Valid as from the academic year 2023–2024

NAME: MODELLING AND SAFETY OF MARITIME TRAFFIC

Credits: 6

Study time: 119 h

Term: 1st semester/ 1st term

Teaching languages: English

Teaching methods:

Lectures (4 hours x 7 weeks), practical (3 hours x 7 weeks), assignments/group work and study (119 hours), Total=168h

Keywords

Maritime safety, Maritime Accidents, Regulatory framework for maritime safety, Maritime traffic safety, Automatic Identification System, Maritime traffic modelling, Collision risk assessment; Maritime anomaly detection.

Position of the course

2nd year of the MSc degree

Contents

Part I Maritime safety*:* Characterization of the maritime transportation sector: Major hazards and their characteristics. Regulatory framework. IMO Conventions on maritime safety. Risk-based approaches to Maritime Safety. IMO instruments. Port State Control program (PSC). Port State Control Inspections. Analysis and investigation of Maritime Accidents. Contribution of Human and Organizational factors to accidents. Methodologies for Analysis and investigation of Maritime Accidents.

Part II Maritime traffic safety: Automatic Identification System (AIS). AIS data. Vessel Monitoring System (VMS). Anti-collision systems and maritime traffic separation schemes. Management and maritime traffic control. Vessel Traffic System (VTS). Maritime traffic extraction. Maritime traffic modelling: (a) grid based; (b) vector based; and (c) statistical based. Parametric and non-parametric methods. Ship trajectory prediction & Maritime traffic probabilistic prediction. Ship-ship collision assessment: Geometric Probability of ship-ship collisions: Collision diameter; Ship domain. Collision risk indicators: CTPA, DCPA, Velocity-based approach. Detection of Collision avoidance behaviour. Maritime anomaly detection. Types of anomalies. Rule-based or Signature-based and Data-driven approaches. Risk mitigation: Search and Rescue (SAR) operations, Probabilistic approaches to SAR.

Initial competences

Basic Matlab and/or Python programming skills

Final competences / Learning outcomes

To understand the main maritime safety issues as well as the risk-based tools and the regulatory framework for maritime safety.

To be able to analyse maritime casualties using methodologies and taxonomies for analysis and investigation of Maritime accidents.

To understand the various problems of maritime traffic in various situations of ship encounters in the open sea or when constrained by restricted waters.

To model, in general and specific terms, maritime traffic problems, as well as, to characterize the collision risk between ships.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment. *(standard option)*

Conditions for exam contract

This course unit cannot be taken via an exam contract. *(standard option)*

Teaching methods

- lecture
- practical
- group work

Extra information on the teaching methods

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Learning materials and price

Lecture slides (free of charge)

References

EMSA. (2022). European Maritime Safety Report 2022. Publications - EMSAFE Report - EMSA - European Maritime Safety Agency.

Kristiansen, S., 2005. Maritime Transportation, Safety Management and Risk Analysis. Elsevier.

Helle A. Oltedal and Margareta Lützhöft (ed.) (2018), Managing Maritime Safety, Routledge.

Papanikolaou, A., Guedes Soares, C., Jasionowski, A., Jensen, J., McGeorge, D., Poylio, E., Sames, P.C., Skjong, R., Skovbakke Juhl, J., Vassalos, D., 2009. Risk-Based Ship Design Methods, Tools and Applications, Apostolos. ed, Psychological Science. Springer Berlin Heidelberg. doi:10.1007/s13398-014-0173-7.2

Marvin Rausand and Stein Haugen, 2020 (2nd edition). Risk Assessment: Theory, Methods, and Applications, Statistics in Pratice. Wiley.

IMO, 2013. Revised guidelines for formal safety assessment (FSA) for use in the IMO rule-making process. MSC-MPEC.2/Circ. 12.

A Guide to the Collision Avoidance Rules, 7th Edition: A.N. Cockcroff and J.N.F. Lameijer 2012, Elsevier.

Mathematical Aspects of Marine Traffic: S.H. Hollingdale 1979 Academic Press, London.

Course content-related study coaching

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Evaluation methods

- continuous assessment

Examination methods in case of periodic evaluation during the first examination period

- 2 assignments

Examination methods in case of periodic evaluation during the second examination period

- 2 assignments

Examination methods in case of permanent evaluation

- 2 assignments

Possibilities of retake in case of permanent evaluation

- Yes

Extra information on the examination methods

Each assignment (Assign.#1, Assign.#2) has a minimum grade of 9.5 points (out of 20).

Calculation of the examination mark

Final grade = 50% Assign.#1 + 50% Assign.#1

Facilities for working students

Similar examination method. Attendance in Part I of the course is not compulsory (although it is recommended).

