UAB
Universitat Autònoma de Barcelona

Multivariable Calculus

Code: 100153
ECTS Credits: 8

2024/2025

Degree	Type	Year
2500097 Physics	OB	2

Contact

Name: Santiago Peris Rodriguez
Email: santiago.peris@uab.cat

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no prerequisites for registering in this course.

However, it will be assumed in this course that the student is already familiar with the contents of the courses Calculus I and Calculus II from the

first year.

Objectives and Contextualisation

It is the natural continuation of the courses Calculus I and Calculus II. It deals with the calculus in several real variables, and the study of curves and surfaces.

Competences

- Develop the capacity for analysis and synthesis that allows the acquisition of knowledge and skills in different fields of physics, and apply to these fields the skills inherent within the degree of physics, contributing innovative and competitive proposals.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation
- Work independently, have personal initiative and self-organisational skills in achieving results, in planning and in executing a project

Learning Outcomes

1. Calculate function limits for several variables.
2. Calculate the curvature and torsion of a curve.
3. Calculate the line integrals and multiple integrals of scalar and vector fields.
4. Determine the extremes, conditional or otherwise, of a scalar field.
5. Identify situations in which a change or improvement is needed.
6. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
7. Use the mathematical tools developed in this subject for the quantitative study of advanced problems in any branch of knowledge.
8. Work independently, take initiative itself, be able to organize to achieve results and to plan and execute a project.

Content

1. The space R^n: Vector space R^n. Scalar (dot) product. Distance. Sequences in R^n. Topology in R^n.
2. Functions in R^n: Scalar and vector fields. Limits and directional limits. Continuity.
3. Vector functions of one variable: Curves. Geometry of a curve in R^2 and in R^3.
4. Derivatives of a scalar field: Directional derivative. Partial derivative. Differential. Chain rule. Higher-order partial derivatives. Taylor's formula. Hessian matrix. Stationary points (maxima, minima and saddle points).
5. Derivative of a vector field: Jacobian matrix. Differentiability. Chain rule. Inverse function. Implicit function. Extrema with constraints (Lagrange's multipliers). Gradient.
6. Line integrals: Line integrals of scalar and vector field. Line integrals which are path independent.
7. Multiple integral: Double integral on a rectangular surface. Simple integration by iteration. Double integral on a general region.Green's theorem.
8. Volume and surface integrals: Surfaces in R^3. Integration on a surface. Stokes's and Gauss's theorems.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises classes	22	0.88	1, 2, 3, 4, 6, 7, 8
Study of the theory fundamentals	44	1.76	1, 2, 3, 4, 6, 7, 8
Type: Autonomous			
Problem solving	64	2.56	1, 2, 3, 4, 6, 7, 8
Study	60	2.4	1, 2, 3, 4, 6, 7

Theory classes:

They consist in the exposition of the theory framework of this subject.

Exercise classes:

They consist in the exposition of the solution of some exercises from the set previously delivered to the students, also helping the students with the rest.

Furthermore, there will be in-class solving by the students of suggested exercises, under the supervision of the instructor.

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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of Exercises	20%	2	0.08	1, 2, 3, 4, 5, 6, 7
Final exam	45%	3	0.12	1, 3, 4, 5, 6, 7, 8
make-up exam	80%	3	0.12	1, 3, 4, 5, 6, 7
mid-term exam	35%	2	0.08	1, 3, 4, 5, 6, 7

Grading (Ordinary)

A) Take-home exercises (20% of the final grade): one or more exercises will be set, periodically, to be solved and handed in at a time that will be eventually established.

B) Mid-semester exam (35% of the final grade): it is a written exam, withour books, individual, about the middle of the semester.

C) Final exam (45% of the final grade): it is a written exam, without books, individual, at the end of the semester. The final grade will be the result of A+B+C.

D) Make-up exam of B+C: this exam is optional, without books, at the end of the semester. If the grade achieved from A+B+C > 3.5/10, the student will have the right to take this make-up final exam provided he/she has already

taken both exams B+C. The final grade achieved in this exam will replace the previous grade from B+C in all cases.

Grading ("Avaluacio Unica")

A) Final Exam (45% of the final grade): it is a written exam, without books, individual, at the end of the semester.

B)Examen Oral (55% of the final grade): it is an oral exam, individual, at the end of the semester.

C)Oral Make-up Exam (100% of the final grade): this exam is optional, at the end of the semester. If the grade achieved from A+B > 3.5/10, the student will have the right to take this make-up final exam provided he/she has already taken both exams A+B. The final grade achieved in this exam will replace the previous grade of A+B (Avaluacio Unica) in all cases.

Both evaluations ("Unica" and Ordinary) will have the final exams on the same day. Idem concerning the make-up exam.

Bibliography

Basic bibliograpy:

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

More advanced basic bibliography:

- J.E. Marsden and J. Tromba, *Vector Calculus*, W.H. Freeman and Co.
- A. Méndez, *Càlcul de vàries 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 isn't one.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	first semester	morning-mixed
(TE) Theory	1	Catalan	first semester	morning-mixed