Course guide
280821 - 280821 - Marine Foundations

Last modified: 09/05/2023

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 751 - DECA - Department of Civil and Environmental 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: MARCOS ARROYO ALVAREZ DE TOLEDO

Others: Segon quadrimestre:
MARCOS ARROYO ALVAREZ DE TOLEDO - MUENO
CARLOS MARIA LOPEZ GARELLO - MUENO
ANNA RAMON TARRAGONA - MUENO
ENRIQUE EDGAR ROMERO MORALES - MUENO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
ENO_CEe2-6. Capacity for the design and project of platforms for offshore wind turbines (specific competence of the specialty in Ocean Energy)
ENO_CEe2-7. Knowledge and design capacity of the different types of foundations for offshore structures. Knowledge of the resistant capacity of soils (specific competence of the specialty in Ocean Energies)

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

4 different type of face-to-face sessions are included in the unit:
1. Theoretical session (T). In which the information relevant to the different topics covered in the syllabus is exposed and discussed in the classroom
2. Exercise session (P). Dedicated to solve application exercises in the classroom
3. Laboratory session (L). Taken place in the soil mechanics laboratory where the class is divided in teams to perform simple soil mechanics tests.
4. Personal work presentation (E). The students present the results of their own research work at the classroom.
The students are expected to
1. Study the contents of the theoretical and exercise sessions
2. Attend the laboratory sessions and report back on their activity during them
3. Hand back a design exercise assigned by groups. The exercise typically consists on the evaluation of some foundation design problem with help from commercial "ad hoc" software (OPILE)
4. Hand back ad present a short research assignment which is distributed in the classroom (individually or to two persons, depending on its difficulty and length)

LEARNING OBJECTIVES OF THE SUBJECT

Familiarity with basic soil mechanics principles relevant for offshore foundation design
Familiarity with offsore geotechnical site investigation procedures and instruments. Awareness of main geohazards affecting offshore developments.
Familiarity with pile design procedures relevant for the offshore environment. Knowledge of alternative offshore foundation types

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

1. Introduction

Description:
Offshore foundations: tipology.
The offshore geotechnical environment.
Geohazards
Normatives

Full-or-part-time: 18h
Theory classes: 3h
Guided activities: 3h
Self study : 12h

2. Soil mechanics

Description:
Soil description and classification.
Groundwater flow and permeability.
Soil strength
Soil stiffness

Specific objectives:
Familiarize the student with the fundamental concepts of soil mechanics relevant for the offshore environment

Related activities:
Laboratory 1: identification of soils
Laboratory 2: flux of water through soils

Full-or-part-time: 31h
Theory classes: 7h
Laboratory classes: 6h
Guided activities: 5h
Self study : 13h

3. Offshore site investigations

Description:
Geophysics
Probing: the CPTu. Other probes
Sampling techniques
Laboratory testing

Specific objectives:
Gain familiarity with the techniques of geotechnical investigation relevant for the offshore environment

Related activities:
Some topics may be developed through individual research work

Full-or-part-time: 21h
Theory classes: 5h
Guided activities: 4h
Self study : 12h

4. Offshore pile foundations

Description:
Types of piles
Pile installation
Axial capacity
Lateral capacity
Effect of cyclic loading

Related activities:
Team design work with OPILE code

Full-or-part-time: 25h
Theory classes: 6h
Practical classes: 6h
Self study : 13h

5. Direct foundations for offshore structures

Description:
Gravity base
Suction caissons
Jack up

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 6h
Guided activities: 6h
Self study : 12h

GRADING SYSTEM

The final grade (0-10) is obtained as a weighted average of the following items
1. Laboratory (attendance) 10%
2. Laboratory (reports) 10%
3. Group design exercise (15%)
4. Research report and presentation (15%)
5. Final exam (50%)
The final exam typically includes an exercise and several theoretical questions.

BIBLIOGRAPHY

Basic:
- Bhattacharya, Subhamoy. Design of foundations for offshore wind turbines [on line]. New York: John Wiley & Sons, 2019 [Consultation: 28/10/2019]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/9781119128137. ISBN 9781119128137.
- Randolph, Mark; Gourvenec, Susan. Offshore geotechnical engineering [on line]. Boca Raton: CRC Press, 2017 [Consultation: 01/09/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=672422. ISBN 9781138074729.

RESOURCES

Other resources:
OPILE (Software for pile design oriented to offshore structures)