Course guide
280823 - 280823 - Mooring Systems

Last modified: 09/05/2023

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 742 - CEN - Department of Nautical Sciences and Engineering.

Degree: MASTER'S DEGREE IN NAVAL AND OCEAN ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: RAFAEL PACHECO BLAZQUEZ

Others: Primer quadrimestre:
RAFAEL PACHECO BLAZQUEZ - ERAS, MUENO

PRIOR SKILLS

Basic concepts referred to the "Numerical Calculus for Naval Structures"

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
ENO_CEe2-1. Capacity for hydrodynamic analysis, stability and behavior in the sea of ??platforms and other offshore structures (specific competence of the specialty in Ocean Energies)
ENO_CEe2-6. Capacity for the design and project of platforms for offshore wind turbines (specific competence of the specialty in Ocean Energy)

Transversal:
CT1. ENTREPRENEURSHIP AND INNOVATION: Knowing and understanding the organization of a company and the sciences that govern the activity; be able to understand the business rules and relationships between planning, industrial and commercial strategies, quality and profit.
CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Know and understand the complexity of economic and social phenomena typical of the welfare society, being able to relate welfare to globalization and sustainability; acquire skills to use in a balanced manner compatible technology, technology, economics and sustainability.
CT3. TEAMWORK: Ability to work as a member of an interdisciplinary team, either as a member or performing management tasks, with the aim of contributing to projects pragmatically and sense of responsibility, assuming commitments considering the resources available.
CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty, and critically evaluate the results of this management.
CT5. THIRD LANGUAGE Learning a third language, preferably English, with adequate oral and written and in line with the future needs of the graduates.

Basic:
CB6. Possess knowledge and understanding that provide a basis or opportunity be original in the development and / or application of ideas, often in a research context.
CB7. That the students can apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their study area.
CB8. Students should be able to integrate knowledge and handle the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the responsibilities social and ethical linked to the application of their knowledge and judgments.
CB9. That students can communicate their conclusions and the knowledge and Latest rationale underpinning to specialists and non Specialty clearly and unambiguously.
CB10. Students must possess the learning skills that enable them continue studying in a way that will be largely self-directed or autonomous.

TEACHING METHODOLOGY

In this subject three different docent metodologies are combined:
- Presential exposition sessions of the contents of the subject, in which the professor shall introduce the theoretical basis of the subject by means of examples that easy their understanding.
- Presential practical coursework sessions by means of explaining the development of such exercices, problems and algorithms in which the professor will guide the students in the aplication of theoretical concepts.
- Autonomous study and undertaking of exercise and activities in which the students will apply the knowledge developed during the presential sessions. Inclusion of brief MATLAB assignments, which will require the submission of a report.

LEARNING OBJECTIVES OF THE SUBJECT

Understanding of the basic concepts related to mooring systems.
Capability to resolve maethematic problems applied to mooring systems.
Understanding the algorithms and numerical methods basis in order to solve this problems.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	36.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

1. Mooring System Concept.

Description:
Introduction to the concept of Mooring,
Mooring system,
Applications for the mooring systems,
Mooring types,
Mooring elements,
Anchorage and Materials.

Full-or-part-time: 24h
Theory classes: 7h
Guided activities: 3h
Self study : 14h

3. Fluid-Structure Interaction

Description:
Introduction to oceanic boundary conditions and their loads for floating structures with their respective mooring system.
Discussion on analysis type of the problem using simple catenary models according to the regulations.

Specific objectives:
Ocean boundary conditions.
Loads.
Problem analysis.
Regulations.

Related activities:
Different computational models to solve the fluid-structure interaction of structures with mooring systems.

Full-or-part-time: 32h
Theory classes: 12h
Guided activities: 8h
Self study : 12h

2. Catenary

Description:
Introduction to catenary models, examples and outline of the assessed coursework.

Specific objectives:
Parabola equation.
Catenary equation.
Boundary conditions.

Full-or-part-time: 27h
Theory classes: 12h
Guided activities: 3h
Self study : 12h

4. Structure-Structure Interaction

Description:
Introduction to numerical methods by means of finite elements for trusses/bars.
Description of the lineal model, structure for a finite element code, introduction to the non-linear model and iterative methods using Newton-Rapshon.
Assessment of the fatigue principles in mooring lines.

Specific objectives:
FEM: bars/trusses and cables.
System resolution: direct and iterative.
Post-processing: fatigue.

Related activities:
Resolution of problems involving bars/trusses, cables and fatigue post-processing.

Full-or-part-time: 26h
Theory classes: 8h
Guided activities: 6h
Self study : 12h

5. Dynamic Position

Description:
Brief introduction to dynamic position.
Utilization of SIMULINK.

Specific objectives:
Coupling between fluid-structure and structure-structure interaction in conjunction with the active position control.

Related activities:
Coupling.
SIMULINIK.

Full-or-part-time: 16h
Theory classes: 6h
Guided activities: 6h
Self study : 4h

GRADING SYSTEM

The final grade is the sum of the partial grades below:

G_final=0.25*G_1+0.25*G_2+0.25*G_3+0.25*G_4

Where:
G_final: Final grade.
G_1: Block 1 grade.
G_2: Block 2 grade.
G_3: Block 3 grade.
G_4: Block 4 grade.

EXAMINATION RULES.

Rules for the fulfilment of the course activities:

Coursework Assessment:
Individual or group submission of the courseworks according to the specifications. A report shall be submitted within the deadline. Any coursework delivered out of the deadline shall be qualified with a penalty of 10% less per day out of the deadline, meaning that a submission over 10 days would be equivalent to a 0.

Exams:
Exams will be open book. A not have taken qualification will be awarded to the student who does not take all the exams.

BIBLIOGRAPHY

Basic:
- Oil Companies International Marine Forum. Mooring equipment guidelines. 4th. London: OCIMF, 2018. ISBN 9781856097710.
- API RP 2S : design and analysis of stationkeeping systems for floating structures. 3rd ed. [Washington]: American Petroleum Institute, 2005. ISBN 9781613995716.
- Gaythwaite, John W. Design of marine facilities for the berthing, mooring, and repair of vessels. 2nd ed. Reston: ASCE Press, 2004. ISBN 9780784407264.
- Ma, Kai-Timg. Mooring system engineering for offshore structures [on line]. Cambridge: Elsevier, 2019 [Consultation: 01/09/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5785417. ISBN 9780128185520.

Complementary:
- Clauss, Günther;Lehmann, Eike; Ostergaard, Carsten. Offshore structures. Vol. 1, Conceptual design and hydromechanics. London: Springer-Verlag, 1992. ISBN 9781447131939.
- Clauss, Günther; Lehmann, Eike; Ostergaard, Carsten. Offshore structures. Vol. 2, Strength and safety for structural design. London: Springer-Verlag, 1994. ISBN 9781447119982.