Valid as from the academic year 2023–2024

NAME: PORTS ORGANIZATION AND MANAGEMENT

Credits: 6

Study time: 119 hours

Term: 1st semester

Teaching languages: English

Teaching methods:

- Lectures (4hours x 7 weeks), practical (3hours x 7 weeks), group work and study (119 hours)

Keywords

Port organization. Port performance. Port Planning. Terminal design. Port concessions. Investment analysis. Logistics.

Position of the course

1st semester of 2nd year of MSc degree

Contents

The evolution of port infrastructures. Port services. Classification of ports. Foreland and hinterland. Port community. Land and multimodal accessibilities. Port Authority. Organizations and roles. Port management models. Performance indicators. Port planning and marketing. Types of port terminals. Infrastructure, superstructure and equipment. Port operations. Automated terminals. Dimensioning of maritime accesses and port terminals. Analysis of port demand. Capital and operating costs. Port leases and concessions. Investment analysis for port terminals. Queueing theory applied to the development of port infrastructure and equipment. Integrating ports in transport chains. Logistic zones. Port regionalization. Performance of port terminals. Productivity. Environmental impact studies. European policies. Intelligent ports.

Initial competences

- Kowledge on basic naval architecture and technical characteristics of main ship types.

Final competences / Learning outcomes

- Ability to identify types of ports and terminals and analyze its evolution.
- Knowledge of the main stakeholders in the port community and ability to identify its roles and responsabilities.
- Ability to characterize the role of the port authority, its work procedures and analyze its performance.
- Ability to carry out the preliminary planning and dimensioning of ports and terminals and to carry out an investment analysis for ports and terminals.
- Ability to apply queueing theory in terminal planning.
- Knowledge on the role of ports in transport chains.
- Ability to characterize the performance of port terminals.
- Knowledge on environmental and labour problems in ports and of the general principles of EU port policies.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment. *(standard option)*

Conditions for exam contract

This course unit cannot be taken via an exam contract. *(standard option)*

Teaching methods

- lecture
- practical
- group work

Extra information on the teaching methods

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Learning materials and price

- Santos, T.A. (2023), “Class Notes for Ports Organization and Management”, Instituto Superior Técnico Universidade de Lisboa, Lisbon, Portugal. (free of charge)

References

Talley, W. (2009), “Port Economics”, Routledge.
Notteboom, T., Pallis, A., Rodrigue, J.-P. (2022), “Port Economics, Management and Policy”, Routledge: Taylor & Francis Group, London, UK.
Hillier, F., Lieberman, G. (2009), “Introduction to Operations Research”, 7th Edition, McGraw-Hill.
Alderton, P. (2005), “Port Management and Operations”, Lloyd's of London Press.
Thoresen, P. (2013), “Port Designer’s Handbook”, ICE Publishing, Westminster, London.
PIANC (2014), “Masterplans for the development of existing ports”, The World Association for Waterborne Transport Infrastructure, Brussels, Belgium.

Course content-related study coaching

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Evaluation methods

- end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

- written assessment
- assignment

Examination methods in case of periodic evaluation during the second examination period

- written assessment
- assignment

Examination methods in case of permanent evaluation

- Not applicable

Possibilities of retake in case of permanent evaluation

- Not applicable

Extra information on the examination methods

Written assessment (exam) has a minimum grade of 8 points (scale of 0-20).

Calculation of the examination mark

Two assignments (25% of grade each one) plus a written assessment (exam) (50% of final grade)

Facilities for working students

Examination method is similar, classes are not mandatory (although recommended) and on-line communication with teaching staff is possible.

Valid as from the academic year 2023–2024

NAME: INTEGRATED PROJECT IN NAVAL ARCHITECTURE AND OCEAN ENGINEERING

Credits: 6

Study time: 154 h

Term: 1st semester/ 2nd year

Teaching languages: English

Teaching methods:

Tutorial session (2h x 7 weeks), individual project development (154 h)

Keywords

Naval Architecture and Ocean Engineering, Scientific project, Company project; SCOPE project, Thesis project.

Position of the course

2nd year of the MSc degree

Contents

The integrated project may fall within one of three modalities: 1. Scientific project, 2. Company project and 3. SCOPE project.
1. Scientific project: an in-depth and academically rigorous analysis of a scientific, technological or management challenge. May include experimental and/or computational work.
2. Company project: individual project focused on a specific challenge posed by a host company that requires a solution or analysis targeted for short-term implementation.
3. SCOPE project: multidisciplinary teamwork based on real and complex problems/challenges posed by companies or other institutions that require inputs from students from different courses.

