

Degree	Type	Year
Physics	FB	1

Contact

Name: Alessio Celi

Email: alessio.celi@uab.cat

Teachers

Marc Miranda Riaza

Axel Pérez-Obiol Castañeda

Teaching groups languages

You can view this information at the [end](#) of this document.

Prerequisites

There are no prerequisites for enrolment.

However, for the development of the course, it is assumed that students have assimilated the contents of the *Càlcul d'una variable* course from the first semester.

Objectives and Contextualisation

This course is the natural continuation of the *Càlcul d'una variable* course from the first semester. It deals with calculus involving functions of several real variables and the study of their differential properties. The main objective is to provide students with the necessary mathematical tools to successfully follow second-year courses such as Classical Mechanics, Electromagnetism, and Optics.

Learning Outcomes

1. CM09 (Competence) Justify the use of calculus in one and several variables and differential equations in the resolution of general problems.
2. CM10 (Competence) Adapt the basic mathematical strategy when approaching a given problem from an analytical point of view.

3. KM09 (Knowledge) Identify the basic concepts of limits, continuity, derivatives and integrals, vector and subspace space, linear and scalar product and the methodology of matrix diagonalisation.
4. KM09 (Knowledge) Identify the basic concepts of limits, continuity, derivatives and integrals, vector and subspace space, linear and scalar product and the methodology of matrix diagonalisation.
5. KM10 (Knowledge) Describe the basic concepts of the calculation of several variables and the different methods of solving differential equations in their different typologies.
6. SM07 (Skill) Apply the mathematical knowledge acquired to the resolution of mathematical and physical problems with mathematical representation.

Content

1. Functions of several variables (limits, continuity, scalar and vector-valued functions, spaces, norm, distance)
2. Differential calculus (partial derivative, directional derivative, differential, gradient, Hessian, implicit function theorem, inverse function theorem, maxima and minima, constrained extrema, Lagrange multipliers)
3. Integration of functions of several variables (parameter-dependent integrals, Leibniz rule, Riemann integral in two variables, double and triple integrals, change of integration order)
4. Vector-valued functions (examples, vector fields, divergence and curl, vector differential calculus)
5. Line and surface integrals (integration over curves and surfaces, surface area calculation, arc length of a curve)
6. Integral theorems of vector calculus (Green's theorem, Stokes' theorem, Gauss' theorem, conservative vector fields)

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem classes	14	0.56	CM10, SM07, CM10
Seminars/In-depth study	8	0.32	CM09, CM10, SM07, CM09
Theory lectures	28	1.12	CM09, KM09, KM10, CM09
Type: Autonomous			
Problem solving	45	1.8	CM10, SM07, CM10
Study	43	1.72	CM09, KM09, KM10, CM09

Theory classes: Presentation of the theoretical content of the course.

Problem-solving classes: Presentation of the solution to some of the problems from the list previously given to the students, along with guidance for solving the remaining ones. In-class problem-solving by the students, working on proposed exercises under the supervision of the instructor.

Seminar/Advanced session: Activity aimed at reviewing and deepening a theoretical topic and/or solving specific problems.

Note: Fifteen minutes of one class session, within the schedule established by the department/degree program, will be reserved for students to complete surveys evaluating the teaching performance of the instructor and the course/module.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Deliveries	20%	5	0.2	CM10, SM07
Partial exam 1	40%	2	0.08	CM09, CM10, KM09, KM10, SM07
Partial exam 2	40%	2	0.08	CM09, CM10, KM09, KM10, SM07
Recovery Exam	40-80%	3	0.12	CM09, CM10, KM09, KM10, SM07

Assessment

- Problem sets (L) (20% of the final grade): one problem will be proposed at the end of each chapter, to be solved individually and submitted within the established deadline. This mark cannot be improved via the recovery exam.
- Midterm and Final Exams (E1 and E2) (40% + 40% of the final grade): to be held halfway through and at the end of the semester, respectively.
- Recovery exam (R): allows improvement of the grade obtained in the midterm and final exams (80% of the final grade). One or both midterms can be retaken, but students must have taken both E1 and E2 and have a combined grade $L+E1+E2 \geq 3/10$ to qualify for the recovery exam.

Non-assessable: students will be marked as non-assessable if they have not completed at least 50% of the assessable activities.

Single-assessment option

Students who opt for the single-assessment mode must take a final exam covering the entire syllabus. This exam will be held on the same day, time, and place as the second midterm exam of the continuous assessment mode. Additionally, before the exam begins, students must submit two written assignments containing the solutions to two selected sets of problems provided earlier. For grading purposes, the exam will account for 80% of the final grade, and each written assignment will account for 10%.

Students who choose the single-assessment mode may still pass or improve their final grade via the same recovery exam used in the continuous assessment (the two exams will be identical and held on the same day, time, and place). However, attending the final exam is a prerequisite for accessing the recovery exam, and students must have obtained a grade $>3/10$. Only the exam component can be retaken; the assignment grades cannot be improved.

Bibliography

Basic Bibliography:

- T.M. Apostol, Calculus (vol.2), Reverté.

Basic more advanced bibliography:

- J.E. Marsden and J. Tromba, Vector Calculus, W.H. Freeman and Co.
- A. Méndez, Càlcul de vèries variables, notes de classe
- J.M. Ortega, Introducció a l'anàlisi matemàtica, Manuals de la UAB.
- J. Rogawski, Càlculo (vol.2), Reverté.
- R. Courant and F. John, Introducción al análisis matemático (vol.2), Limusa.

Software

There are not.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	second semester	morning-mixed
(SEM) Seminars	11	Catalan	second semester	morning-mixed
(SEM) Seminars	12	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed
(TE) Theory	2	Catalan	second semester	morning-mixed