

Course guide

230083 - CAVEC - Vector Calculus

Last modified: 17/06/2024

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

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: CARLES PADRO LAIMON

Others:

Primer quadrimestre:
MIGUEL ESCUDERO ROYO - 40
SEBASTIA MARTIN MOLLEVI - 10
NARCISO ROMAN ROY - 10

Segon quadrimestre:
MARIA BRAS AMOROS - 40
ALVARO MOZOTA FRAUCA - 20, 30
CARLES PADRO LAIMON - 40
NARCISO ROMAN ROY - 10

PRIOR SKILLS

Linear algebra and differential and integral calculus on one variable

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

12 CPE N1. They will be able to identify, formulate and solve engineering problems in the ICC field and will know how to develop a method for analysing and solving problems that is systematic, critical and creative.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

To begin with, the concepts introduced in Càlcul 1 about functions of one real variable are generalized to several variables. Specifically, differential and integral calculus and their applications as, for example, optimization problems.

The basic concepts of differential geometry of curves and surfaces, in the plane and in the space, are introduced with the aim to study the fundamental theorems of vector calculus: Stokes' theorem and divergence theorem, which are fundamental to the study of electromagnetic fields.

STUDY LOAD

Type	Hours	Percentage
Hours large group	65,0	43.33
Self study	85,0	56.67

Total learning time: 150 h

CONTENTS

Euclidean space

Description:

Euclidean space. Scalar product, norm and distance. Interior, exterior and boundary of a set. Limit points. Open and closed sets. Compact sets. Completeness of the Euclidean space, Bolzano-Weierstrass theorem. Limits of sequences and Cauchy sequences

Full-or-part-time: 16h

Theory classes: 7h

Self study : 9h

Functions of several variables

Description:

Scalar and vector functions. Graph and level sets. Composition of functions. Limits and continuity. Continuous functions on compact sets and on arc-connected sets.

Full-or-part-time: 14h

Theory classes: 6h

Self study : 8h

Differentiation of functions of several variables

Description:

Differentiable functions, derivative of a function. Jacobian matrix. Directional derivatives. Gradient. Chain rule. Functions of class C^1 . Inverse and implicit function theorems. Diffeomorphisms. Polar, cylindrical and spherical coordinates. Differential operators: curl and divergence. Derivatives of higher order. Schwarz theorem. Hessian matrix and Taylor formula of degree 2. Local extrema.

Full-or-part-time: 35h

Theory classes: 15h

Self study : 20h

Curves and surfaces

Description:

Regular parameterization of curves and surfaces. Implicit curves and surfaces. Computation of constrained extrema. Lagrange multipliers. Optimization: extreme values.

Full-or-part-time: 24h

Theory classes: 10h

Self study : 14h

Multiple integration

Description:

Riemann integral. Fubini's theorem. Change of variables. Leibniz formula. Improper integrals.

Full-or-part-time: 24h

Theory classes: 10h

Self study : 14h

Line and surface integrals

Description:

Line and surface integrals of a scalar function. Geometrical applications. Circulation and flux of a vector field. Path independence. Conservative fields. Computation of the scalar potential. Simply connected sets. Green's and Stokes' theorems. Solenoidal vector fields. Divergence theorem.

Full-or-part-time: 35h

Theory classes: 15h

Self study : 20h

GRADING SYSTEM

Evaluation: continuous, along the term, with a 40% weight, and a final test, with a 60% weight. Or 100% for the final test if the mark is higher

BIBLIOGRAPHY

Basic:

- Marsden, Jerrold E; Tromba, Anthony. Cálculo vectorial [on line]. 6a ed. Madrid [etc.]: Addison Wesley, 2018 [Consultation: 08/05/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7634. ISBN 9788490355787.

Complementary:

- Apostol, Tom M. Calculus, vol. 1 [on line]. 2a. ed. Barcelona [etc.]: Reverté, 1972 [Consultation: 16/11/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8020. ISBN 8429150013.

- Marsden, Jerrold E; Tromba, Anthony. Cálculo vectorial : problemas resueltos. 3ª ed. Argentina [etc.]: Addison-Wesley Iberoamericana, 1993. ISBN 0201625644.

- Spiegel, Murray R. Cálculo superior. México [etc.]: McGraw-Hill, 1969. ISBN 8485240663.

- Bombal Gordon, Fernando; Rodríguez Marín, Luis; Vera Botí, Gabriel. Problemas de análisis matemático. 2a ed. Madrid: AC, 1987-1988. ISBN 8472881024.

- Spiegel, Murray R.; Lipschutz, Seymour. ; Liu, John. Fórmulas y tablas de matemática aplicada [on line]. 4a ed. Madrid [etc.]: Mc Graw-Hill, 2014 [Consultation: 14/05/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5688. ISBN 9786071511454.

RESOURCES

Other resources:

Lecture notes and slides, collected exercises, solutions to exercises and exams