In the "1. Scientific Project" modality, the student can choose one of the following options:

a) Scientific project on an advanced topic in Naval Architecture and Ocean Engineering.
In this case, the project consists of a study formulated by a professor or PhD researcher, who will act as supervisor. The study must be in line with the general objectives of PIC2, namely to apply the knowledge acquired or extend it to areas not covered in the master's degree in the development of a scientific study that may involve: 1) researching, compiling and analysing relevant information; 2) planning and carrying out experiments; 3) analysing and interpreting data; 4) developing analytical or numerical models, 5) carrying out numerical simulations.

b) Thesis project
The thesis project carried out within the scope of PIC2 allows students to begin the work leading to the preparation of the Master's Dissertation in Naval Architecture and Ocean Engineering. The PIC2 thesis project is carried out in the semester preceding the first enrolment in the Dissertation UC, and is used for students to carry out part of the initial work for their Dissertation.

Initial competences

Specific knowledge in the Naval Architecture and Ocean Engineering

Final competences / Learning outcomes

Learning outcomes will depend on the specific project, but in general, students should be able to:
- apply the knowledge acquired during their degree to undertake a project of a scientific, technological or management nature.
- extend their knowledge to areas not covered in their degree.
- search, obtain, compile and summarize information (scientific, technical, legislation, interviews, polls) relevant to the project - plan and execute experiments, analyse and interpret data, develop mathematical models, perform computer simulations
- develop Critical and Innovative Thinking, intrapersonal and Interpersonal Skills.
- write and orally present and discuss a technical report.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment. *(standard option)*

Conditions for exam contract

This course unit cannot be taken via an exam contract. *(standard option)*

Teaching methods

- Independent work
- group work
- master's dissertation

Extra information on the teaching methods

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Learning materials and price

Depends on the project topic

References

Depends on the project topic

Course content-related study coaching

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Evaluation methods

- end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period

- written document
- presentation

Examination methods in case of periodic evaluation during the second examination period

- written document
- presentation

Examination methods in case of permanent evaluation

- written document
- presentation

Possibilities of retake in case of permanent evaluation

- Yes

Extra information on the examination methods

For modalities types 1 and 2 a report must be submitted for evaluation and discussion by a jury of at least) two professors.

For modalities type 3 evaluation will be continuous, with 3 moments of public exposure (initial pitch (30%) + midterm presentation (30%) + final presentation (40%)). Development of a portfolio of variable content, depending on the project (website, report/poster, presentation, dissemination video).

Calculation of the examination mark

Modalities type 1 and 2: 75% Written report + 25% oral presentation

Modalities type 3: Initial pitch (30%) + midterm presentation (30%) + final presentation (40%)

Facilities for working students

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Valid as from the academic year 2023–2024

NAME: SHIP AND OCEAN SYSTEMS DESIGN

Credits: 6

Study time:

Term: 1st Semester

Teaching languages: English

Teaching methods:

- Lectures (4hours x 7 weeks), practical (3hours x 7 weeks), group work and study (119 hours)

Keywords

Ship design. Concept design. Optimization.

Position of the course

1st year of the MSc degree

Contents

Ship design process. Contract documents. Initial ship dimensioning. Ship synthesis model. Voyage model. Financial analysis. Ship optimization. Design criteria. Conventions, Rules and Regulations. Specific design aspects of the main types of merchant ships. Hull form and compartment layout in 3D.

Initial competences

- Basic knowledge of the ship, ship stability, resistance and propulsion.
- Basic programming knowledge (either Excel, Matlab or Python)

Final competences / Learning outcomes

- Knowledge of the ship design process, documents produced and associated entities
- Knowledge of methodology for the initial dimensioning of merchant vessels
- Knowledge on the international IMO conventions relevant to initial design
- Use of optimization methods

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment. *(standard option)*

Conditions for exam contract

This course unit cannot be taken via an exam contract. *(standard option)*

Teaching methods

- Lectures
- Practical (class exercises)
- Group work

Extra information on the teaching methods

- Eventual study visits tos ships, when possible.

Learning materials and price

Ventura, M. (2023). Ship Design Lecture's Notes. Instituto Superior Técnico, Universidade de Lisboa (free of charge)

References

Alvarino, Ricardo; Azpíroz, Juan José e Meizoso, Manuel (1997). El Proyecto Básico del Buque Mercante. Fundo Editorial de Ingeniería Naval, Colegio de Ingenieros Navales.

Lamb, Thomas (2003). Ship Design and Construction. Vol. I, SNAME.

Lewis, E. V. (1988). Principles of Naval Architecture. Vols.I, II & III, SNAME.

