Course guide
280817 - 280817 - Lightweight Structural Design

Last modified: 21/01/2026

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: 2025 **ECTS Credits:** 5.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: FERMIN ENRIQUE OTERO GRUER

Primer quadrimestre:
FERMIN ENRIQUE OTERO GRUER - Grup: MUENO

Others: Primer quadrimestre:
FERMIN ENRIQUE OTERO GRUER - Grup: MUENO

PRIOR SKILLS

Advanced knowledge of strength of materials and structural analysis. Knowledge on numerical methods for structural analysis.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
ENO_CEe1-1. Knowledge of the existing regulations that regulate the project of pleasure and competition boats (specific competence of the specialty in Design of Yachts and Recreational Boats)
ENO_CEe1-4. Ability to analyze the structural behavior and optimize the structure of pleasure and competition boats (specific competence of the specialty in Yacht and Recreational Boat Design)
ENO_CEe1-7. Knowledge of the materials used in the construction of pleasure boats. Knowledge of your working conditions and maintenance requirements. Knowledge of the mechanical behavior of these materials and their failure modes (specific competence of the specialty in Design of Yachts and Pleasure Boats)

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

Master Class
Class with students participation
Cooperative learning
Self learning by solving problems and exercises
Learning based on projects

LEARNING OBJECTIVES OF THE SUBJECT

Capacity to design light structures made of composite materials.
Capacity to use this knowledge for the design of naval architecture structures.

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 to Composite Materials

Description:
Types of composite materials and their constituents: fibres, matrices, and cores.
Manufacturing methods for composite materials.
Numerical characterization methods for the analysis and design of composite structures.
Naval structures made of composite materials.

Full-or-part-time: 5h
Theory classes: 3h
Self study : 2h

2. Laminate Mechanics

Description:
Mechanical behaviour of laminated composites: elastic properties and lamina failure criteria.
Calculation of the mechanical properties of composite laminates.
Introduction to the ComposeIT software.

Full-or-part-time: 14h
Theory classes: 3h
Practical classes: 3h
Self study : 8h

3. Laminated Composite Structures

Description:
Laminate orientation.
Laminate stiffness as a function of topology: monolithic laminates, symmetric and asymmetric laminates, and sandwich structures.
Failure modes of laminated composites.
Numerical simulation of laminated composite structures.

Full-or-part-time: 45h
Theory classes: 6h
Practical classes: 9h
Self study : 30h

4. Advanced Simulation of Composite Structures

Description:
Nonlinear simulation of materials.
Damage and plasticity theories for laminated composite simulation.
Nonlinear analysis of composite structures.

Full-or-part-time: 42h
Theory classes: 6h
Practical classes: 6h
Self study : 30h

5. Regulations for Lightweight Structure Design

Description:
Regulatory framework for the design of composite structures established by classification societies.
Current regulations for the design of small composite vessels.

Full-or-part-time: 19h
Theory classes: 4h 30m
Practical classes: 4h 30m
Self study : 10h

GRADING SYSTEM

The final mark of the course will be obtained with the following formula:
Nfinal = 0.5·Npp + 0.5·Nec

Nfinal: Final Mark
Npp: Mark obtained in a mid-term test
Nec: Mark obtained from course projects and assignments

EXAMINATION RULES.

The student must complete at least the 75% of the course exercises and assignments to be evaluated of the course.

BIBLIOGRAPHY

Basic:
- Barbero, Ever J. Introduction to composite materials design [on line]. 2nd ed. Boca Raton: Taylor & Francis, 2011 [Consultation: 11/07/2025]. Available on: https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9781439894132/introduction-composite-materials-design-ever-barbero. ISBN 9781420079159.
- International Organization for Standardization. UNE-EN ISO 12215-5 : Pequeñas embarcaciones. Construcción de cascos y escantillones. Parte 5: Presiones de diseño, tensiones de diseño y determinación del escantillón [on line]. Madrid: AENOR, 2019 [Consultation: 04/07/2022]. Available on: https://discovery.upc.edu/permalink/34CSUC_UPC/rdgucl/alma991000617169706711.
- Oller, Sergio. Numerical simulation of mechanical behavior of composite materials [on line]. Barcelona: CIMNE : Springer, 2014 [Consultation: 04/07/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-319-04933-5. ISBN 9783319049328.

Complementary:
- Oller, Sergio. Nonlinear dynamics of structures [on line]. Barcelona: International Center for Numerical Methods in Engineering (CIMNE) : Springer, 2014 [Consultation: 04/07/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-319-05194-9. ISBN 9783319051932.