courses and a number of elective ones selected by the students. In the third semester, students select from the remaining elective courses in order to complete the required number (12) of taught courses that they have to attend at minimum. In parallel, they prepare and write their PDT. Postgraduate students not successfully completing the PDT within the third semester of study may be granted an extension of one academic semester so as to avail of the maximum period allowed for studying in the MSc Program (four semesters).

The maximum number of postgraduate courses in which the PS may be enrolled per semester is five (or six in exceptional cases, with the agreement of the Academic Advisor). In all cases, postgraduate students should successfully complete all the required courses (being 8 at most) within the first two semesters of study.

The distribution of courses over semesters is summarized in the tables below. With the agreement of the Academic Advisor, students are allowed to select courses from specialization directions other than the one they follow in order to complete the required number (at most six) of specialization courses.

FIRST SEMESTER 2023-2024

Core Courses

Code	*Required Courses*	*Lecturers*	*Entity*	*ECTS*
8002	**Special Topics in Ship and Marine Hydrodynamics**	K. Belibassakis	SNAME	6
8005	**Numerical Analysis**	K. Chrysafinos E. Georgoulis	SAMPS	6

Direction I “Maritime Technology”

Code	*Required Courses*	*Lecturers*	*Entity*	*ECTS*
8003	**Finite Element Method for the Static and Dynamic Analysis of Structures**	E. Samuelides K. Anyfantis	SNAME	6

8101	**Seakeeping Behavior of Ships and Applications in Their Design and Operation**	G. Grigoropoulos	SNAME	6
8119	**Ship Dynamic Stability and Safety**	K. Spyrou	SNAME	6
8121**	**Fundamentals of Naval Architecture**	D. Konovessis	SNAME	6
Code	***Elective Courses (*)***	***Lecturers***	***Entity***	***ECTS***
8103***	**Hydraulic Systems Onboard Ships**		SME	6

(*) Direction I students must select one additional course (two courses in total) from the group of elective courses available for Direction I in the second semester.

(**) Required course only for students holding a first-cycle degree other than in Naval Architecture.

(***) This course will not be offered in the academic year 2024-25.

Direction II "Marine Structures and Exploitation of Hydrocarbons"

Code	***Required Courses***	***Lecturers***	***Entity***	***ECTS***
8121*	**Fundamentals of Naval Architecture**	D. Konovessis	SNAME	6
8202	**Materials for Marine Structures**	N. Tsouvalis A. Zervaki	SNAME	6
8314	**Introduction to Marine Renewable Energy Sources**	T. Soukissian K. Belibassakis	HCMR SNAME	6
Code	***Elective Courses***	***Lecturers***	***Entity***	***ECTS***
8203	**Hydro-Mechanical Analysis and Design of Mooring Structures**	S. Mavrakos I. Chatjigeorgiou D. Konispoliatis	SNAME	6

(*) Required course only for students holding a first-cycle degree other than in Naval Architecture.

Direction III: "Marine Environment and Renewable Energy Resources"

Code	***Required Courses***	***Lecturers***	***Entity***	***ECTS***
8301	**Wave Phenomena in the Sea Environment (Water Waves and Ocean Acoustics)**	K. Belibassakis	SNAME	6
8302*	**Marine Geology and Geophysics**	V. Kapsimalis G. Rousakis	HCMR	6
8314	**Introduction to Marine Renewable Energy Sources**	T. Soukissian K. Belibassakis	HCMR SNAME	6
Code	***Elective Courses***	***Lecturers***	***Entity***	***ECTS***
-	**-**	-	-	-

(*) This course will not be offered in the academic year 2024-25. Instead, students are required to attend the second semester course 8309 – "Remote Sensing Methods for Mapping and Monitoring of Marine Environment".

Joint Elective Course for All Directions

Code	***Course***	***Lecturers***	***Entity***	***ECTS***
8007	**Communication Skills for Engineers**	G. Togia and K. Spyrou	FLC SNAME	3

SECOND SEMESTER 2023-2024

Core courses

Code	*Elective Courses (*)*	*Lecturers*	*Entity*	*ECTS*
8006	**Finite Difference and Finite Element Methods for PDEs**	E. Georgoulis K. Chrysafinos	SAMPS	6

Direction I “Maritime Technology”

Code	*Required Courses*	*Lecturers*	*Entity*	*ECTS*
8004	**Measurements and Instruments for Marine Applications**	M. Anagnostakis P. Rouni G. Grigoropoulos	SME SNAME	6
8106	**Design and Operation of Marine Diesel Engines**	G. Dimopoulos	SNAME	6
8108	**Maritime Transportation Systems**	D. Lyridis M. Founti D. Yannopoulos	SNAME SME	6
Code	*Elective Courses (*)*	*Lecturers*	*Entity*	*ECTS*
8118	**Computational Fluid Dynamics**	G. Papadakis	SNAME	6
8114	**Linear and Nonlinear Dynamics-Vibrations of Shaft-Rotors Systems**	I. Georgiou N. Tsoulakos	SNAME	6
8308	**Nonlinear Water Waves**	K. Belibassakis	SNAME	6
8313	**Non-Markovian Stochastic Functions. Stochastic Dynamics**	G. Athanassoulis	SNAME	6

(*) Direction I students must select one from the group of elective courses in this semester. Especially for the academic year 2024-25, two elective courses have to be selected.

Direction II “Marine Structures and Exploitation of Hydrocarbons”

Code	*Required Courses*	*Lecturers*	*Entity*	*ECTS*
8201	**Environmental Conditions and Wave Loads on Marine Structures**	S. Mavrakos I. Chatjigeorgiou D. Konispoliatis	SNAME	6
8205	**Dynamic Response of Floating Structures**	G. Triantafyllou I. Chatjigeorgiou	SNAME	6
8209	**Structural Design**	K. Anyfantis	SNAME	6
8213	**Mechanics of Geomaterials (Soils and Rocks)**	E. Kapogianni P. Psarropoulos	SRSGE	6
Code	*Elective Courses (*)*	*Lecturers*	*Entity*	*ECTS*
8118	**Computational Fluid Dynamics**	G. Papadakis	SNAME	6
8207	**Seminars on Topics of Marine and Underwater Technology**	S. Mavrakos D. Konispoliatis T. Soukissian A. Prospathopoulos	SNAME HCMR	6

8212	**Structural Mechanics and Design of Offshore Pipelines**	S. Karamanos I. Chatjigeorgiou A. Zervaki	Univ. of Thes-saly SNAME	6
8214	**Ultimate Limit State Analysis of Marine Structures**	E. Samuelides	SNAME	6
8216	**Reliability and Risk Analysis for Offshore Structures**	D. Vamvatsikos	SCE	6
8308	**Nonlinear Water Waves**	K. Belibassakis	SNAME	6
8313	**Non-Markovian Stochastic Functions. Stochastic Dynamics**	G. Athanassoulis	SNAME	6

(*) Direction II students must select one from the group of elective courses in this semester.

Direction III: "Marine Environment and Renewable Energy Resources"

Code	*Required Courses*	*Lecturers*	*Entity*	*ECTS*
8307	**Atmosphere and Ocean Dynamics**	G. Triantafyllou H. Floca S. Sofianos	SNAME Physics NKUA	6
8308	**Nonlinear Water Waves**	K. Belibassakis	SNAME	6
8309	**Remote Sensing Methods for Mapping and Monitoring of Marine Environment**	D. Argialas V. Karathanassi K. Karantzalos P. Kolokoussis	SRSGE	6
Code	*Elective Courses (*)*	*Lecturers*	*Entity*	*ECTS*
8118	**Computational Fluid Dynamics**	G. Papadakis	SNAME	6
8207	**Seminars on Topics of Marine and Underwater Technology**	S. Mavrakos D. Konispoliatis T. Soukissian A. Prospathopoulos	SNAME HCMR	6
8313	**Non-Markovian Stochastic Functions. Stochastic Dynamics**	G. Athanassoulis	SNAME	6

(*) Direction III students must select two from the group of elective courses in this semester.

Joint Elective Course for All Directions

Code	*Course*	*Lecturers*	*Entity*	*ECTS*
8008	**European and Greek Technical Law**	Eugenia Tzanini	SAMPS	3

Optional Course for All Directions

Code	*Course*	*Lecturers*	*Entity*	*ECTS*
8318	**Internship**	-	-	-

THIRD SEMESTER 2023-2024

Direction I “Maritime Technology”

Code	*Required Courses*	*Lecturers*	*Entity*	*ECTS*
	Preparation and Writing of the Postgraduate Diploma Thesis	-	-	18
Code	***Elective Courses (*)***	***Lecturers***	***Entity***	***ECTS***
8105	**Hydrodynamics and Aerodynamics of Sailing Yachts**	G. Grigoropoulos E. Angelou	SNAME	6
8116**	**Modeling and Simulation of Flow and Combustion Processes in Internal Combustion Engines**	L. Kaiktsis D. Kazangas	SNAME	6
8120	**Management of Safety and Environmental Hazards for Offshore Oil and Gas Industry (Platforms and Drilling Ships)**	N. Ventikos	SNAME	6
8122	**Introduction to Ship Performance Assessment**	N. Themelis	SNAME	6
8315	**Optimization Problems and Variational Principles in Mathematical Physics**	G. Athanassoulis	SNAME	6
8316**	**System Dynamics, Stability and Control**	G. Athanassoulis K. Spyrou G. Papalambrou	SNAME	6

(*) Direction I students must select two from the group of elective courses in this semester.
(**) This course will not be offered in the academic year 2024-25.

Direction II “Marine Structures and Exploitation of Hydrocarbons”

Code	*Required Courses*	*Lecturers*	*Entity*	*ECTS*
	Preparation and Writing of the Postgraduate Diploma Thesis	-	-	18
Code	***Elective Courses (*)***	***Lecturers***	***Entity***	***ECTS***
8120	**Management of Safety and Environmental Hazards for Offshore Oil and Gas Industry (Platforms and Drilling Ships)**	N. Ventikos	SNAME	6
8122	**Introduction to Ship Performance Assessment**	N. Themelis	SNAME	6
8211	**Ocean Energy Converters**	S. Mavrakos I. Prousalidis	SNAME	6
8215	**Basic Principles for the Design of Foundation of Marine Structures**	E. Kapogianni P. Psarropoulos	SRSGE	6
8217	**Steel Structures for Marine Applications**	Ch. Gantes P. Thanopoulos	SCE	6

8315	**Optimization Problems and Variational Principles in Mathematical Physics**	G. Athanassoulis	SNAME	6
8316**	**System Dynamics, Stability and Control**	G. Athanassoulis K. Spyrou G. Papalambrou	SNAME	6
8317	**Basic Programming Principles and Uses in Mathematics**	K. Papaodyssefs	SECE	6

(*) Direction II students must select two from the group of elective courses in this semester.
(**) This course will not be offered in the academic year 2024-25.

