UAB
Universitat Autònoma de Barcelona

Fundamentals of Mathematics II

Code: 106551
ECTS Credits: 9

2024/2025

Degree	Type	Year
2504392 Artificial Intelligence	FB	1

Contact

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Teachers

Sundus Zafar

Teaching groups languages

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

Prerequisites

There are no oficial prerequisites. However, it is recommended for students to have taken the course "Fundamentals of Mathematics I".

Objectives and Contextualisation

The course contains three fundamental parts: Differential calculus, integral calculus and vector analysis.

The objectives of the course are:

(i) Understand the basic concepts in each of these parts. These concepts include both the definitions of the mathematical objects being introduced and their interrelationship.

(ii) To know how to apply the concepts studied in a coherent way to the approach and resolution of problems.

(iii) Acquire skills in mathematical writing and calculus.

Competences

- Analyse and solve problems effectively, generating innovative and creative proposals to achieve objectives.
- Introduce changes to methods and processes in the field of knowledge in order to provide innovative responses to society's needs and demands.
- Know, understand, use and apply appropriately the mathematical foundations necessary to develop systems for reasoning, learning and data manipulation.
- 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.

Learning Outcomes

1. Analyse a situation and identify areas for improvement.
2. Analyse and solve problems effectively, generating innovative and creative proposals to achieve objectives.
3. Perform derivatives, partial derivatives and integrals.
4. 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.
5. Understand and apply function optimisation methods.
6. Understand the difference between derivative and integral.

Content

(1) Functions of several variables

-Geometry of the plane and space.
-Graph of a function, curves and level surfaces.
-Directional derivatives.
-Differentiability. Chain rule. Higher order derivatives. Absolute and relative extremes.
-Critical points, saddle points. Hessian criterion forrelative extremes. Lagrange multipliers for the calculation of absolute extremes.

(2) Multiple integrals.
-Integral iterations. Fubini's theorem.
-Variable change theorem. Polar, cylindrical and spherical coordinates. Calculation of masses and centers of mass.

(3) Integrals on curves and surfaces.
-Parameters and parameterized surfaces.
-Implicitly given surfaces. Vector tangent to a curve at a point. Tangent plane and normal vector to a surface.
-Length of a curve. Area ofa surface. Line integrals.
-Flow of a vector field.

(4) Continuous optimization
-Optimization using gradient descent.
-Constrained optimization and Lagrange multipliers.
-Convex optimization.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problems	35	1.4	
Theory	40	1.6	
Type: Supervised			
Practical sessions	10	0.4	
Type: Autonomous			
Study	85	3.4	

The methodology will be the standard for this type of subject with theory classes, problems and practical sessions.

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
Exams	80%	5	0.2	1, 2, 3, 4, 5, 6
Exercise practices	20%	50	2	2, 4

The assessment consists of an inter-semester exam (compulsory) that will count for 40% of the semester grade, and a final semester exam (compulsory) that will count for 40% of the semester grade.The remainder 20% will come from the exercises of the practical sessions.

To pass the course, the average of the corresponding grades must be greater than or equal to 5, and each of these grades must be greater than or equal to 3.

There will be a resit exam at the end of the course and the student will pass the course if he meets the above conditions by replacing the grades of the partial and final exam by the one obtained in the resit exam.

Bibliography

M.P. Deisenroth, A.A. Faisal and C.S. Ong, Mathematics for maching learning, Cambridge University Press, 2020.

B. Demidovich. Problemas y ejercicios de Análisis Matemático. Ed. Paraninfo, 1970.

J. E. Marsden y A.J. Tromba. Cálculo vectorial, cuarta edición. Addison-Wesley Longman, 1998.

S. L. Salas y E. Hille. Calculus, Vol. 1 y 2, tercera edición. Reverté, Barcelona, 1995.

Software

In the exams we will let the students write in the language that be most comfortable for them, but in principle

we prefer that they use the English. We will work within sage.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	711	English	second semester	afternoon
(TE) Theory	71	English	second semester	afternoon