Universitat Autònoma de Barcelona

2019/2020

Calculation of Variables

Code: 100153
ECTS Credits: 8

Degree	Type	Year	Semester
2500097 Physics	OB	2	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

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 critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- 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.
- Respect the diversity and plurality of ideas, people and situations
- 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

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. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
6. Develop independent learning strategies.
7. Respect diversity in ideas, people and situations.
8. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
9. Use the mathematical tools developed in this subject for the quantitative study of advanced problems in any branch of knowledge.

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.

Methodology

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises classes	22	0.88	
Study of the theory fundamentals	44	1.76	
Type: Autonomous			
Problem solving	64	2.56	
Study	60	2.4	

Assessment

Grading

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, without any books or student's notes, individual, about the middle of the semester.

C) Final exam (45% of the final grade): it is a written exam, with books and/or student's notes, 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 or student's notes, 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.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of Exercises	20%	2	0.08	3, 2, 1, 6, 5, 4, 8, 7, 9
Final exam	45%	3	0.12	3, 1, 6, 5, 4, 8, 7, 9
make-up exam	80%	3	0.12	3, 1, 6, 5, 4, 8, 7, 9
mid-term exam	35%	2	0.08	3, 1, 6, 5, 4, 8, 7, 9

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.