Direction III: "Marine Environment and Renewable Energy Resources"

Code	***Required Courses***	***Lecturers***	***Entity***	***ECTS***
8317	**Basic Programming Principles and Uses in Mathematics**	K. Papaodyssefs	SECE	6
	Preparation and Writing of the Postgraduate Diploma Thesis	-	-	18
Code	***Elective Courses (*)***	***Lecturers***	***Entity***	***ECTS***
8211	**Ocean Energy Converters**	S. Mavrakos I. Prousalidis	SNAME	6
8217	**Steel Structures for Marine Applications**	Ch. Gantes P. Thanopoulos	SCE	6
8311	**GIS and Spatial Databases for the Marine Environment**	A. Skopeliti L. Stamou	SRSGE	6
8315	**Optimization Problems and Variational Principles in Mathematical Physics**	G. Athanassoulis	SNAME	6
8316**	**System Dynamics, Stability and Control**	G. Athanassoulis K. Spyrou G. Papalambrou	SNAME	6

(*) Direction III students must select two from the group of elective courses in this semester.
(**) This course will not be offered in the academic year 2024-25.

The detailed content of the courses offered per Specialization Direction and semester of study is presented below.

CORE COURSES FOR ALL SPECIALIZATION DIRECTIONS

8002 SPECIAL TOPICS IN SHIP AND MARINE HYDRODYNAMICS

CONTENT: Water wave propagation in intermediate and shallow water depth. Representations of the wave fields. Green's theorem. Series expansions of the wave field. Computational models with application to water wave propagation and scattering over non-uniform bathymetry (general bottom topography). Wave generation by oscillatory body. Wave-floating body interaction. Mathematical formulation. Far-field representation. Diffraction and radiation problems. Hydrodynamic loads and responses. Added mass and hydrodynamic damping of floating bodies in waves. Calculation methods. Linearized equations of motions and response coefficients, Comparison with experimental data. Development of Matlab programs and application to various problems concerning water wave propagation over bathymetry (finite and shallow water depth and variable bathymetry regions) and wave-floating body interaction problems.

LECTURER: *K. Belibassakis*, Professor, School of Naval Architecture and Marine Engineering NTUA

8005 NUMERICAL ANALYSIS

CONTENT: Introduction (Norms, Spectral Radius, Conditioning of Linear Systems, Numerical Linear Algebra (Direct and Iterative Methods, Conjugate Gradient Methods, Krylov Subspace Iteration Methods, QR), Nonlinear Systems (Fixed Points, Newton Raphson), Approximation-Interpolation (Weierstrass Theorem, Piecewise Linear Approximation, Cubic Splines, Best Approximation Theorems, Chebyshev Polynomials, Asymptotic behavior of Polynomial Interpolation, Runge Divergence Theorem), Numerical Integration (Orthogonal Polynomials, Gauss Quadrature).

LECTURERS: *K. Chrysafinos*, Professor, *E. Georgoulis*, Professor, School of Applied Mathematical and Physical Sciences NTUA

8006 FINITE DIFFERENCE AND FINITE ELEMENT METHODS FOR PDEs

CONTENT: Part I: Very brief Introduction to the theory of Partial Differential Equations (PDEs) - Classification of PDEs, solution by the method of characteristics, Cauchy problem, Cauchy-Kowaleskaya Theorem, well-posedness in the sense of Hadamard, equations of mathematical physics, Dirichlet and Neumann problems, solution by separation of variables, Fourier series. Part II: Finite Difference Methods for PDEs - Divided differences, the two-point boundary value problem and a simple finite difference method for it, its error analysis, explicit and implicit finite difference methods for parabolic problems, error analysis and stability analysis, simple finite difference methods for elliptic problems, the CFL condition, finite difference methods for hyperbolic problems, the upwin scheme, the Lax-Wendroff method, the leapfrog scheme. Part III: Finite Element Methods for PDEs - Introduction to weak derivatives and to function spaces (Lebesgue and Sobolev spaces), Dirichlet principle, weak form of PDE problems, energy method, Galerkin projection and orthogonality, finite element spaces, the finite element method, Cea's lemma, a priori error analysis of the finite element method for elliptic problems, finite element methods for parabolic problems, discontinuous Galerkin finite element methods for hyperbolic problems, a posteriori error analysis and adaptivity.

LECTURERS: *E. Georgoulis*, Professor, *K. Chrysafinos*, Professor, School of Applied Mathematical and Physical Sciences NTUA

FIRST SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION I "MARITIME TECHNOLOGY"

8003 FINITE ELEMENT METHOD FOR THE STATIC AND DYNAMIC ANALYSIS OF STRUCTURES

CONTENT: Introduction to the Finite Element Method (FEM). The principle of virtual work and the application of the method for the approximation of the structural response of simple structures is detailed. Illustrative examples of the analysis of truss structures with the stiffness method. Theoretical background of the FEM: formulation of fundamental equations for the static and dynamic analysis of structures, boundary conditions, discretized nodal forces, shape

functions. Isoparametric elements and numerical integration. Rules for proper meshing. Convergence requirements. Beam elements and plate elements. Isoparametric elements. Introduction to shell elements. Application of FE software for modeling 2D and 3D structures. Simulation of simplified geometries with FEM. Exercises and projects with commercial software.
LECTURERS: *E. Samuelides*, Professor, *K. Anyfantis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8101 SEAKEEPING BEHAVIOR OF SHIPS AND APPLICATIONS IN THEIR DESIGN AND OPERATION

CONTENT: Introduction. The dynamic performance of ships in regular and random sea waves. Formulation and methods of solution of the problem. Linearization. Dynamic response of ships. Roll damping and stabilization. Seakeeping performance recording via sea trials and model tests at the lab and at sea. Added resistance in waves and involuntary speed reduction. Random events. Effect of the ship motions on the passengers, the crew and respective criteria. Voluntary speed reduction. Seakeeping behavior of high-speed vessels. Operational effectiveness. Effect of hull form on the dynamic performance of ships in waves.
LECTURER: *G. Grigoropoulos*, Professor, School of Naval Architecture and Marine Engineering NTUA

8119 SHIP DYNAMIC STABILITY AND SAFETY

CONTENT: Regulatory framework of maritime safety and how it affects ship design. The concepts of floatability and stability. Dynamic stability and its qualitative differentiation from static stability. Historical review. Stability for large angles. Moseley's energy view of dynamic stability and its demonstration for wind or wave excitation. Qualitative mathematical model of ship rolling in harmonic beam waves based on Froude's approach. Non-linear resonance, transient capsize diagram, the effect of permanent inclination. Mitigation by roll damping. Changes of the roll restoring lever in longitudinal waves. Parametric instability of ships and development of mathematical model based on the Mathieu equation. Detailed prediction of instability areas. Pure loss of stability in following seas and the role of ship's speed. Other problems of ship dynamic instability in waves. IMO Guidance for the avoidance of dangerous situations in high waves. Framework of international regulations for the stability of ships in intact condition. The general criteria; the weather criterion; the developing second generation stability criteria. Probabilistic approach to stability assessment and simplified application for regulating the safety of fishing vessels. Historical perspective of "damage stability" accidents. The deterministic versus the probabilistic approach and the implications for ship design. An explanation of the basic principles of Wendel's probabilistic model. Current status of the "damage stability" regulations. Summary.
LECTURER: *K. Spyrou*, Professor, School of Naval Architecture and Marine Engineering NTUA

SECOND SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION I "MARITIME TECHNOLOGY"

8106 DESIGN AND OPERATION OF MARINE DIESEL ENGINES

CONTENT: Construction of marine engines. General aspects of engine design. Slow-speed, Medium-speed engines. Fuel injection system. High power and supercharging. Turbochargers. Compressors. Turbines. Combination of compressor-turbine characteristics. Turbo-

charger construction. Turbocharger systems. Turbocharger-engine coupling. Air cooling systems. Advances in turbocharging. Reduced cooling engines. Upgrading and retrofitting. Energy saving systems. Power turbines. Engine development trends. Engine operation. Heavy fuels. Fuel-caused problems. Fuel system. Lubricants. Characteristics and properties of lubricants. Engine wear. Engine basement. Engine trials, land trials, sea trials. Crankcase explosions. Sweeping chamber flames. Maintenance and monitoring of operation. Monitoring methods. Fault diagnosis. Advanced systems. Emission reduction methods. Marine engine maintenance and repair operations.
LECTURER: *G. Dimopoulos,* Associate Professor, School of Naval Architecture and Marine Engineering NTUA

8108 MARITIME TRANSPORTATION SYSTEMS

CONTENT: Short microeconomic review. Elements of international trade theory. Investment evaluation criteria. Shipping markets; charter and liner. Types of freight rates and contracts/fixtures. Port management and competitiveness. Intermodal transport. Regulatory and institutional issues. Ferry/passenger shipping and cabotage. Short Sea Shipping. Alternative marine fuels. Introduction to lifecycle cost and analysis. Applications in the marine fuels supply chain. Shipping company valuation. Environmental valuation of shipping companies.
LECTURERS: *D. Lyridis*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA, *M. Founti*, Professor Emerita, Dr. *D. Yannopoulos*, Laboratory Teaching Staff, School of Mechanical Engineering NTUA

8004 MEASUREMENTS AND INSTRUMENTS FOR MARINE APPLICATIONS

CONTENT: Introduction in the statistics and the statistical tests. Error tests. Regression analysis & covariance analysis. Collection of experimental data. Transducers for temperature, pressure, delivery, humidity, wind speed, torque, force, sound, vibrations. Statistical tests. Analog and digital data ad converters. Evaluation and analysis of data with focus on stochastic quantities. Spectral analysis. Digital filters. Data acquisition in the marine environment and at the lab. Operational principles of measuring instruments. Training in the laboratory (two lab exercises and optional short project.
LECTURERS: *M. Anagnostakis*, Professor, *P. Rouni*, Lecturer, School of Mechanical Engineering NTUA, *G. Grigoropoulos*, Professor, School of Naval Architecture and Marine Engineering NTUA

THIRD SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION I “MARITIME TECHNOLOGY”

NOT EXISTING

FIRST SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION II “MARINE STRUCTURES AND EXPLOITATION OF HYDROCARBONS”

