Course guide
280800 - 280800 - Ship Dynamics

Last modified: 25/10/2023

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). (Compulsory subject).

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

LECTURER

Coordinating lecturer: ANNA MUJAL COLILLES

Others: Primer quadrimestre:
ANNA MUJAL COLILLES - MUENO
PAU TRUBAT CASAL - MUENO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
MUENO_CE1. Ability to design ships suitable for the needs of the maritime transport of people and goods, and those of maritime defense and security
MUENO_CE3. Knowledge of the dynamics of the ship and of the naval structures, and ability to perform optimization analysis of the structure, the integration of the systems on board, and the behavior of the ship at sea and its maneuverability

Generical:
MUENO_CG1. Ability to solve complex problems and to make responsible decisions based on the scientific and technological knowledge acquired in basic and technological subjects applicable in naval and ocean engineering, and in management methods
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_CG3. Ability to project ships and boats of all kinds
MUENO_CG6. Ability to conduct research, development and innovation in naval and ocean products, processes and methods
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:
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

Lectures
Participative lecturers
Self-study by solving exercises
Learning based in problems / projects

LEARNING OBJECTIVES OF THE SUBJECT

The study of the ship behavior at sea is focused to the movements and efforts produced by waves in the marine systems. The behavior at sea affects the design and the operation. The operating conditions depend, to a large extent, on the stations and the navigation area, among many other conditions.
Main objectives are:
Give a basic knowledge of ship dynamics and how to predict ship motions in advance based on its state of load and the prevailing sea and wind conditions.
Provide information on fundamentals of linear and non-linear ship motion in calm water and in waves.
Establish a background of applied methods for description of natural ocean waves and calculation of forces and moments on ship due to sea loads and the resultant ship motion.

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. Ship Dynamics

Description:
Spiral design.
Ship motion.
Wave characteristics.
Models used.
Physical modelling.

Specific objectives:
Overview of the course. Understanding what ship dynamics is. Basis of the course notation. Which type of models are used in Ship Dynamics to predict the response of a ship in the design process.

Related activities:
Assignment 1

Full-or-part-time: 11h
Theory classes: 3h
Guided activities: 2h
Self study : 6h

2. Initial motion

Description:
Propulsion system.
Rudders and initial rudder design.
Hull form.
Stabilization systems.

Specific objectives:
At the initial design steps dtermine the power needed, the rudder characteristics and the hull form of the ship. Know and understand the mechanisms of stabilization systems

Related activities:
Assignment 2

Full-or-part-time: 18h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 2h
Self study : 8h

3. Ocean waves

Description:
Basic definitions.
Potential flow.
Time domain vs. frequency domain.
Waves formation.
Irregular seas

Specific objectives:
Be able to describe the characteristics of the sea state at which the ship will be operating

Related activities:
Assignment 3

Full-or-part-time: 41h
Theory classes: 8h
Laboratory classes: 4h
Guided activities: 4h
Self study : 25h

4. Equations of motion

Description:
Encountering frequency.
Linear systems.
Response Amplitude Operation.
Equations of Motion.
Strip theory

Specific objectives:
To understand the equations of motion and the ship responses to particular sea states

Related activities:
Assignment 4

Full-or-part-time: 24h
Theory classes: 8h
Laboratory classes: 4h
Guided activities: 4h
Self study : 8h

5. Maneuvering

Description:
Controllability.
Linear Equation of Motion.
Experiments and index.
Rudder design

Specific objectives:
learn the maneuvering tests and the impact the rudder design has on them

Related activities:
Assignment 5

Full-or-part-time: 18h
Theory classes: 4h
Laboratory classes: 2h
Guided activities: 4h
Self study : 8h

6.Effects on crew and passengers

Description:
Welfare on board.
Sporadic phenomena

Specific objectives:
Estimate the wave frequency that can produce effects on crew and passengers. Lear the sporadic phenomena that can affect both people on board and the ship structures

Related activities:
Assignment 6

Full-or-part-time: 13h
Theory classes: 2h
Laboratory classes: 2h
Guided activities: 2h
Self study : 7h

GRADING SYSTEM

The final score is the sum of the following partial grades:

Nfinal=0.35Nfp+0.25Nsp+0.4Nac

The second exam will ve evaulated only if the marks of the first exam are larger or equal to 3.5 over 10. Otherwise the class will be evaluated as follows:
Nfinal = 0.7Nef + 0.3Nac

Also, students have the free evaluation option which consists on the marks of the final exam.

Nac will only be evaluated if all the works are presented on time

Nfinal: final score
Nfp: first partial exam
Nsp: second partial exam
Nac: continuous assessment
Nef: final exam marks

Partial exams consist of some issues associated with the learning objectives of the course so that respects the knowledge and understanding concepts, and a set of application exercises. The continuous assessment consists of different activities cumulative and formative character, both individual and group, made during the course.

EXAMINATION RULES.

It is not possible to pass the course if all work activities and continuous assessment are carried out and submitted.
If the student does not carried out partial and/or final exam, he or she will be considered as: Not Presented
In any case, the student can use any kind of predesigned form in controls or tests.

Work activities consist in a time-sequential work group divided in 6 assignments. At the end of the course an oral presentation will be required.

BIBLIOGRAPHY

Basic:
- Lloyd, A.R.J.M. Seakeeping : ship behaviour in rough weather. 2nd rev. ed. Hampshire: Seakeeping, 1996. ISBN 0953263401.
- Olivella Puig, Joan. Teoría del buque : ola tricoidal, movimientos y esfuerzos [on line]. Barcelona: Edicions UPC, 1998 [Consultation: 24/02/2020]. Available on: http://hdl.handle.net/2099.3/36646. ISBN 8483012596.
- Lewis, Edward V (ed.). Principles of naval architecture. Vol 3 : motions in waves and controllability. 2nd revision. Jersey City, NJ: The Society of Naval Architects and Marine Engineers, 1988-1989. ISBN 0939773023.
- Baquero, Antonio. Maniobrabilidad del buque. Madrid: ETSIN, 2014.
- González Álvarez-Campana, José Ma. Comportamiento del buque en la mar : fundamentos. Madrid: ETSIN, 2013.
- González Álvarez-Campana, José Ma. Comportamiento del buque en la mar : aplicación. Madrid: ETSIN, 2011.