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330507 - CAL2 - Calculus 2

Coordinating unit: 330 - EPSEM - Manresa School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Gimenez Pradales, Jose Miguel

Others: Alsina Aubach, Montserrat
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Puente Del Campo, M. Albina
Rossell Garriga, Josep Maria
Rubió Massegú, Josep
Ventura Capell, Enric

Degree competences to which the subject contributes

Basic:

CB1. The students have demonstrated to possess and to understand knowledge in an area of study that starts from the base of the general secondary education, and is usually found to a level that, although it relies on advanced textbooks, also includes some aspects that involve knowledge from the vanguard of their field of study.
CB2. Students can apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of study.

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 in basic and technological subjects that will enable them to learn new methods and theories and give them the versatility 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.

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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

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	20.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

Topic 1: Functions of several variables

Learning time: 21h

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

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

Related activities:
P1, E1, EF

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

Topic 2: Multiple integrals

Learning time: 43h

Theory classes: 8h
Laboratory classes: 10h
Self study : 25h

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.

Related activities:
P1, E1, EF

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

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Topic 3: Line integrals

Learning time: 27h

Theory classes: 5h
Laboratory classes: 6h
Self study : 16h

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.

Related activities:
P2, E2, EF

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

Topic 4: Surface integrals

Learning time: 27h

Theory classes: 5h
Laboratory classes: 6h
Self study : 16h

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.

Related activities:
P2, E2, EF

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

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Planning of activities

Activity 1: P1 Practical session 1

Hours: 5h
Laboratory classes: 2h
Self study: 3h

Description:
Questionnaire or practical exercises.

Support materials:
Atenea virtual campus, specific software.

Descriptions of the assignments due and their relation to the assessment:
The results of the activity must be submitted to the professor.

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

Activity 2: E1 Partial exam 1

Hours: 5h
Theory classes: 2h
Self study: 3h

Description:
Practical exercises and questions related to Topics 1 and 2.

Support materials:
None.

Descriptions of the assignments due and their relation to the assessment:
The results of the activity must be submitted to the professor.

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

Activity 3: P2 Practical session 2

Hours: 5h
Laboratory classes: 2h
Self study: 3h

Description:
Questionnaire or practical exercises.

Support materials:
Atenea virtual campus, specific software.

Descriptions of the assignments due and their relation to the assessment:
The results of the activity must be submitted to the professor.

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

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Activity 4: E2 Partial exam 2	Hours: 5h Theory classes: 2h Self study: 3h

Description:
Practical exercises and questions related to Topics 3 and 4.

Support materials:
None.

Descriptions of the assignments due and their relation to the assessment:
The results of the activity must be submitted to the professor.

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

Activity 5: EF Final exam	Hours: 12h Theory classes: 3h Self study: 9h

Description:
Practical exercises and questions related to all topics.

Support materials:
None.

Descriptions of the assignments due and their relation to the assessment:
The results of the activity must be submitted to the professor.

Specific objectives:
Work with the concepts and the procedures presented in all topics.

Qualification 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}

Regulations for carrying out activities

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

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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. 7ª ed. Madrid: Pirámide, 2002-2003. ISBN 844811729X.

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

Thomas, George B., i altres. Cálculo. Vol. 2, Varias variables. 11ª ed. México: Pearson Educación, 2005-2006. ISBN 9702606446.

Others resources: