Course guide
280813 - 280813 - Design of Offshore Platforms and Structures

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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). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: DANIEL SA LOPEZ

Others: Primer quadrimestre:
DANIEL SA LOPEZ - ERAS, MUENO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
MUENO_CE7. Ability to project ocean platforms and artifacts
MUENO_CE9. Ability to organize and direct the construction of ocean platforms and artifacts
MUENO_CE10. Knowledge of positioning systems and the dynamics of platforms and artifacts

Generical:
MUENO_CG2. Ability to conceive and develop solutions that are technically, economically and environmentally appropriate to the needs of maritime or integral transportation of people and goods, of the use of oceanic resources and of the marine subsoil (fishing, energy, minerals, etc.), adequate use of the marine habitat and means of defense and maritime security)
MUENO_CG4. Capacity for the project of platforms and artifacts for the use of ocean resources
MUENO_CG5. Ability to design and control the construction, repair, transformation, maintenance and inspection processes of previous mills
MUENO_CG6. Ability to conduct research, development and innovation in naval and ocean products, processes and methods
MUENO_CG7. Ability to integrate complex maritime systems and translation into viable solutions
MUENO_CG8. Ability to analyze and interpret measurements, calculations, evaluations, appraisals, studies, reports, work plans and other similar works
MUENO_CG13. Ability to develop the necessary engineering in rescue and rescue operations and in the design and use of the required means
MUENO_CG15. Ability to organize and direct multidisciplinary work groups in a multilingual environment, and to generate reports for the transmission of knowledge and results

Transversal:
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

The lecture will be structured in three parts. Each part will have a specific goal and will be presented and evaluated independently. Students will have different roles on each part depending on the content and the expected learnings.

During the three parts of the lecture, there will be presentations, exercises in class and home-tasks. In addition, there will be workshops related with specific software that is of common use in the offshore industry.

1. Offshore Industry Overview: In this first part of the lecture, there will be a presentation of what is the offshore industry, the history of how it started and how it has transformed to date. What have been the challenges, either technical, economical, and other aspects that have impacted the feasibility of the offshore projects. Types of project (EPCI vs Reimbursable). Cicle of life of a structure (FEED, Detail Design, Procurement, Fabrication, Transport, Installation, Operation, Decomissioning)

2. Basics of structural design: In the second part, students will learn the basics of the structural design. Types of structural elements that form a structure. How they are calculated as individual items or as a complex configuration. The standards and codes that apply for the offshore structures. The typical standards that major operators include in the project specifications. Design approach WSD vs LRFD. Design for Elastic and Plastic limits of material. General calculations that are to be included in design (CoG, Lift, Transport, Corrosion, etc). Common software that is used in industry for the solution of the complex calculations (FEA).

3. Development of a Project – Study Case: In the third part, students will be asked to carry out a complete offshore project. This will cover the whole part of Engineering, Procurement, Construction and Installation (EPCI). The project will run along a study case of a subsea structure project, the SLOR design for a ultra deep water project in the Atlantic Ocean. Students will carry out the project in groups. In each class, there will be a theory presentation based on the study case, and it will serve as a base to progress with the project that students will develop.

Activities will be carried out so that the students know how to apply their knowledge to their work or vocation in a professional way and possess the necessary skills through the elaboration and defense of arguments and problem solving within their area of study, aiming at acquiring the following capabilities:

1. Being responsible for self-learning, and being able to learn independently and continuously, being self-demanding and knowing how to define achievable goals.
2. Be able to analyze the current state of a discipline.
3. Develop critical and self-critical skills.
4. Acquire habits and skills to work responsibly in a team, possess negotiation and leadership skills, and be able to propose constructive solutions to potential conflicts.
5. Be able to weigh and manage information effectively, and know how to apply information and communication technologies to your management and analysis.
6. To be fluent in oral and written communication.

LEARNING OBJECTIVES OF THE SUBJECT

The main learning objectives of the course are:

1. Understanding the functions of each type of offshore structures
2. Understanding and application of basic principles for the design of offshore structures
3. Becoming familiar with the standards and codes of common use in the industry
4. Understanding the design spiral for offshore structures
5. Becoming familiar with the use of key design tools offshore engineering
6. Understanding the key issues and trade-off principles
7. Understanding issues for detail design, considering fabrication, transportation and installation
8. Becoming familiar with general procedures and issues in fabrication, manufacture, and installation
9. Developing effective communication and presentation skills for the final report

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

Part 1. Offshore Industry Overview

Description:
Lecture will cover the following topics: Offshore industry overview – upstream vs downstream. Cycle of Exploration, Appraisal, Development, Production, and abandonment. History of the offshore, Technical and economical challenges. Offshore industry outlook – future prospects. Types of structure depending function and configuration. Types of project (EPCI vs Reimbursable). Cicle of life of a structure (FEED, Detail Design - Engineering, Procurement, Fabrication, Transport, Installation, Operation, Decommissioning). Supply chain in the industry – Economic ecosystem map. Professional career for offshore engineers, depending on knowledge, skills and capacities. Offshore projects on Shallow water vs ultradeepwater.