8202 MATERIALS FOR MARINE STRUCTURES

CONTENT: Marine environment, marine structures and the role of the materials technology. Requirements for the mechanical and physical properties for marine structures materials. Metallic materials (steels, aluminum and titanium alloys, stainless steels, copper alloys). Wear of metallic structures (corrosion, protection). Polymeric composite materials. Failure of polymeric composite materials.
LECTURERS: *N. Tsouvalis*, Professor, *A. Zervaki*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8314 INTRODUCTION TO MARINE RENEWABLE ENERGY SOURCES

CONTENT: PART A - Introduction: Description of the main marine renewable energy (MRE) sources: Offshore wind energy, wave energy, tidal/current energy, salinity and thermal gradient energy, marine biomass energy. Advantages and disadvantages - positive and negative environmental impacts from all considered types of MRE. Emerging MRE sources (offshore solar energy, ocean geothermal energy). PART B - Metocean data and analysis for MRE potential assessment: Sources of available metocean data and description of metocean climate. Data modeling – regression – calibration. Estimation of extreme/design values of metocean parameters. Spatial and temporal variabilities. PART C - MRE potential assessment: Assessment of marine potential energy and temporal variabilities. Power curves / matrices of energy converters. Estimation of annual energy production. Environmental feasibility studies. Particularities of the Mediterranean and Greek seas.
LECTURERS*:* Dr. *T. Soukissian*, Senior Researcher, Hellenic Centre for Marine Research (HCMR), *K. Belibassakis*, Professor, School of Naval Architecture and Marine Engineering NTUA

SECOND SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION II "MARINE STRUCTURES AND EXPLOITATION OF HYDROCARBONS"

8201 ENVIRONMENTAL CONDITIONS AND WAVE LOADS ON MARINE STRUCTURES

CONTENT: Classification of marine structures. Description of environmental conditions (wind, current, sea waves). Analytical theories of waves. Superposition of wave and current. Description of the sea waves stochastic modeling and of statistical properties of irregular waves. Wave spectra. Statistical properties of maxima and extremes. Wave loads on small and large volume marine structures: Potential flow, Morison Equation, Applications to moving and flexible structures, methods for the linearization of the quadratic drag. Linearized and higher-order Diffraction and Radiation problems for the evaluation of the wave loads on large volume marine structures. Analytical, numerical and approximate solutions. Representative results for typical marine structures. Wave loads in irregular seas.
LECTURERS: *S. Mavrakos*, Professor Emeritus, *I. Chatjigeorgiou*, Professor, *D. Konispoliatis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8205 DYNAMIC RESPONSE OF FLOATING STRUCTURES

CONTENT: Responses of systems of one and multi- degrees of freedom due to periodic, percussive, and stochastic loading. Statistical properties of the responses. Discretization. Motion Equations. Determination of the dynamic responses of typical marine structures (piles, Jacket platforms). Dynamic analysis of slender marine structures: risers and mooring lines. Time and frequency domain methods for the solution of the equations of motions. Introduction

to oscillations due to vortices. Vortex phenomena on fixed and moving cylindrical bodies. Responses of flexible structures in vortex flows. Life cycle estimation of marine structures.
LECTURERS: *G. Triantafyllou*, Professor Emeritus, *I. Chatjigeorgiou*, Professor, School of Naval Architecture and Marine Engineering NTUA

8209 STRUCTURAL DESIGN

CONTENT: Introduction to the field of structural design of marine load bearing components and assemblies (rules, prescriptive calculations, numerical methods, reliability analysis methods). Principles and criteria for structural design. Loads acting on ships. Structural design of representative arrangements and units. Design against fatigue. Stochastic design and structural reliability analysis and design. Investigation of specific case studies.
LECTURER: *K. Anyfantis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8213 MECHANICS OF GEOMATERIALS (SOILS AND ROCKS)

CONTENT: Elements of engineering geology for applications in marine projects. Physical soil properties - soil classification - granular & cohesive soils. Physical rock properties. Ground stresses (active & total stresses, pore pressures), Mohr cycle, Geostatic stresses & stresses due to external loading. Mechanical properties of soil (compressibility, strength). Rock failure theories. Soil hydraulics (underground flow, consolidation). Limit Equilibrium Analysis: Rankine Theory, Coulomb Theory. Hydraulic rock fracture. Mechanical behavior of geomaterials under dynamic-cyclic loading. Soil liquefaction due to dynamic-cyclic loading.
LECTURERS: Dr. *E. Kapogianni*, Civil Engineer, Dr. *P. Psarropoulos*, Laboratory Teaching Staff, School of Rural, Surveying and Geoinformatics Engineering NTUA

THIRD SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION II “MARINE STRUCTURES AND EXPLOITATION OF HYDROCARBONS”

NOT EXISTING

FIRST SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION III “MARINE ENVIRONMENT AND RENEWABLE ENERGY RESOURCES”

8301 WAVE PHENOMENA IN THE SEA ENVIRONMENT (WATER WAVES AND OCEAN ACOUSTICS)

CONTENT: Wave phenomena in the sea environment. Overview of basic theorems and equations of Fluid Mechanics. General principles of wave motion. Principle of Heron-Fermat. Ray theory. Reflection, refraction and diffraction in stratified and inhomogeneous media. Representation of wave field in waveguides with non-planar boundaries. Variational principles. Coupled-mode theory. Green’s functions in waveguides with general boundaries. Disturbance field by a localized scatterer in a waveguide. Numerical solutions of waveguide-scattering problems. Wave equations with application to the propagation of surface gravity water-waves and hydroacoustic waves. Boundary conditions. Radiation conditions. Formulation of the

waveguide problem in stratified and inhomogeneous media. Simple solutions obtained by separation of variables (in infinite and semi-infinite strips). Propagating and evanescent modes. Energy theorems. Group velocity. Green's functions in simple waveguides. Technological applications and environmental problems of gravity waves (interaction of water waves with structures and the marine/coastal environment, wave energy systems). Technological applications and environmental problems of underwater acoustics (underwater telecommunications, tomographic applications, marine environment remote sensing, shipping noise).
LECTURER: *K. Belibassakis*, Professor, School of Naval Architecture and Marine Engineering NTUA

8302 MARINE GEOLOGY AND GEOPHYSICS*

CONTENT: Introduction to Marine Geology and Geophysics; Fundamentals of plate tectonics; Morphology of ocean floor; Marine environments; Seabed sediments (lithogenous, biogenous, hydrogenous, cosmogenous); Sedimentary processes, mass movements (e.g., rockfalls, topples, slides, slumps, debris flows, turbidity currents), continental shelf and deep-sea sedimentation, sedimentary forms; Eustatic sea level changes; Basic Principles of Stratigraphy; Lithostratigraphy / seismic stratigraphy (fundamentals, methodology, geophysical instrumentation, interpretation of seismic-reflection profiling data and chronostratigraphic synthesis, acoustic stratigraphy of sedimentary sequences, sedimentary facies and depositional environments, application of seismic stratigraphy principles to hydrocarbon exploration); Submarine geology of Greece (geodynamic evolution, tectonics, volcanism, Quaternary sedimentation processes and neotectonics of the Aegean Sea, vertical tectonic motions, eustatic sea level changes, sedimentary facies, sedimentary forms, sedimentation rates during the Upper Pleistocene and Holocene (129 ka to present)); Representative examples from the Greek territory: North, Central and South Aegean Sea as well as Corinth, Saronic and Thermaic gulfs; Marine geological surveys in Greek areas addressing technical geology issues, particularly, focusing on slope instabilities (scheduled visits to the HCMR facilities and RV Aegaeo for instrumentation and methodology demonstrations).
LECTURERS:
(*) This course will not be offered in the academic year 2023-24. Instead, students are required to attend the second semester course 8309 – "Remote Sensing Methods for Mapping and Monitoring of Marine Environment".

8314 INTRODUCTION TO MARINE RENEWABLE ENERGY SOURCES

CONTENT: PART A - Introduction: Description of the main marine renewable energy (MRE) sources: Offshore wind energy, wave energy, tidal/current energy, salinity and thermal gradient energy, marine biomass energy. Advantages and disadvantages - positive and negative environmental impacts from all considered types of MRE. Emerging MRE sources (offshore solar energy, ocean geothermal energy). PART B - Metocean data and analysis for MRE potential assessment: Sources of available metocean data and description of metocean climate. Data modeling – regression – calibration. Estimation of extreme/design values of metocean parameters. Spatial and temporal variabilities. PART C - MRE potential assessment: Assessment of marine potential energy and temporal variabilities. Power curves / matrices of energy converters. Estimation of annual energy production. Environmental feasibility studies. Particularities of the Mediterranean and Greek seas.
LECTURERS*:* Dr. *T. Soukissian*, Senior Researcher, Hellenic Centre for Marine Research (HCMR), *K. Belibassakis*, Professor, School of Naval Architecture and Marine Engineering NTUA

SECOND SEMESTER REQUIRED COURSES IN SPECIALIZATION DIRECTION III "MARINE ENVIRONMENT AND RENEWABLE ENERGY RESOURCES"

8307 ATMOSPHERE AND OCEAN DYNAMICS

CONTENT: Structure and characteristics of the atmosphere. Basic elements of atmospheric thermodynamics. Solar and terrestrial radiation. Atmospheric boundary layer. The equations of atmospheric dynamics. Cyclones, anticyclones, fronts, tropical cyclones. Surface and isobaric meteorological charts. Mesoscale weather phenomena. Measurements of atmospheric parameters. Numerical models and weather forecasting. Physical properties of seawater. Observational methods and ocean forecasting and the distribution of the physical properties in the ocean. The equations of the ocean dynamics. Ocean circulation (wind-driven and thermohaline ocean circulation). Oceanic waves affected by the earth's rotation.
LECTURERS: *H. Floca*, Professor, *S. Sofianos*, Associate Professor, Department of Physics NKUA, *G. Triantafyllou*, Professor Emeritus, School of Naval Architecture and Marine Engineering NTUA

8308 NONLINEAR WATER WAVES

CONTENT: Nonlinear hydrodynamic flows with free surface effects. Review of laws of hydrodynamics and mathematical formulation of problems concerning propagation of surface-gravity water waves. Variational formulations: Luke's variational principle and Hamilton's principle. Representations of the wave fields. Green's theorem. Modal series expansions of the wave field using local vertical eigenfunctions. Derivation of non-linear models for the propagation of surface gravity waves in finite water depth and in shallow water. Derivation of simplified depth-integrated models (shallow water equations, Boussinesq and mild-slope equations). Non-linear wave-wave and wave-current interaction. Computational models with application to water wave propagation and scattering over non-uniform bathymetry (general bottom topography). Focusing and refraction effects of waves in the variable bathymetry waveguide. Wave and wave-current energy applications. Development of Matlab programs and application to various problems concerning water wave propagation over bathymetry (finite and shallow water depth and variable bathymetry regions).
LECTURER: *K. Belibassakis*, Professor, School of Naval Architecture and Marine Engineering NTUA

