



Course guide

2400305 - 240MAU16 - Composite Materials in Structures

Last modified: 26/06/2026

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering.

Degree: MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2026). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 2.5 **Languages:** Spanish

LECTURER

Coordinating lecturer: Juan Pedro Roldán Blasco

Others: Juan Pedro Roldán Blasco

TEACHING METHODOLOGY

The teaching methodology combines theoretical lectures, practical sessions using computational tools, and experimental laboratory activities. Lectures are devoted to the presentation of the theoretical foundations and mechanical models addressed in the course. Practical sessions provide training in the use of appropriate software for the analysis and design of composite materials. Finally, laboratory activities are aimed at experimentally assessing the theoretical models and analysing their range of applicability.

LEARNING OBJECTIVES OF THE SUBJECT

The course aims to introduce the mechanical behaviour of composite materials from a hierarchical modelling perspective, combining theory and experimentation to identify the range of validity of each modelling approach.

The objective is not only to determine material properties, but also to compare theoretical predictions with experimental observations in order to understand the limitations of the models employed.

STUDY LOAD

Type	Hours	Percentage
Self study	40,0	64.00
Hours large group	15,0	24.00
Hours small group	7,5	12.00

Total learning time: 62.5 h

CONTENTS

Bending with composite action

Description:

Extension of the Euler–Bernoulli beam theory to cross-sections with multiple materials.

- Neutral axis in composite cross-sections
- Transformed section method
- Equivalent modulus

Specific objectives:

Understanding stress redistribution in heterogeneous systems.

Related activities:

Bending of composite beams with different materials: numerical simulation and theoretical analysis. (1/3 Lecture, 2/3 lab simulation)

Full-or-part-time: 6h

Theory classes: 2h

Laboratory classes: 4h

Elastic and strength orthotropy.

Description:

Introduction to the anisotropic behaviour of composite materials at lamina level.

- Orthotropic elastic constants (EL, ET, GLT, vLT)
- Directional dependence of the mechanical response

Specific objectives:

To demonstrate elastic anisotropy and the directional dependence of the mechanical behaviour.

Related activities:

Tensile testing and numerical simulation of unidirectional laminates with different fibre orientations (0° , 90° , $\pm 45^\circ$).

Full-or-part-time: 6h

Theory classes: 2h

Laboratory classes: 4h

Classical Laminate Theory (CLT).

Description:

Modelling of the global behaviour of multilayer laminates.

- Constitutive matrices A, B, D
- Extensional–flexural coupling (related to the concept of neutral axis introduced in Topic 1)
- Influence of the stacking sequence

Specific objectives:

Modelling of the global behaviour of multilayer laminates.

Related activities:

Flexural testing of laminates with different stacking sequences.

Full-or-part-time: 9h

Theory classes: 3h

Laboratory classes: 6h



Laminated plate theory with shear deformation.

Description:

Introduction of first-order plate models (FSDT) to capture transverse shear effects.

- Limitations of classical plate theory (Kirchhoff)
- Importance of shear deformation
- Core stiffness in sandwich structures

Specific objectives:

Demonstrate the need for shear-deformable models in thick structures or structures with compliant cores.

Related activities:

Flexural testing and simulation of sandwich structures with honeycomb core.

Full-or-part-time: 6h

Theory classes: 2h

Laboratory classes: 4h

GRADING SYSTEM

Laboratory reports (40%):

Students shall submit reports corresponding to the experimental laboratory activities. These reports will assess the ability to interpret the experimental results, compare them with the theoretical models studied, and analyse the limitations and range of applicability of the different models.

Final examination (60%):

Written examination aimed at assessing the understanding of the theoretical models developed throughout the course, as well as their application to practical problems related to composite materials.

Reevaluation exam (60%) replaces the mark of the final exam

EXAMINATION RULES.

Assessment activities may be written and/or practical in nature. Depending on the characteristics of each assessment activity, the use of computers, calculators, or other supporting materials may be permitted or restricted. The specific conditions for each assessment activity will be communicated in advance.

RESOURCES

Other resources:

Resources will be provided during the course, and will include simulation software.