

Course guide

230455 - CAL2 - Calculus 2

Last modified: 25/05/2023

Unit in charge:	Barcelona School of Telecommunications Engineering		
Teaching unit:	749 - MAT - Department of Mathematics.		
Degree:	BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Compulsory subject).		
Academic year: 2023	ECTS Credits: 6.0	Languages: Spanish	

LECTURER

Coordinating lecturer:	Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura
Others:	Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS

Knowledge of notions and methods of one-variable-calculus and linear algebra

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

3. Ability to solve math problems that may arise in engineering. Ability to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, ordinary and partial differential equations, probability and statistics.
4. Ability to select numerical and optimization methods suitable for solving physical and engineering problems. Ability to apply the knowledge of numerical algorithms and optimization.

Generical:

2. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:

1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

· Presentiality: 2.6 ECTS
Showroom (theory + problems) with student participation.
Practical work individually or in teams. Tutoring

Do not presentiality: 3.4 ECTS
Exercises and theoretical or practical projects outside the classroom
Preparation and measurable activities.

LEARNING OBJECTIVES OF THE SUBJECT

The first objective of this course is extending to functions of several variables the concepts learned in the course of Calculus I, for one variable functions. In particular we study the concepts of differentiability of functions of several variables, multiple integration, and integration on curves and surfaces and their applications to physics and engineering.

It also introduces basic concepts of geometry such as curves and surfaces, with the aim of studying the fundamental theorems of vector analysis, theorems of Green, Stokes and Gauss. These theorems are the theoretical study of electromagnetic fields.

Learning Outcome:

- Domain solving math problems that may arise in physics, and the ability to apply their knowledge of geometry, vector analysis, differential and integral calculus (several variables).
- Use the resources and services available to run simple searches. Classifies and summarizes the information gathered.
- Carries out the tasks on schedule, according to the guidelines set by the teacher or tutor.
- It raises the problem correctly from the proposed language and identify options for resolution.
- Apply the appropriate solution method and identifies the correct solution.
- Identify, model and poses problems from open situations. Explore and implement alternatives for resolution. Known approximations.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Topology. Limits and continuity of functions of several variables.

Description:

Open sets. Closed sets. Closure. Compact sets.

Vector sequences.

Functions of several variables. Level sets. Limits. Continuity.

Full-or-part-time: 11h 30m

Theory classes: 3h 30m

Practical classes: 2h 15m

Self study : 5h 45m

Differentiability of functions of several variables.

Description:

Partial derivatives and directional derivatives. Differentiability. Differential properties of functions. Chain rule. Implicit function theorem and inverse function

Full-or-part-time: 32h 20m

Theory classes: 7h 45m

Practical classes: 5h 35m

Self study : 19h



Taylor's formula.

Description:

Higher-order derivatives. Taylor's theorem. Applications.

Full-or-part-time: 12h 55m

Theory classes: 4h 05m

Practical classes: 2h 10m

Self study : 6h 40m

Applications of differential calculus: Extremals. Differential operators. Curves and surfaces.

Description:

Critical points. Local extremes. Sufficient conditions of extremals.

Extreme conditions. Lagrange multipliers.

Absolute extremals.

Gradient. Curl. Divergence. Laplacian.

Curves and surfaces. Parametrizations.

Full-or-part-time: 23h

Theory classes: 5h 50m

Practical classes: 4h 25m

Self study : 12h 45m

Multiple integrals.

Description:

Double and triple integrals. Definition of integral (Riemann). Fubini theorem. Change of variable.

Functions defined by integrals and derivation under the integral sign.

Improper integrals.

Applications.

Full-or-part-time: 27h 30m

Theory classes: 6h 05m

Practical classes: 4h 55m

Self study : 16h 30m

Integrals along curves and integrals on surfaces.

Description:

Line and surface integrals of scalar fields. Calculating lengths and areas. Applications.

Line and surface integrals of vector fields: circulations and flows. Applications.

Conservative and solenoidal fields.

Full-or-part-time: 16h 10m

Theory classes: 4h 40m

Practical classes: 3h 10m

Self study : 8h 20m

Theorems of vector calculus.

Description:

Theorems of Green, Stokes and Gauss-Ostrogadski. Applications.

Full-or-part-time: 26h 35m

Theory classes: 7h 05m

Practical classes: 4h 30m

Self study : 15h

GRADING SYSTEM

The rating will consist of a final exam (FE) and an evaluation along the course that will take into account the implementation of a mid-term exam (EP).

The final rating will be given by

$\max \{EF, 0.60 * EF + 0.40 * EP\}$

BIBLIOGRAPHY

Basic:

- Marsden; J.E.; Tromba; A.J. Cálculo vectorial [on line]. 6a ed. Madrid: Pearson, 2018 [Consultation: 10/06/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7634. ISBN 9788490355787.
- Spiegel, M.; Lipschutz, S.; Spellman, D.. Análisis Vectorial. Mexico: McGraw-Hill, 1998. ISBN 9701020960.

Complementary:

- Burgos, J. Cálculo infinitesimal de varias variables [on line]. 2a. Madrid: McGraw-Hill, 2008 [Consultation: 13/10/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=3974. ISBN 9788448161088.
- Compta, A.; Bonet, C.; Consul, N.; Ollé, M.; Roig, A.; Pascual, P. Càlcul integral per a enginyers [on line]. Barcelona: Universitat Politècnica de Catalunya, 2002 [Consultation: 26/06/2020]. Available on: <http://hdl.handle.net/2099.3/36742>. ISBN 8483016273.
- Apostol, Tom M. Análisis matemático. 2a ed. Barcelona [etc.]: Reverté, 1977. ISBN 9788429150049.