8309 REMOTE SENSING METHODS FOR MAPPING AND MONITORING OF MARINE ENVIRONMENT

CONTENT: Earth Observation methods for Remote Sensing. Satellite, airborne and UAV observation systems. Multispectral, Hyperspectral and Microwave Remote Sensing. Digital image analysis methods, pattern recognition and machine learning methods. Semi-automatic and automatic seabed mapping. Object and landform identification from optical, acoustic and digital surface models. Remote Sensing applications through advanced image analysis techniques, databases and Geographic Information Systems (GIS).
LECTURERS: *D. Argialas*, Professor Emeritus, *V. Karathanassi*, Professor, *K. Karantzalos*, Associate Professor, Dr. *P. Kolokoussis*, Laboratory Teaching Staff, School of Rural, Surveying and Geoinformatics Engineering NTUA

THIRD SEMESTER REQUIRED COURSES IN

SPECIALIZATION DIRECTION III “MARINE ENVIRONMENT AND RENEWABLE ENERGY RESOURCES”

8317 BASIC PROGRAMMING PRINCIPLES AND USES IN MATHEMATICS

CONTENT: Basic Programming Principles. Study of matrices, curves, surfaces using MATLAB. The Fourier transform in the discrete domain. The Z-transform. Linear systems (invariant to shifts, stable and unstable), filters (causal). The method of least squares. Adaptive algorithms. Non-causal Wiener filters. Numerical error due to finite precision in filter implementation. Statistical aspects. Computational applications using MATLAB and C/C++.
LECTURER: *K. Papaodyssefs*, Retired Professor, School of Electrical and Computer Engineering NTUA

FIRST SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION I “MARITIME TECHNOLOGY”

8103 HYDRAULIC SYSTEMS ONBOARD SHIPS*

CONTENT: Short description of hydraulic systems onboard ships. Fluid motion in pipes (types of pipes and fittings, hydraulic losses). Introduction to the configuration, functioning of pumps, pump types (hydrodynamic and positive displacement). Pump efficiency, similarity laws, specific speed, operating characteristic curves, cavitation in centrifugal pumps. Combination of pumps with hydraulic network, pumps in series and in parallel, operational stability. Variation in pumping system flow rate. Pumping of liquids of various viscosities and densities. Pumping of liquids onboard and pump configuration (cargo, ballast, feed, fresh water, etc.). Role and sizing of pressure vessel. Introduction and description of transient phenomena (hydraulic shock). High-pressure hydraulic and pneumatic systems with emphasis on positive displacement pumps, valves, transfer and rotary actuators (pistons), operation and control of circuits. Underwater thrust augmentation systems via cryptostable single-phase and two-phase flow.
LECTURERS:
(*) This course will not be offered in the academic year 2023-24.

SECOND SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION I “MARITIME TECHNOLOGY”

8118 COMPUTATIONAL FLUID DYNAMICS

CONTENT: Fundamentals partial differential equations (PDE’S) in fluid dynamics and how they can be discretized. Regarding spatial discretization finite difference and finite volume methods are presented. Focus on convection-diffusion equations using the finite volume approach. Explicit-Implicit schemes for time discretization. Various options are presented for the spatial discretization with focus on the numerical properties of the schemes (error and stability). Solution of system of equations using the previous techniques- basic introduction to the Navier-Stokes equations and turbulence modelling using the RANS approach. The course has compulsory assignments.
LECTURER: *G. Papadakis,* Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8114 LINEAR AND NONLINEAR DYNAMICS-VIBRATIONS OF SHAFT-ROTORS SYSTEMS

CONTENT: 1-Introduction: Classification of rotor systems, historical prospective. 2-Vibrations of Massless Shafts and Rigid Disks: General considerations, rotor unbalance, lateral and inclination vibrations of an elastic shaft-disk system (Jeffcott rotor), vibrations of a 4DOF rotor system, vibrations of rigid rotors, balancing of rigid rotors, critical speeds of a shaft with multiple disks. 3-Vibrations of a Continuous Rotor: General considerations, equation of motion, free vibration and critical speeds, major critical speeds, forced vibration, balancing of a flexible rotor. 4-Vibrations of an asymmetrical shaft and an asymmetrical rotor: Equations of motions, analytic computations of free and forced vibrations, critical speeds. 5-Nonlinear vibrations: General considerations, causes of nonlinear spring nonlinearities, types of nonlinear resonances (subharmonic, combination), system with radial clearance, nonlinear resonances of a continuous rotor, internal resonance phenomenon, chaotic vibrations in critical speeds, vibrations of a cracked rotor. 6-Self-Excited vibrations due to internal damping: General considerations, friction in rotor systems, self-excited vibrations due to hysteric damping and structural damping. 7-Nonstationary vibrations during passage through critical speeds: General considerations, transition with constant acceleration and limited driving torque, stability analysis, nonstationary vibration. 8-Vibrations Due to Mechanical Elements: General considerations, ball bearings, bearing pedestals with directional difference in stiffens, universal joint, self-exited vibrations due to contact. 9-Flow-induced vibrations: General considerations, oil whip and oil whirl, seals, tip-clearance excitations, hollow rotor partial filled with liquid (self-excited whirling motion, resonance curves at major critical speed). 10-Finite element method: General considerations, discretization of a rotor system, free vibrations: eigen-value problem, forced vibrations. 11-Transfer matrix method: General considerations, fundamental procedure of the transfer matrix method, free vibrations of a rotor, forced vibrations of a rotor. 12-Measurement and Signal Processing: General considerations, Fourier transform, Fast Fourier Transform, applications of FFT to rotor vibrations.
LECTURER: *I. Georgiou*, Professor, School of Naval Architecture and Marine Engineering NTUA

8313 NON-MARKOVIAN STOCHASTIC FUNCTIONS. STOCHASTIC DYNAMICS

CONTENT: Part A: Probability theory background. Theory and experiment. Definition of scientific experiment. Deterministic and random experiments. The probability space as a mathematical model of the random experiment. Set-theoretical background and measure-theoretic approach to probability (extension from semi-algebras to σ-algebras by means of the Carathéodory theorem and the Hopf lemma). Non-measurable sets. Measurable covering of (non-measurable) sets. Transfer of probability to a non-measurable set of outer measure 1. Part B: Non-Markovian stochastic functions. Inadequacy of the Markovian approach. Examples from physics and technology (turbulence, seismic motion, wind-generated sea waves, loads on structures from wind, earthquake, waves, statistical biophysics, statistical mechanics of out-of-equilibrium systems). Hierarchy of probability distributions of various orders. Moment-generating functions. Methods for constructing probability measures in function spaces. Kolmogorov's theorem and arising problems. The characteristic functional. Construction of probability measures via the characteristic functional. Sazonov and Minlos theorems. Indistinguishable stochastic functions, modifications and versions of stochastic functions. Stochastic convergence (L^2, in probability, with probability 1). Elements of Stochastic Calculus. Analytic properties of stochastic functions (continuity, integrability, differentiability). Part C: Stochastic differential equations – Stochastic dynamics. Examples of stochastic differential

equations from physics and technology (oscillations of structures under the influence of stochastic excitations by wind, waves or earthquake. Long-distance propagation of sound waves at sea, long-distance propagation of electromagnetic waves in the atmosphere). Random excitations (additive excitation) or/and random coefficients (multiplicative excitation) with continuous autocovariance of general form (not white noise). Non-Markovian responses. The meaning of the solution of a stochastic differential equation in this case. Liouville's equation and its stochastic analog. The LMN hierarchy of dynamic equations for response-related probability distribution functions of various orders. The Novikov-Furutsu theorem and its use for deriving (closed, approximate) dynamic equations for the evolution of the first-order probability distribution function (generalized Fokker-Planck-Kolmogorov equations). Applications to specific dynamical systems (oscillators).
LECTURER: *G. Athanassoulis*, Professor Emeritus, School of Naval Architecture and Marine Engineering NTUA

THIRD SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION I "MARITIME TECHNOLOGY"

8105 HYDRODYNAMICS AND AERODYNAMICS OF SAILING YACHTS

CONTENT: Basic principles of operation of sailing vessels. Flow dynamics around the hull and the appendages of sailing yachts. Viscous flows around sailing yachts. Experimental evaluation of the performance of sailing yachts. Systematic series of sailing yachts and semi-empirical methods to estimate their behavior.
LECTURERS: *G. Grigoropoulos*, Professor, *E. Angelou*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8120 MANAGEMENT OF SAFETY AND ENVIRONMENTAL HAZARDS FOR OFFSHORE OIL AND GAS INDUSTRY (PLATFORMS AND DRILLING SHIPS)

CONTENT: Introduction to safety analysis – presentation of methodologies for the study and investigation of accidents in the offshore oil and gas industry: discussion on HAZID methodologies, such as HAZOP or FMEA; and causal related methodologies such as the Bow-Tie analysis. Study of the role and contribution of the human element (along with installed technologies) to the escalation of problems and accidents. Study of the impacts from accidents on offshore platforms and drilling ships: the main focus is on oil pollution, its confrontation and the overall planning of such operations. Explanation of what is a Safety Case and how this is employed in the offshore oil and gas industry; discussion of regulatory issues (national and regional). Development and examination of a project dealing with safety driven and/or environmental impact driven topics (after an accident) for the sector of interest.
LECTURER: *N. Ventikos*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA

8122 INTRODUCTION TO SHIP PERFORMANCE ASSESSMENT

CONTENT: Basic principles of performance assessment: frameworks, methods, tools, and applications. Performance evaluation criteria and metrics. Introduction to basic statistics for exploratory data analysis. Ship operational performance: hull and propeller performance monitoring based on ISO 19030. Main data collection methods and presentation of key sensors. Basic steps of data pre-processing (outliers detection methods, filtering, smoothing). Definition of reference performance and calculations of KPIs. Uncertainty and confidence intervals

in KPI evaluation. Ship performance assessment in the framework of IMO's energy efficiency framework. Analysis of the Energy Efficiency Design Index (EEDI). Presentation of innovative technologies to reduce EEDI. IMO's minimum propulsion power calculation to maintain maneuverability in adverse conditions (reference to added wind and wave resistances). Presentation of operations indicators (EEOI and CII) and examples of operational measures to increase energy efficiency. An introduction to statistical regression using multiple linear regression examples. Two student projects are planned during the semester.
LECTURER: *N. Themelis,* Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8116 MODELING AND SIMULATION OF FLOW AND COMBUSTION PROCESSES IN INTERNAL COMBUSTION ENGINES*

CONTENT: Introduction. Thermodynamic models: mass and energy balances, single-zone models, scavenging models, two-zone models, applications. Phenomenological models: classification, burning rate functions, turbulent mixing models, heat transfer models, combustion models. Computational Fluid Dynamics (CFD) models: conservation equations, numerical methods, turbulence models, modeling of hydrodynamic and thermal boundary layers. Spray models: spray phenomenology, equation of Williams, droplet kinematics, spray primary and secondary breakup models, collision models, evaporation models. Multidimensional combustion models: fundamentals of Chemical Thermodynamics and Chemical Kinetics, ignition modeling, premixed flame modeling, diffusion flame modeling. Pollutant formation models: formation of nitrogen oxides, formation of soot. Applications in Diesel engines.
LECTURER: *L. Kaiktsis*, Professor, School of Naval Architecture and Marine Engineering NTUA
(*) This course will not be offered in the academic year 2023-24.