Full-or-part-time: 30h
Theory classes: 5h
Guided activities: 5h
Self study : 20h

Part 2. Basics of Design

Description:
Lecture will cover the following topics: General concepts for structural Design. Calculation of tubular and plate capacity. Approach of Allowable Stresses based on WSD and LRFD. Review on API, AISC, ASME, DNV for design in offshore environment, welding design, special design considerations, Lift loads, padeye design, rigging design, transporation forces, barge and seastate, stability of barges, grillage and seafastening. Tubular Joint Connections. Elastic design vs Plastic Design. Codes for Plastic Desgin. Review on FEA packages used for design Offshore. Review of Pipeline Design.

Full-or-part-time: 37h
Theory classes: 10h
Guided activities: 5h
Self study : 22h

Part 3. Development of Detail Design Project

Description:
Students will carry out the design of a subsea structure. For this project, a framework will be provided with regards to functional requirements from the "client", the standards and codes that apply to the project, the requirements for construction, the functional limitations for transport and installation, and the restrains of cost and time from the "project manager". Study case will be presented alongside with the development of the project, and challenges will be posed to students while the design is being progressed.

Design Premise, Pressure Piping, T&I, Strength, Weight calculation, Cathodic protection, Drawings, Fabrication, Flexible Jumper Connection, Miscellaneous Items, Structural Frame, Bend Stiffener, Subsea Connector, Top Assembly, Bottom Assembly

Full-or-part-time: 58h
Theory classes: 10h
Practical classes: 20h
Guided activities: 5h
Self study : 23h

GRADING SYSTEM

Final mark will be the summation of the following parts:

Nfinal = 0.0•N_Part 1 + 0.3•N_Part 2 + 0.4•N_Part 3_GR + 0.3•N_Part 3_IN

N_Part 1: Do not account for final mark
N_Part 2: Mark from Examn on Part 2
N_Part 3_GR: Mark from Project part 3 as group (continuous evaluation)
N_Part 3_IN: Mark from Project part 3 as individual (continuous evaluation)

EXAMINATION RULES.

Theory classes
These classes will cover an overview and outlook of the offshore industry, and the theoretical concepts on the design of offshore structures. The main objective of these classes is to provide a general understanding of the industry, and to understand the structural concepts and will be necessary for the students to deal with the development of the project in groups.

Directed Activities
During the classes there will be resolution of typical engineering problems related with the design of offshore structures. Students will have to learn them so to be able to resolve as practical exercises during the exam.

FEA tools workshop
Industry software provider will give a session about FEA tools used in the industry for the design of offshore structures. Software provider will hand out attendance certificates to the attendees. This session will be necessary for the students to be able to progress with the development of the project of the third part of the structure.

Development of a Detail Design Project
Students will be asked to carry out the detail design of an offshore structure. For that, they will be working in groups. The project will have to be developed based on specific functional requirements from the "client", the standards and codes that apply to the project, the requirements for construction, the functional limitations for transport and installation, and the restrains of cost and time from the "project manager". For the project, students will be asked to do hand calculations, as well as use software tools such as spreadsheets and FEA packages.

Tutorials
The tutorial action will be carried out offering availability through e-mail.

Exams
There will be an exam, in the middle of the quartermaster, that will cover the second part of the course (Basics of Structural Design). Students that don´t pass the exam will have the opportunity to repeat the exam during the exam period at the end of the quartermaster. Those who do not attend any of the two exams, will be classified as not presented

BIBLIOGRAPHY

Basic:
- Gerwick, Ben C. Construction of marine and offshore sructures. 3rd. Boca Raton: CRC Press, 2007. ISBN 9780849330520.
- Chakrabarti, Subrata K. Handbook of offshore engineering [on line]. Amsterdam [etc.]: Elsevier, cop. 2005 [Consultation: 01/09/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780080443812/handbook-of-offshore-engineering. ISBN 0080443818.
- API. Recommended practice 2A-WSD : planning, designing and constructing fixed offshore platforms : working stress design. 22nd. Washington: American Petroleum Institute, 2014.
- Cobb, Fiona. Structural engineer's pocket book. 2nd. Oxford: Elsevier/Butterworth-Heinemann, 2009. ISBN 9780750686860.

RESOURCES

Other resources:
Standards:

Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms—Working Stress Design API, 21st Edition , 2000, American Petroleum Institute
Specification for Structural Steel Buildings AWD and Plastic Design, 1989 American National Standard
Specification for Structural Steel Buildings ANSI/AISC 360-10, 2010 American National Standard