Universitat Autònoma de Barcelona

2023/2024

Multi-Variable Calculus

Code: 104387
ECTS Credits: 6

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	FB	1	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Prerequisites

Calculus in one real variable. Linear Algebra.

Objectives and Contextualisation

See the catalan document.

Competences

- Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
- Calculate and reproduce certain mathematical routines and processes with ease.
- Demonstrate a high capacity for abstraction and translation of phenomena and behaviors to mathematical formulations.
- Formulate hypotheses and think up strategies to confirm or refute them.
- Make effective use of bibliographical resources and electronic resources to obtain information.
- Relate new mathematical objects with other known objects and deduce their properties.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

- Use computer applications for statistical analysis, numerical and symbolic computation, graphic visualisation, optimisation and other to experiment and solve problems.
- Using criteria of quality, critically evaluate the work carried out.
- Work cooperatively in a multidisciplinary context assuming and respecting the role of the different members of the team.

Learning Outcomes

1. "Explain ideas and mathematical concepts pertinent to the course; additionally, communicate personal reasonings to third parties."
2. Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
3. Calculate and study function endpoints.
4. Calculate derivatives of functions through string rule, implicit function theorem, etc.
5. Classify matrices and linear applications according to different criteria (rank, diagonal and Jordan forms).
6. Contrast, if possible, the use of calculation with the use of abstraction in solving a problem.
7. Describe the concepts and mathematical objects pertaining to the subject.
8. Develop autonomous strategies for solving problems such as identifying the ambit of problems within the course, discriminate routine from non-routine problems, design an a priori strategy to solve a problem, evaluate this strategy.
9. Evaluate the advantages and disadvantages of using calculation and abstraction.
10. Identify the essential ideas in the demonstration of ceratin basic theorems and know how to adapt these to obtain other results.
11. In an orderly and accurately manner, draft brief mathematical texts (exercises, resolution of theoretical questions, etc.).
12. Make effective use of bibliographical resources and electronic resources to obtain information.
13. Read and understand a mathematical text at the current level of the course.
14. Solve problems by approaching them with integrals (lengths, areas, volumes, etc.).
15. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
16. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
17. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
18. Understand and work intuitively, geometrically and formally with the notions of limit, derivative and integral.
19. Using criteria of quality, critically evaluate the work carried out.
20. Work cooperatively in a multidisciplinary context, taking on and respecting the role of the distinct members in the team.
21. Work with different bases of finite-dimension vector spaces.

Content

FIRST PART. **DIFERENTIAL CALCULUS**

- Basic geometric and topological notions in the Euclidean space. Limits
- Functions defined in R ^ n. Limits and continuity. Graphs and level sets.
- The concept of differentiability. Partial derivatives and directional derivatives.
- Local maximum and minimum of functions.
- Derivatives of a higher order. Taylor's formula
- Inverse function theorem. Implicit function theorem.
- Optimization subjected to constraints.. The Lagrange Multipliers Theorem

SECOND PART. INTEGRAL CALCULUS

- Riemann Integral of functions bounded in rectangles. Basic properties.
- Fubini's Theorem.
- Integration oon bounded sets.
- Chance of variable theorem. Meaning of the Jacobian.
- Elements of length and area, computation in noneuclidean coordinates. Integration on curves and surfaces.
- The classical theorems of Vector Analysis.

Methodology

Thirty sessions of theory, 11 of problems and 12 of practices with adequate software will be carried out.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exams	6	0.24	17, 16, 15
Problems sessions	10	0.4	2, 19, 9, 4, 3, 5, 18, 6, 7, 8, 1, 10, 13, 17, 16, 15, 11, 14, 21, 20, 12
Theoretical sessions	27	1.08	19, 5, 18, 7, 1, 13, 17, 16, 15, 11, 20, 12
practice Sessions	12	0.48	2, 19, 9, 6, 8, 17, 15, 14, 20, 12
Type: Supervised			
Supervised problems	10	0.4	2, 19, 9, 4, 3, 5, 18, 6, 7, 8, 1, 10, 13, 16, 15, 11, 14, 21, 20, 12
Supervision	5	0.2	2, 19, 1, 17, 16, 15, 20
Type: Autonomous			
Deliberations on the concepts treated in the classroom	35	1.4	17, 16, 15
Homework	45	1.8	2, 19, 9, 4, 3, 5, 18, 6, 7, 8, 1, 10, 13, 17, 16, 15, 11, 14, 21, 20, 12

Assessment

Partial exams, evaluation of practices and delivery of problems.

Studnets can also ask for a unique evaluation.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Homework	5	0	0	2, 19, 9, 4, 3, 18, 6, 7, 8, 1, 10, 17, 16, 11, 14, 20, 12
Midterm exam	40	0	0	19, 9, 4, 3, 18, 6, 7, 8, 1, 10, 13, 17, 15, 11, 14, 21
Midterm exam	40	0	0	2, 19, 9, 4, 3, 5, 18, 6, 7, 8, 1, 10, 13, 17, 16, 11, 14, 21, 20, 12
Practice skills	15	0	0	2, 19, 4, 3, 5, 18, 6, 8, 1, 16, 11, 14, 21, 12

Bibliography

- *Cálculo Vectorial.* J.E. Marsden y A.J.Tromba, Addison Wesley Longman
- Teacher notes.

Software

Sagemath