

Course guide

330507 - CAL2 - Calculus 2

Last modified: 28/04/2025

Unit in charge: Manresa School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Gimenez Pradales, Jose Miguel

Others: Freixas Bosch, Josep

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE1. Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives; numerical methods; numerical algorithms; statistics and optimization.

Generical:

CG3. Knowledge of basic and technological subjects that will enable students to learn new methods and theories and that will endow them with the versatility needed to adapt to new situations.

Transversal:

1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Basic:

CB1. Students will be able to demonstrate their knowledge of a field of study that builds on secondary education and is usually found at a level that, while supported by advanced textbooks, also includes aspects that involve knowledge of the latest developments in the field of study.

CB2. Students will be able to apply their knowledge to their work or vocation in a professional manner and demonstrate that they possess the competencies that are typically demonstrated by elaborating and defending arguments and solving problems in the field of study.

TEACHING METHODOLOGY

- MD1 Master class or lecture (EXP)
- MD2 Problem solving and case study (RP)
- MD5 Small-scale project, activity or assignment (PR)
- MD6 Large-scale project or assignment (PA)
- MD7 Assessment activities (EV)

LEARNING OBJECTIVES OF THE SUBJECT

To identify curves, surfaces and level curves on surfaces.
 To compute and apply partial derivatives and gradient vectors.
 To use equations to describe regions of the plane, of space, curves and surfaces.
 To apply multiple integrals to obtain areas, volumes, masses and moments.
 To work with vector calculus, especially applied to curves and surfaces.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Topic 1: Functions of several variables

Description:

Surfaces and level curves.
 Partial derivatives.
 Gradient and directional derivatives.
 Maxima, minima, and saddle points.
 Constraints and Lagrange multipliers.

Specific objectives:

Introduction of the concept of the function with several variables and ability to work with partial derivatives.

Related activities:

P1, E1, EF

Full-or-part-time: 21h

Theory classes: 4h
 Laboratory classes: 5h
 Self study : 12h

Topic 2: Multiple integrals

Description:

Definition of double integral.

Surfaces: paraboloids, hyperboloids, spheres, cylinders, cones, ellipsoids.

Fubini's Theorem.

Change to other coordinates. Polar coordinates.

Definition and computation of triple integrals.

Cylindrical and spherical coordinates.

Applications: area, volume, mass, moments.

Specific objectives:

To introduce the concept of multiple integrals and the ability to describe the integration regions in the plane or in space.

Related activities:

P1, E1, EF

Full-or-part-time: 43h

Theory classes: 8h

Laboratory classes: 10h

Self study : 25h

Topic 3: Line integrals

Description:

Curves. Parametrized curves. Curvature. Torsion. The Frenet frame.

Length of a curve from parametric equations.

Line integral of scalar functions.

Line integral of vector fields.

Application: work along a curve.

Green's theorem.

Independence of paths.

Conservative fields and potential functions.

Specific objectives:

To learn to describe curves in parametric form and to learn integration techniques on curves.

Related activities:

P2, E2, EF

Full-or-part-time: 27h

Theory classes: 5h

Laboratory classes: 6h

Self study : 16h



Topic 4: Surface integrals

Description:

Surfaces. Parametrized surfaces.
Area of a surface from parametric equations.
Surface integral of scalar functions.
Surface integral of vector fields.
Application: flow through a surface.
The divergence theorem.
The curl of a vector field and Stokes' theorem.

Specific objectives:

Ability to describe surfaces in parametric form and knowledge of integration techniques on surfaces.

Related activities:

P2, E2, EF

Full-or-part-time: 27h

Theory classes: 5h

Laboratory classes: 6h

Self study : 16h

ACTIVITIES

Activity 1: P1 Practical session 1

Description:

Questionnaire or practical exercises.

Specific objectives:

Work with the concepts and the procedures exposed in Topics 1 and 2.

Material:

Atenea virtual campus, specific software.

Delivery:

The results of the activity must be submitted to the professor.

Full-or-part-time: 5h

Self study: 3h

Laboratory classes: 2h

Activity 2: E1 Partial exam 1

Description:

Practical exercises and questions related to Topics 1 and 2.

Specific objectives:

Work with the concepts and the procedures presented in Topics 1 and 2.

Material:

None.

Delivery:

The results of the activity must be submitted to the professor.

Full-or-part-time: 5h

Theory classes: 2h

Self study: 3h

Activity 3: P2 Practical session 2

Description:

Questionnaire or practical exercises.

Specific objectives:

Work with the concepts and the procedures presented in Topics 3 and 4.

Material:

Atenea virtual campus, specific software.

Delivery:

The results of the activity must be submitted to the professor.

Full-or-part-time: 5h

Self study: 3h

Laboratory classes: 2h

Activity 4: E2 Partial exam 2

Description:

Practical exercises and questions related to Topics 3 and 4.

Specific objectives:

Work with the concepts and the procedures presented in Topics 3 and 4.

Material:

None.

Delivery:

The results of the activity must be submitted to the professor.

Full-or-part-time: 5h

Self study: 3h

Theory classes: 2h

Activity 5: EF Final exam

Description:

Practical exercises and questions related to all topics.

Specific objectives:

Work with the concepts and the procedures presented in all topics.

Material:

None.

Delivery:

The results of the activity must be submitted to the professor.

Full-or-part-time: 12h

Theory classes: 3h

Self study: 9h

GRADING SYSTEM

Class attendance is not considered as part of a student's course mark.

NP1 = the mark obtained from the partial exam E1 with a maximum of 30% obtained from the practical session E1.

NP2 = the mark obtained from the partial exam E2 with a maximum of 30% obtained from the practical session E2.

NEF = the mark obtained from the final exam (EF).

Course mark = $\max \{NEF, 0.5 NP1 + 0.5 NP2\}$

EXAMINATION RULES.

A missed activity results in a mark of 0 for the activity.

BIBLIOGRAPHY

Basic:

- Bradley, Gerald L.; Smith, Karl J. Cálculo. Vol. 2, Cálculo de varias variables. Madrid: Prentice Hall, 1998. ISBN 8489660778.

- Larson, Ron; Hostetler, Robert P.; Edwards, Bruce H. Cálculo [on line]. 9a ed. Madrid: Pirámide, 2010 [Consultation: 07/06/2022]. Available on :

https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686. ISBN 9786071502735.

- Stewart, James. Cálculo multivariable. 4ª ed. México: International Thomson, 2001. ISBN 9706861238.

- Thomas, George B., i altres. Cálculo. Vol. 2, Varias variables [on line]. 11ª ed. México: Pearson Educación, 2005-2006 [Consultation: 14/09/2022]. Available on :

https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5852. ISBN 9702606446.