8315 OPTIMIZATION PROBLEMS AND VARIATIONAL PRINCIPLES IN MATHEMATICAL PHYSICS

CONTENT: Part A: Background - Functional Derivatives. Metric spaces (convergence, continuity, completeness), Banach spaces, Hilbert spaces, function spaces. Linear and nonlinear functionals. Examples of important functionals from physics and technology. Linear, multilinear and polynomial maps. Derivatives of functionals and operators (Gateaux, Frechet, Hadamard, Volterra). Differential calculus of Volterra and Frechet functionals and operators (Mean value theorems, derivation of operators, higher order derivatives, Volterra-Taylor and Frechet-Taylor theorems). Part B: Optimization problems and variational mechanics. Examples of optimization problems from geometry, physics and technology. Necessary conditions for extrema (optimization), Euler's equations. Variational equations. Relationship of variational equations with equations of other forms (differential, integral, integro-differential). Sufficient conditions for extrema. Variational equations in mechanics and modern mathematical physics. Mechanical systems with constraints. Holonomic and non-holonomic constraints. Generalized coordinates and generalized velocities. Lagrange equations of the first and second kind. Potential functions. Generalized momenta and Hamilton's equations. First and second formulation of Hamilton's principle. Applications. Part C: Variational principles and modeling of the continuum. Variational principles in continuum mechanics. Elastodynamic equations and Hamilton's principle. Derivation of theories for beams and plates from Hamilton's principle. Irrotational flow and Hamilton's principle. Variational principles for nonlinear free-surface waves. Luke's variational principle. Systematic derivation of simplified wave theories from variational principles. Hamilton's principle and vorticity. Variational principles in electrodynamics. Applications to coupled fields. Hydro-piezoelectric power generation systems.

LECTURER: *G. Athanassoulis*, Professor Emeritus, School of Naval Architecture and Marine Engineering NTUA

8316 SYSTEM DYNAMICS, STABILITY AND CONTROL

CONTENT: Part A: The system as a concept. Linear and non-linear systems. Time-domain analysis, Impulse response, general response of linear systems. Extension of the above to (weakly) non-linear systems (of 2nd order, 3rd order, etc.). General form of response, Volterra series. Frequency-domain analysis. Transfer function of linear systems. Extension of the above to (weakly) non-linear systems (of 2nd, 3rd order, etc.). Transfer functions of higher order. Part B: Stability of steady-state responses and stability diagrams. Vector field and flow in phase space. The concept of bifurcation and its basic forms in low-dimensional systems. Hysteresis phenomena. Applications. Stability of periodic responses. Limit cycles. Approximate solutions to weakly nonlinear systems near resonance. Oscillation mechanisms. The Poincaré-Bendixson theorem. Conditions for exhibiting oscillatory behavior. Stability analysis based on the Poincaré map. Floquet theory. Part C: Mathematical modelling for control applications: Transfer functions & Bode diagrams. State-space representation. Environmental disturbances. Examples on a ship/oil platform. Sensors, actuators, data acquisition, control hardware, signal processing with filters, implementation. Introduction to closed loop control (e.g., PID), single/multi-input/multi-output SISO/MIMO systems, optimal LQG/LQR control. Examples on ship/oil platform. Uncertainty concepts. H-infinity robust control. Selected applications with simulation in MATLAB / Simulink or other programming language (e.g., C, Python). Dynamic stability analysis in connection with the criteria for MODUs. Dynamic positioning of ship/oil platform.
LECTURERS: *G. Athanassoulis*, Professor Emeritus, *K. Spyrou*, Professor, *G. Papalambrou*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA
(*) This course will not be offered in the academic year 2023-24.

FIRST SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION II “MARINE STRUCTURES AND EXPLOITATION OF HYDROCARBONS”

8203 HYDRO-MECHANICAL ANALYSIS AND DESIGN OF MOORING STRUCTURES

CONTENT: Equations of motions of moored structures. Static analysis and design of mooring systems of single and multiple legs. Restoring forces of several types of mooring systems. Non – linearities. Duffin and Mathieu Equations. Evaluation of mean, slowly- and high-varying second – order wave loadings. Approximate and exact theories. Sources of damping (mooring line damping, second – order wave drift damping, drag, bottom – line interaction, etc.). Solution methods for solving the motions equations of a moored floating structure in the frequency and the time domain.
LECTURERS: *S. Mavrakos*, Professor Emeritus, *I. Chatjigeorgiou*, Professor, *D. Konispoliatis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

SECOND SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION II “MARINE STRUCTURES AND EXPLOITATION OF HYDROCARBONS”

8214 ULTIMATE LIMIT STATE ANALYSIS OF MARINE STRUCTURES

CONTENT: Plastic Limit theorems; application on beams and plates. Determination of ultimate loads of structural components. Ultimate Limit State of ship's hull in intact and damaged condition (residual strength). Design requirements. Numerical methods for the calculation of ultimate strength.
LECTURER: *E. Samuelides*, Professor, School of Naval Architecture and Marine Engineering NTUA

8207 SEMINARS ON TOPICS OF MARINE AND UNDERWATER TECHNOLOGY

CONTENT: Part A: Geological oceanography research for the installation of submarine cables, pipelines and structures; Methodologies; Geophysical/seismic prospection techniques; Natural (geological) and anthropogenic hazards; Particularities of the submarine Greek territory; Instability of the surface seafloor sediments; Gas hydrates and seabed stability; Causes of coastal erosion and the subsequent impacts on coastal infrastructure; Guidelines and best practices commonly implemented for the safe and secure installation of submarine cables and pipelines, offshore wind farms and artificial reefs, as well as for the mitigation of shoreline erosion; Representative examples: submarine geological-geomorphological investigations in the Aegean Sea and Eastern Mediterranean (scheduled visits to the HCMR's sedimentology and geotechnics laboratory, and RV Aegaeo for instrumentation and methodology demonstrations). Part B: Ocean remote sensing and operational oceanography. Data sources, ocean, wave and atmospheric models, forecasting, hindcasting, real time measurements, telecommunication systems. Applications of Operational Oceanography. Part C: Computer supported applications for the evaluation of the loads and the motions of floating marine structures. Part D: The Anthropogenic Underwater Noise (AUN) as a pollution factor in the marine environment. Adverse effects of AUN on the marine animals. Sources, related anthropogenic activities and categories of AUN. AUN measurements, relevant technology and specifications. The EU Marine Strategy Framework Directive and the AUN. Modelling continuous AUN with emphasis on the shipping/vessel's noise. AUN in Europe and especially in Greece: Important marine areas, AUN sources and available data.
LECTURERS: *S. Mavrakos*, Professor Emeritus, *D. Konispoliatis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA, Dr. *T. Soukissian*, Senior Researcher, Dr. *A. Prospathopoulos*, Assistant Researcher, Institute of Oceanography, Hellenic Centre for Marine Research (HCMR)

8216 RELIABILITY AND RISK ANALYSIS FOR OFFSHORE STRUCTURES

CONTENT: Reliability of offshore structures: Principles of probabilistic approach, failure probability and risk assessment under environmental loads, relationship of the safety factor and the probability of failure, reliability-based design of structures, decision analysis. Applications to offshore structures, including wind turbines and jacket platforms.
LECTURER: *D. Vamvatsikos*, Associate Professor, School of Civil Engineering NTUA

8212 STRUCTURAL MECHANICS AND DESIGN OF OFFSHORE PIPELINES

CONTENT: Introduction to offshore pipelines (history, important projects, materials for line pipes, line pipe manufacturing methods). Ultimate capacity of offshore pipelines (introduction to international standards, design of internal and external pressure, design against longitudinal action, bending and axial loading, combined loading, transverse loads, impact loads and denting, thermal and lateral buckling). Installation of offshore pipelines (S-lay, J-lay, reeling, towing). Structural Integrity of Offshore Pipelines (inspection, types of damage: corrosion, dents,

buckles, gauges, weld defects). Special issues (analysis of special components: elbows and Tee-branches, free spans: vibrations, fatigue and hooking, on-bottom stability, seismic analysis and design).
LECTURERS: *S. Karamanos*, Professor, Department of Mechanical Engineering of the University of Thessaly, *I. Chatjigeorgiou*, Professor, *A. Zervaki*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8118 COMPUTATIONAL FLUID DYNAMICS

CONTENT: Fundamentals partial differential equations (PDE'S) in fluid dynamics and how they can be discretized. Regarding spatial discretization finite difference and finite volume methods are presented. Focus on convection-diffusion equations using the finite volume approach. Explicit-Implicit schemes for time discretization. Various options are presented for the spatial discretization with focus on the numerical properties of the schemes (error and stability). Solution of system of equations using the previous techniques- basic introduction to the Navier-Stokes equations and turbulence modelling using the RANS approach. The course has compulsory assignments.
LECTURER: *G. Papadakis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8313 NON-MARKOVIAN STOCHASTIC FUNCTIONS. STOCHASTIC DYNAMICS

CONTENT: Part A: Probability theory background. Theory and experiment. Definition of scientific experiment. Deterministic and random experiments. The probability space as a mathematical model of the random experiment. Set-theoretical background and measure-theoretic approach to probability (extension from semi-algebras to σ-algebras by means of the Carathéodory theorem and the Hopf lemma). Non-measurable sets. Measurable covering of (non-measurable) sets. Transfer of probability to a non-measurable set of outer measure 1. Part B: Non-Markovian stochastic functions. Inadequacy of the Markovian approach. Examples from physics and technology (turbulence, seismic motion, wind-generated sea waves, loads on structures from wind, earthquake, waves, statistical biophysics, statistical mechanics of out-of-equilibrium systems). Hierarchy of probability distributions of various orders. Moment-generating functions. Methods for constructing probability measures in function spaces. Kolmogorov's theorem and arising problems. The characteristic functional. Construction of probability measures via the characteristic functional. Sazonov and Minlos theorems. Indistinguishable stochastic functions, modifications and versions of stochastic functions. Stochastic convergence (L^2, in probability, with probability 1). Elements of Stochastic Calculus. Analytic properties of stochastic functions (continuity, integrability, differentiability). Part C: Stochastic differential equations – Stochastic dynamics. Examples of stochastic differential equations from physics and technology (oscillations of structures under the influence of stochastic excitations by wind, waves or earthquake. Long-distance propagation of sound waves at sea, long-distance propagation of electromagnetic waves in the atmosphere). Random excitations (additive excitation) or/and random coefficients (multiplicative excitation) with continuous autocovariance of general form (not white noise). Non-Markovian responses. The meaning of the solution of a stochastic differential equation in this case. Liouville's equation and its stochastic analog. The LMN hierarchy of dynamic equations for response-related probability distribution functions of various orders. The Novikov-Furutsu theorem and its use for deriving (closed, approximate) dynamic equations for the evolution of the first-order probability distribution function (generalized Fokker-Planck-Kolmogorov equations). Applications to specific dynamical systems (oscillators).