Molland, Anthony F. (2008). The Maritime Engineering Reference Book: A Guide to Ship Design, Construction and Operation. Butterworth-Heinemann.

Papanikolaou, Apostolos (2014). Ship Design: Methodologies of Preliminary Design. Springer, Netherlands.

Roh, Myung-II and Lee, Kyu-Yeul (2018). Computational Ship Design. Springer.

Schneekluth, H. and Bertram, V. (1998). Ship Design for Efficiency and Economy. Butterworth Heinemann.

Course content-related study coaching

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Evaluation methods

- Written Test (30 minutes)
- Project with two main tasks (Task1 + Task2) during the semester
- Final oral presentation/discussion

Examination methods in case of periodic evaluation during the first examination period

- Not applicable (no final examination)

Examination methods in case of periodic evaluation during the second examination period

- Not applicable (no final examination)

Examination methods in case of permanent evaluation

- Final oral presentation/discussion

Possibilities of retake in case of permanent evaluation

- Yes (repetition of one of the Tasks work)

Extra information on the examination methods

Continuous evaluation, no final examinations considered

Project Tasks to be carried out by groups of 2 students.

Calculation of the examination mark

Final mark = 0.20 Test + 0.45 Task1 + 0.25 Task2 + 0.10 Oral presentation

Facilities for working students

Assessment method is identical, classes are not mandatory (although recommended) and on-line communication with lecturer is possible.

Valid as from the academic year 2023–2024

NAME: MARITIME TRANSPORTATION AND PORTS

Credits: 6

Study time: 119 h

Term: 1st semester

Teaching languages: English

Teaching methods:

- Lectures (4hours x 7 weeks), practical (3hours x 7 weeks), group work and study (119 hours)

Keywords

Shipping industry. Shipping markets. Cost and revenue structures. Voyage planning. Investment analysis. Intermodality. Short sea shipping. Ports.

Position of the course

1st year of the MSc degree

Contents

The shipping industry. Ship's papers. Maritime insurance. Maritime transportation and world trade. Main types of cargos. Concept of ton.km. The four shipping markets. Cargo capacity. Autonomy. The ships' cost structure: capital costs, operating costs, voyage costs. Revenue generated by the ship. Service speed. Ship and fleet sizing. Investment analysis applied to ships and marine equipment. Freight rates and indices. Types of contracts in shipping markets. Liner shipping. Tramp shipping. Logistics and the transport chain. Multimodality. Intermodality. Short Sea Shipping. European Policies for maritime transportation. Types of ports and terminals. Types of equipment and productivity. Port time and its components. The port Community. Logistic zones. Port services. Added value services. Port management models. Port costs.

Initial competences

- Kowledge on basic naval architecture and technical characteristics of main ship types.

Final competences / Learning outcomes

- Ability to characterize the role of the main players in the shipping industry.
- Knowledge on the types and particulars of main cargos carried through the sea globally.
- Identifying the different shipping cycles and its impacts in the four shipping markets.
- Ability to evaluate the cost and revenue structure of ships (voyage estimate).
- Ability to develop an investment analysis for a ship or a marine equipment.
- Knowledge of main types of contracts used in the shipping industry.
- Ability to characterize the main port terminals and to assess port time.
- Knowledge on port types, its management models and main players in the port community.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment. *(standard option)*

Conditions for exam contract

This course unit cannot be taken via an exam contract. *(standard option)*

Teaching methods

- lecture
- practical
- group work

Extra information on the teaching methods

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Learning materials and price

- Santos, T.A. (2023), “Class Notes for Maritime Transportation and Ports I”, Instituto Superior Técnico Universidade de Lisboa, Lisbon, Portugal. (free of charge)

References

- Stopford, M. (2009), “Maritime Economics”, 3rd Edition, Routledge.

- Talley, W. (2009), “Port Economics”, Routledge.

- Branch, A.E. (2007), “Elements of Shipping”, 8th Ed, Routledge.

- UNCTAD (2022), “Review of Maritime Transport”, United Nations Publications, New York, USA

Course content-related study coaching

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Evaluation methods

- end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

- written assessment
- assignment

Examination methods in case of periodic evaluation during the second examination period

- written assessment
- assignment

Examination methods in case of permanent evaluation

- Not applicable

Possibilities of retake in case of permanent evaluation

- Not applicable

Extra information on the examination methods

Written assessment (exam) has a minimum grade of 8 points (scale of 0-20).

Calculation of the examination mark

Two assignments (25% of grade each one) plus a written assessment (exam) (50% of final grade)

Facilities for working students

Examination method is similar, classes are not mandatory (although recommended) and on-line communication with teaching staff is possible.