LECTURER: *G. Athanassoulis*, Professor Emeritus, School of Naval Architecture and Marine Engineering NTUA

THIRD SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION II “MARINE STRUCTURES AND EXPLOITATION OF HYDROCARBONS”

8120 MANAGEMENT OF SAFETY AND ENVIRONMENTAL HAZARDS FOR OFFSHORE OIL AND GAS INDUSTRY (PLATFORMS AND DRILLING SHIPS)

CONTENT: Introduction to safety analysis – presentation of methodologies for the study and investigation of accidents in the offshore oil and gas industry: discussion on HAZID methodologies, such as HAZOP or FMEA; and causal related methodologies such as the Bow-Tie analysis. Study of the role and contribution of the human element (along with installed technologies) to the escalation of problems and accidents. Study of the impacts from accidents on offshore platforms and drilling ships: the main focus is on oil pollution, its confrontation and the overall planning of such operations. Explanation of what is a Safety Case and how this is employed in the offshore oil and gas industry; discussion of regulatory issues (national and regional). Development and examination of a project dealing with safety driven and/or environmental impact driven topics (after an accident) for the sector of interest.
LECTURER: *N. Ventikos*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA

8122 INTRODUCTION TO SHIP PERFORMANCE ASSESSMENT

CONTENT: Basic principles of performance assessment: frameworks, methods, tools, and applications. Performance evaluation criteria and metrics. Introduction to basic statistics for exploratory data analysis. Ship operational performance: hull and propeller performance monitoring based on ISO 19030. Main data collection methods and presentation of key sensors. Basic steps of data pre-processing (outliers detection methods, filtering, smoothing). Definition of reference performance and calculations of KPIs. Uncertainty and confidence intervals in KPI evaluation. Ship performance assessment in the framework of IMO’s energy efficiency framework. Analysis of the Energy Efficiency Design Index (EEDI). Presentation of innovative technologies to reduce EEDI. IMO’s minimum propulsion power calculation to maintain maneuverability in adverse conditions (reference to added wind and wave resistances). Presentation of operations indicators (EEOI and CII) and examples of operational measures to increase energy efficiency. An introduction to statistical regression using multiple linear regression examples. Two student projects are planned during the semester.
LECTURER: *N. Themelis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8215 BASIC PRINCIPLES FOR THE DESIGN OF FOUNDATION OF MARINE STRUCTURES

CONTENT: Stability of seabed and submarine slopes: Failure mechanisms. Theories of safety factor determination. Foundation systems of marine structures. Bearing Capacity of surface foundations. Sediments of surface foundations. Axial loading of deep foundations (piles & caissons). Horizontal loading of deep foundations (piles & caissons). Numerical analysis of deep foundations (piles & caissons) with the p-y and t-z methods (distributed Winkler’s springs). Characteristics of dynamic charges from seismic waves. Seismic stress of steel pipes

under pressure. Dynamic behavior of surface foundations. Dynamic behavior of deep foundations (e.g., piles & caissons). Dynamic soil-foundation-structure interaction. Characteristics and design of floating breakwaters. Anchors. Dynamic behavior. Slope stability: Safety factor determination, influence of pore water pressures, influence of water level change. Wave loading, earthquake loading. Breakwaters: Formulation, stability analysis. Quay walls: Open-type quay walls - calculation of pile loading. Closed-type quay walls - stability analysis.
LECTURERS: Dr. *E. Kapogianni,* Civil Engineer, Dr. *P. Psarropoulos,* Laboratory Teaching Staff, School of Rural, Surveying and Geoinformatics Engineering NTUA

8211 OCEAN ENERGY CONVERTERS

CONTENT: Overview of wave hydrodynamics, wave spectra and wave energy. Basic design/ operation principles and performance evaluation of wave energy converters. Power absorption mechanisms. Heaving devices. Oscillating water column devices. Tidal energy converters. Electricity production by alternative energy sources. Electric grid connectivity. Power storage applications.
LECTURERS: *S. Mavrakos*, Professor Emeritus, *I. Prousalidis*, Professor, School of Naval Architecture and Marine Engineering NTUA

8217 STEEL STRUCTURES FOR MARINE APPLICATIONS

CONTENT: Formation of static systems of marine structures for steel applications (jetties, trestles, dolphins, offshore platforms, offshore wind turbines), selection of suitable cross-sections, connection detailing, link of design with method of construction. Modelling of marine steel structures (selection of software, finite elements type and mesh, connection modelling). Methods of analysis of marine steel structures (static & dynamic analyses, linear & non-linear analyses, evaluation of results). Dimensioning (Checks according to the limit states philosophy, design requirements – failure criteria, member design – buckling lengths, joint design, fatigue). Structural drawings of steel structures (General layout, shop, assembly and erection drawings).
LECTURERS: *Ch. Gantes*, Professor, *P. Thanopoulos*, Assistant Professor, School of Civil Engineering NTUA

8315 OPTIMIZATION PROBLEMS AND VARIATIONAL PRINCIPLES IN MATHEMATICAL PHYSICS

CONTENT: Part A: Background - Functional Derivatives. Metric spaces (convergence, continuity, completeness), Banach spaces, Hilbert spaces, function spaces. Linear and nonlinear functionals. Examples of important functionals from physics and technology. Linear, multilinear and polynomial maps. Derivatives of functionals and operators (Gateaux, Frechet, Hadamard, Volterra). Differential calculus of Volterra and Frechet functionals and operators (Mean value theorems, derivation of operators, higher order derivatives, Volterra-Taylor and Frechet-Taylor theorems). Part B: Optimization problems and variational mechanics. Examples of optimization problems from geometry, physics and technology. Necessary conditions for extrema (optimization), Euler's equations. Variational equations. Relationship of variational equations with equations of other forms (differential, integral, integro-differential). Sufficient conditions for extrema. Variational equations in mechanics and modern mathematical physics. Mechanical systems with constraints. Holonomic and non-holonomic constraints. Generalized coordinates and generalized velocities. Lagrange equations of the first and second kind. Potential functions. Generalized momenta and Hamilton's equations. First and second formulation of Hamilton's principle. Applications. Part C: Variational principles and model-

ing of the continuum. Variational principles in continuum mechanics. Elastodynamic equations and Hamilton's principle. Derivation of theories for beams and plates from Hamilton's principle. Irrotational flow and Hamilton's principle. Variational principles for nonlinear free-surface waves. Luke's variational principle. Systematic derivation of simplified wave theories from variational principles. Hamilton's principle and vorticity. Variational principles in electrodynamics. Applications to coupled fields. Hydro-piezoelectric power generation systems.
LECTURER: *G. Athanassoulis*, Professor Emeritus, School of Naval Architecture and Marine Engineering NTUA

8316 SYSTEM DYNAMICS, STABILITY AND CONTROL

CONTENT: Part A: The system as a concept. Linear and non-linear systems. Time-domain analysis, Impulse response, general response of linear systems. Extension of the above to (weakly) non-linear systems (of 2nd order, 3rd order, etc.). General form of response, Volterra series. Frequency-domain analysis. Transfer function of linear systems. Extension of the above to (weakly) non-linear systems (of 2nd, 3rd order, etc.). Transfer functions of higher order. Part B: Stability of steady-state responses and stability diagrams. Vector field and flow in phase space. The concept of bifurcation and its basic forms in low-dimensional systems. Hysteresis phenomena. Applications. Stability of periodic responses. Limit cycles. Approximate solutions to weakly nonlinear systems near resonance. Oscillation mechanisms. The Poincaré-Bendixson theorem. Conditions for exhibiting oscillatory behavior. Stability analysis based on the Poincaré map. Floquet theory. Part C: Mathematical modelling for control applications: Transfer functions & Bode diagrams. State-space representation. Environmental disturbances. Examples on a ship/oil platform. Sensors, actuators, data acquisition, control hardware, signal processing with filters, implementation. Introduction to closed loop control (e.g., PID), single/multi-input/multi-output SISO/MIMO systems, optimal LQG/LQR control. Examples on ship/oil platform. Uncertainty concepts. H-infinity robust control. Selected applications with simulation in MATLAB / Simulink or other programming language (e.g., C, Python). Dynamic stability analysis in connection with the criteria for MODUs. Dynamic positioning of ship/oil platform.
LECTURERS: *G. Athanassoulis*, Professor Emeritus, *K. Spyrou*, Professor, *G. Papalambrou*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA
(*) This course will not be offered in the academic year 2023-24.

8317 BASIC PROGRAMMING PRINCIPLES AND USES IN MATHEMATICS

CONTENT: Basic Programming Principles. Study of matrices, curves, surfaces using MATLAB. The Fourier transform in the discrete domain. The Z-transform. Linear systems (invariant to shifts, stable and unstable), filters (causal). The method of least squares. Adaptive algorithms. Non-causal Wiener filters. Numerical error due to finite precision in filter implementation. Statistical aspects. Computational applications using MATLAB and C/C++.
LECTURER: *K. Papaodyssefs*, Retired Professor, School of Electrical and Computer Engineering NTUA

FIRST SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION III "MARINE ENVIRONMENT AND RENEWABLE ENERGY RESOURCES"

NOT EXISTING

SECOND SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION III "MARINE ENVIRONMENT AND RENEWABLE ENERGY RESOURCES"

8207 SEMINARS ON TOPICS OF MARINE AND UNDERWATER TECHNOLOGY

CONTENT: Part A: Geological oceanography research for the installation of submarine cables, pipelines and structures; Methodologies; Geophysical/seismic prospection techniques; Natural (geological) and anthropogenic hazards; Particularities of the submarine Greek territory; Instability of the surface seafloor sediments; Gas hydrates and seabed stability; Causes of coastal erosion and the subsequent impacts on coastal infrastructure; Guidelines and best practices commonly implemented for the safe and secure installation of submarine cables and pipelines, offshore wind farms and artificial reefs, as well as for the mitigation of shoreline erosion; Representative examples: submarine geological-geomorphological investigations in the Aegean Sea and Eastern Mediterranean (scheduled visits to the HCMR's sedimentology and geotechnics laboratory, and RV Aegaeo for instrumentation and methodology demonstrations). Part B: Ocean remote sensing and operational oceanography. Data sources, ocean, wave and atmospheric models, forecasting, hindcasting, real time measurements, telecommunication systems. Applications of Operational Oceanography. Part C: Computer supported applications for the evaluation of the loads and the motions of floating marine structures. Part D: The Anthropogenic Underwater Noise (AUN) as a pollution factor in the marine environment. Adverse effects of AUN on the marine animals. Sources, related anthropogenic activities and categories of AUN. AUN measurements, relevant technology and specifications. The EU Marine Strategy Framework Directive and the AUN. Modelling continuous AUN with emphasis on the shipping/vessel's noise. AUN in Europe and especially in Greece: Important marine areas, AUN sources and available data.
LECTURERS: *S. Mavrakos*, Professor Emeritus, *D. Konispoliatis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA, Dr. *T. Soukissian*, Senior Researcher, Dr. *A. Prospathopoulos*, Assistant Researcher, Institute of Oceanography, Hellenic Centre for Marine Research (HCMR)

8118 COMPUTATIONAL FLUID DYNAMICS

CONTENT: Fundamentals partial differential equations (PDE'S) in fluid dynamics and how they can be discretized. Regarding spatial discretization finite difference and finite volume methods are presented. Focus on convection-diffusion equations using the finite volume approach. Explicit-Implicit schemes for time discretization. Various options are presented for the spatial discretization with focus on the numerical properties of the schemes (error and stability). Solution of system of equations using the previous techniques- basic introduction to the Navier-Stokes equations and turbulence modelling using the RANS approach. The course has compulsory assignments.
LECTURER: *G. Papadakis*, Assistant Professor, School of Naval Architecture and Marine Engineering NTUA

8313 NON-MARKOVIAN STOCHASTIC FUNCTIONS. STOCHASTIC DYNAMICS

CONTENT: Part A: Probability theory background. Theory and experiment. Definition of scientific experiment. Deterministic and random experiments. The probability space as a

mathematical model of the random experiment. Set-theoretical background and measure-theoretic approach to probability (extension from semi-algebras to σ-algebras by means of the Carathéodory theorem and the Hopf lemma). Non-measurable sets. Measurable covering of (non-measurable) sets. Transfer of probability to a non-measurable set of outer measure 1. Part B: Non-Markovian stochastic functions. Inadequacy of the Markovian approach. Examples from physics and technology (turbulence, seismic motion, wind-generated sea waves, loads on structures from wind, earthquake, waves, statistical biophysics, statistical mechanics of out-of-equilibrium systems). Hierarchy of probability distributions of various orders. Moment-generating functions. Methods for constructing probability measures in function spaces. Kolmogorov's theorem and arising problems. The characteristic functional. Construction of probability measures via the characteristic functional. Sazonov and Minlos theorems. Indistinguishable stochastic functions, modifications and versions of stochastic functions. Stochastic convergence (L^2, in probability, with probability 1). Elements of Stochastic Calculus. Analytic properties of stochastic functions (continuity, integrability, differentiability). Part C: Stochastic differential equations – Stochastic dynamics. Examples of stochastic differential equations from physics and technology (oscillations of structures under the influence of stochastic excitations by wind, waves or earthquake. Long-distance propagation of sound waves at sea, long-distance propagation of electromagnetic waves in the atmosphere). Random excitations (additive excitation) or/and random coefficients (multiplicative excitation) with continuous autocovariance of general form (not white noise). Non-Markovian responses. The meaning of the solution of a stochastic differential equation in this case. Liouville's equation and its stochastic analog. The LMN hierarchy of dynamic equations for response-related probability distribution functions of various orders. The Novikov-Furutsu theorem and its use for deriving (closed, approximate) dynamic equations for the evolution of the first-order probability distribution function (generalized Fokker-Planck-Kolmogorov equations). Applications to specific dynamical systems (oscillators).
LECTURER: *G. Athanassoulis*, Professor Emeritus, School of Naval Architecture and Marine Engineering NTUA

THIRD SEMESTER ELECTIVE COURSES IN SPECIALIZATION DIRECTION III "MARINE ENVIRONMENT AND RENEWABLE ENERGY RESOURCES"

8211 OCEAN ENERGY CONVERTERS

CONTENT: Overview of wave hydrodynamics, wave spectra and wave energy. Basic design/operation principles and performance evaluation of wave energy converters. Power absorption mechanisms. Heaving devices. Oscillating water column devices. Tidal energy converters. Electricity production by alternative energy sources. Electric grid connectivity. Power storage applications.
LECTURERS: *S. Mavrakos*, Professor Emeritus, *I. Prousalidis*, Professor, School of Naval Architecture and Marine Engineering NTUA

8315 OPTIMIZATION PROBLEMS AND VARIATIONAL PRINCIPLES IN MATHEMATICAL PHYSICS

CONTENT: Part A: Background - Functional Derivatives. Metric spaces (convergence, continuity, completeness), Banach spaces, Hilbert spaces, function spaces. Linear and nonlinear functionals. Examples of important functionals from physics and technology. Linear, multilinear and polynomial maps. Derivatives of functionals and operators (Gateaux, Frechet,

Hadamard, Volterra). Differential calculus of Volterra and Frechet functionals and operators (Mean value theorems, derivation of operators, higher order derivatives, Volterra-Taylor and Frechet-Taylor theorems). Part B: Optimization problems and variational mechanics. Examples of optimization problems from geometry, physics and technology. Necessary conditions for extrema (optimization), Euler's equations. Variational equations. Relationship of variational equations with equations of other forms (differential, integral, integro-differential). Sufficient conditions for extrema. Variational equations in mechanics and modern mathematical physics. Mechanical systems with constraints. Holonomic and non-holonomic constraints. Generalized coordinates and generalized velocities. Lagrange equations of the first and second kind. Potential functions. Generalized momenta and Hamilton's equations. First and second formulation of Hamilton's principle. Applications. Part C: Variational principles and modeling of the continuum. Variational principles in continuum mechanics. Elastodynamic equations and Hamilton's principle. Derivation of theories for beams and plates from Hamilton's principle. Irrotational flow and Hamilton's principle. Variational principles for nonlinear free-surface waves. Luke's variational principle. Systematic derivation of simplified wave theories from variational principles. Hamilton's principle and vorticity. Variational principles in electrodynamics. Applications to coupled fields. Hydro-piezoelectric power generation systems.
LECTURER: *G. Athanassoulis*, Professor Emeritus, School of Naval Architecture and Marine Engineering NTUA

8316 SYSTEM DYNAMICS, STABILITY AND CONTROL

CONTENT: Part A: The system as a concept. Linear and non-linear systems. Time-domain analysis, Impulse response, general response of linear systems. Extension of the above to (weakly) non-linear systems (of 2nd order, 3rd order, etc.). General form of response, Volterra series. Frequency-domain analysis. Transfer function of linear systems. Extension of the above to (weakly) non-linear systems (of 2nd, 3rd order, etc.). Transfer functions of higher order. Part B: Stability of steady-state responses and stability diagrams. Vector field and flow in phase space. The concept of bifurcation and its basic forms in low-dimensional systems. Hysteresis phenomena. Applications. Stability of periodic responses. Limit cycles. Approximate solutions to weakly nonlinear systems near resonance. Oscillation mechanisms. The Poincaré-Bendixson theorem. Conditions for exhibiting oscillatory behavior. Stability analysis based on the Poincaré map. Floquet theory. Part C: Mathematical modelling for control applications: Transfer functions & Bode diagrams. State-space representation. Environmental disturbances. Examples on a ship/oil platform. Sensors, actuators, data acquisition, control hardware, signal processing with filters, implementation. Introduction to closed loop control (e.g., PID), single/multi-input/multi-output SISO/MIMO systems, optimal LQG/LQR control. Examples on ship/oil platform. Uncertainty concepts. H-infinity robust control. Selected applications with simulation in MATLAB / Simulink or other programming language (e.g., C, Python). Dynamic stability analysis in connection with the criteria for MODUs. Dynamic positioning of ship/oil platform.
LECTURERS: *G. Athanassoulis*, Professor Emeritus, *K. Spyrou*, Professor, *G. Papalambrou*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA
(*) This course will not be offered in the academic year 2023-24.

8311 GIS AND SPATIAL DATABASES FOR THE MARINE ENVIRONMENT

CONTENT: Introduction to GIS, The nature of Spatial data, Spatial data models (Raster and Vector), Spatial data structures, Data input and editing, Manual and automatic digitization, Vector to Raster and Raster to Vector conversion, Coordinate Systems and Map Projections, Georeferencing, Spatial Database design and creation, Interoperability - Standards - Spatial

data from different sources, Spatial Data quality, Generalization, Modeling surfaces - Spatial Interpolation, Analysis of Surfaces, Spatial Data analysis, Map elements and principles of map symbolization.
LECTURERS: *A. Skopeliti*, Assistant Professor, *L. Stamou*, Special Technical Laboratory Staff, School of Rural, Surveying and Geoinformatics Engineering NTUA

FIRST SEMESTER REQUIRED COURSES ONLY FOR NON-NAVAL ARCHITECTS IN SPECIALIZATION DIRECTION I "MARITIME TECHNOLOGY"

8121 FUNDAMENTALS OF NAVAL ARCHITECTURE

CONTENT: Introduction: Types of ships, General Arrangement, Regulatory issues in naval architecture and marine engineering, Ships' Lines, Numerical Integration (e.g. Simpson's rules), Archimedes' principle, Hydrostatic curves, Effects of weights on trim and draft, Initial Stability, Inclining experiment, Watertight subdivision and Damage stability. Ship Structural Strength: Longitudinal bending – Hogging and sagging due to wave, Buoyancy curve, weight curve, the load curve, the shearing force and bending moment curve, Maximum Bending Moment in hogging and sagging condition, Bending theory, Calculation of section modulus, Bending Stress. Ship Resistance: The influence of sea waves, Dimensional Analysis, Components of resistance – frictional, wave, appendage (etc.), The use of models to determine ship resistance and influence of hull form, Powering of ships. Ship Propulsion: Ship propulsion – propellers and other propulsive devices, Maneuvering devices – rudders, thrusters, Introduction to marine power plants, Shafting and transmission.
LECTURERS: *D. Konovessis*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA

FIRST SEMESTER REQUIRED COURSES ONLY FOR NON-NAVAL ARCHITECTS IN SPECIALIZATION DIRECTION II "MARINE STRUCTURES AND EXPLOITATION OF HYDROCARBONS"

8121 FUNDAMENTALS OF NAVAL ARCHITECTURE

CONTENT: Introduction: Types of ships, General Arrangement, Regulatory issues in naval architecture and marine engineering, Ships' Lines, Numerical Integration (e.g. Simpson's rules), Archimedes' principle, Hydrostatic curves, Effects of weights on trim and draft, Initial Stability, Inclining experiment, Watertight subdivision and Damage stability. Ship Structural Strength: Longitudinal bending – Hogging and sagging due to wave, Buoyancy curve, weight curve, the load curve, the shearing force and bending moment curve, Maximum Bending Moment in hogging and sagging condition, Bending theory, Calculation of section modulus, Bending Stress. Ship Resistance: The influence of sea waves, Dimensional Analysis, Components of resistance – frictional, wave, appendage (etc.), The use of models to determine ship resistance and influence of hull form, Powering of ships. Ship Propulsion: Ship propulsion – propellers and other propulsive devices, Maneuvering devices – rudders, thrusters, Introduction to marine power plants, Shafting and transmission.
LECTURERS: *D. Konovessis*, Associate Professor, School of Naval Architecture and Marine Engineering NTUA

FIRST SEMESTER OPTIONAL COURSE (ALL SPECIALIZATION DIRECTIONS)

8007 COMMUNICATION SKILLS FOR ENGINEERS

CONTENT: This course is designed to enhance students' knowledge of written and oral communication skills in an engineering context. The course will help students to properly structure and write their course assignments and dissertation. In particular, students will learn how to manage and evaluate relevant and reliable sources, cite sources appropriately in their written material, write abstracts and reports concisely and meaningfully, write critical literature reviews and critically analyze key issues in engineering topics both in a written and an oral format. This course is interdisciplinary, and is mainly based on the use of case studies addressing a number of topical engineering issues (e.g. sustainability, engineering failure analysis, engineering ethics, energy transition, etc.). By engaging with these case studies, students will not only refine their communication skills, but also deepen their understanding of specialized engineering terminology while gaining valuable insights into the principal challenges faced today.
LECTURER: Dr. *G. Togia*, NTUA Foreign Language Center, *K. Spyrou*, Professor School of Naval Architecture and Marine Engineering NTUA

SECOND SEMESTER OPTIONAL COURSE (ALL SPECIALIZATION DIRECTIONS)

Course description: European and Greek Technical Law

The aim of this course is to bring young engineers in touch with concepts of Law that affect their working fields. The course aims to help them understand and be able to resolve issues that arise during the drafting of public/private project contracts and the relevant licensing procedures. In addition, it aims to provide students with general knowledge of legal rules and how to interpret them, as well as to make them familiar with the way of operation and delivery of justice and the concept of judicial reasoning. Within the complexity of their fields, the young engineers should be able to understand basic concepts of Public and Technical Law and to gain some familiarity with Public Works contracts, Maritime Law, and the Law of the Sea, as well as with the particularities of the tax environment across the EU, within which they will pursue a career. International and European Law are also taught aiming to provide the young engineers with broad knowledge on energy related investments, on issues regarding the transit and the cross-border energy transport, on how the EU institutions operate and last but quite crucial, on how the EU energy and environmental Law and Policy are being shaped and developed. Finally, Energy Law is taught, and students are introduced to the field of Energy Law and in particular: the evolution of the energy sector historically, the concept of energy security, the environmental and energy strategies of the European Union. Under that prism, students are also introduced to the operation of the Target Model, the tendency for the digitalization of Energy and the problems in contractualization of purchase and sale transactions, as well as to the evolution of the Renewable Energy Sources sector and to the Licensing Process of energy and environmental projects.

LECTURERS: *E Tzanini*, Assistant Professor, School of Applied Mathematical and Physical Sciences NTUA

8318 INTERNSHIP COURSE

CONTENT: A two-month internship period in a professional setting, involved in the field of Ship and Marine Technology.

LECTURER: Designated for each student individually, *Supervisor*

3.8. Academic Calendar

- Duration of semesters and examination periods in line with those being in force for the undergraduate studies at the NTUA:

  1st semester (Lectures: 13 weeks, Period of special educational procedures (fieldwork) and examinations: 3 weeks, Christmas holidays: 2 weeks).

  2nd semester (Lectures: 13 weeks, Period of special educational procedures, excursions and examinations: 3 weeks, Easter holidays: 2 weeks).

  3rd semester (Lectures for a maximum of three elective courses and writing of the Postgraduate Diploma Thesis: 13 weeks, Christmas holidays: 2 weeks, Examination period: 2 weeks, Thesis examination).

  Retake examination period in September: Beginning of the period of special educational procedures and re-examinations of winter and spring semester courses: 2 weeks (first and second weeks of September).
- The candidates who have been selected as PS are enrolled in the MSc Program in the first ten days of October.
- The PS are enrolled in the semester courses and prerequisite undergraduate courses (on a separate list) within the week before the first week of the lectures.
- The PS are allowed to change one elective course (at most) or withdraw from a course by the end of the first week of the course's lectures.
- Each semester, within the 2nd week from the beginning of the lectures, the Secretariat issues a list of the PS enrolled per course and forwards it to the responsible lecturers and to the PSC. It also issues a separate list of the prerequisite courses specified for the PS and forwards it to the Secretariats of the Departments offering these courses.
- Applications for initiating the preparation of the Postgraduate Diploma Thesis are due by the end of the third week of September.

Day	Time period	Procedure
		First semester
Mon.	23.09.2024	PS enrolment opening.
Fri.	11.10.2024	PS enrolment closing.
Mon.	7.10.2024	Beginning of lectures. One-week deadline for changing one (at most) elective course.
Fri.	18.10.2024	The Secretariat of the MSc Program issues lists of the PS enrolled per course, with separate reference to prerequisite courses.
Fri.	17.01.2025	End of lectures.

Mon.	20.01.2025	Lecturers submit to the Secretariat of the MSc Program the attendance sheets for the first semester courses.
Mon.	20.01.2025	The list of the PS being eligible to take examinations is issued and communicated to the responsible lecturers.
Mon.	20.01.2025	Beginning of special educational procedures and examinations.
Fri.	14.02.2025	End of special educational procedures and examinations.
Fri.	21.02.2025	Lecturers submit the course grade sheets.
		Second semester
Mon.	17.02.2025	Opening of PS enrolments and beginning of lectures. One-week deadline for changing one (at most) elective course.
Mon.	17.02.2025	The Secretariat of the MSc Program issues lists of the PS enrolled per course, with separate reference to prerequisite courses.
Fri.	30.5.2025	End of lectures.
	Last ten days of May	Announcement for next year postgraduate studies.
Fri.	30.05.2025	Lecturers submit to the Secretariat of the MSc Program the attendance sheets for the second semester courses.
Mon.	02.06.2025	The list of the PS being eligible to take examinations is issued and communicated to the re-sponsible lecturers.
Mon.	02.06.2025	Beginning of special educational procedures and examinations.
Fri.	27.06.2025	End of special educational procedures and examinations.
Fri.	04.07.2025	Lecturers submit the course grade sheets.
		Students who availed of the 4th semester to complete the writing of the PDT submit their thesis for examination.
Wed.	26.06.2025	Beginning of the PDT examination week.
Mon.	From 07.07.2025 to 11.07.2025	Results issue week.
		Third semester
Mon.	23.9.2024	Opening of PS enrolments and PDT assignments.
Mon.	7.10.2024	Beginning of lectures. One-week deadline for changing one (at most) elective course.
Fri.	18.10.2024	The Secretariat of the MSc Program issues lists of the PS enrolled per course, with separate reference to prerequisite courses.
Fri.	17.01.2025	End of lectures.

Fri.	17.01.2025	Lecturers submit to the Secretariat of the MSc Program the attendance sheets for the third semester courses.
Mon.	20.01.2025	The list of the PS being eligible to take examinations is issued and communicated to the re-sponsible lecturers.
Mon.	20.01.2025	Beginning of special educational procedures and examinations.
Fri.	14.02.2025	End of special educational procedures and examinations.
Fri.	21.02.2025	Lecturers submit the course grade sheets. Students submit their Postgraduate Diploma Thesis for examination.
Mon.	17.02.2025	Beginning of the PDT examination week.
Mon.-Fri	17.02.2025 - 21.02.2025	Results issue week.

		Resit examination period in September
Mon.	1.09.2025	Beginning of the resit examination period concerning both winter and spring semester courses.
Fri.	19.09.2025	End of the above-mentioned period.
		Students who availed of the 4th semester to complete the writing of the PDT submit their thesis for examination. Maximum time allowed for completing the MSc Program.
Wed.	8.10.2025	Beginning of the PDT examination week.
Fri.	10.09.2025	Lecturers submit the course grade sheets.
Mon.-Fri	13.10.2025 - 17.10.2025	Results issue week.

		PS selection for the MSc Program
	up to (and including) the 3rd week of May	Last term for publishing calls for PS applications in the daily press.
	up to (and including) the 3rd week of June	Last term for interested candidates to submit an application.
	up to (and including) the 3rd week of July	Last term for the Secretariat of the coordinating School of the MSc Program to issue the results

- Holidays and vacation

Lectures are not given on the following dates:

28 October (National Day)
17 November (Remembrance Day)
23 December to 6 January (Christmas holiday period)
30 January (Feast of the Three Holy Hierarchs)
5 March (Clean Monday)
25 March (National Day)
28 April to 13 May (Easter holiday period)
1 May (May Day celebration)

24 June (Holy Spirit Monday)

3.9. Awarding of the Inter-University Postgraduate Studies Diploma (PSD)

a. Students who successfully fulfil all the requirements for the MSc Program are awarded a PSD on which are indicated the scientific field of Ship and Marine Technology as well as the specialization direction they had selected.
b. The PSD is accompanied by a diploma supplement in which are listed all the courses of the program that the postgraduate student successfully attended along with the corresponding grades received. The topic of the Postgraduate Diploma Thesis (PDT) and the grade it received are indicated as well.
c. The PSD and the Diploma Supplement are issued in English and are signed by the Rectors of the NTUA and the NKUA as well as by the Director of the MSc Program.