Universidad Zaragoza

**Academic Year/course: 2024/25**

# 26908 - Differential Calculus

## Syllabus Information

**Academic year:** 2024/25
**Subject:** 26908 - Differential Calculus
**Faculty / School:** 100 - Facultad de Ciencias
**Degree:** 447 - Degree in Physics
**ECTS:** 6.0
**Year:** 1
**Semester:** Second semester
**Subject type:** Basic Education
**Module:**

## 1. General information

In general, the objective of the subjects of Algebra I, Mathematical Analysis and Differential Calculus is that the student acquires the capacity of analysis, abstraction and adequate synthesis and to learn to express scientific concepts with the necessary rigor.

In addition, this block of subjects should provide students with the basic mathematical techniques necessary for the study of physics

Within these general objectives, this subject presents a generalization to functions of several variables of the subject of Mathematical Analysis (with functions of one variable) that the students have seen in the first semester, and uses some of the concepts of Algebra I.

We will begin by studying metric spaces and successions in metric spaces and the concept of a complete metric space . Then we will give some brief notions of topological spaces (metric topology) to move on to study the continuity and differentiability of functions in Rn, the gradient, divergence, rotational and Laplacian operators and their expressions in different coordinate systems, the Taylor development in functions of several variables and we will finish seeing how to calculate the extremes, conditional or not, of functions of several variables and the theorems of the implicit and inverse function.

## 2. Learning results

- Determine the existence of the limit of a sequence in a metric space and, if necessary, calculate it.
- Discuss the continuity and differentiability of functions of several variables and calculate their directional derivatives and their differential.
- Calculate the Taylor series of functions in several variables and determine their convergence.
- Obtain gradients, divergences, rotational and Laplacian fields in different coordinate systems.
- Apply the calculation of extremes, conditioned if necessary, to concrete examples.

## 3. Syllabus

- Metric spaces. Open balls.
- Successions in metric spaces.
- Limit and continuity of functions of several variables.
- Directional derivative. Partial derivative. Differential. Variable change, chain rule and other properties.
- Taylor series in several variables.
- Extremes and conditioned extremes.
- Inverse and implicit function theorems.
- Scalar and vector fields.
- Vector Calculus. Fundamental identities.
- Curvilinear coordinate systems: cylindrical, spherical,...

## 4. Academic activities

- **Master classes**: 3 hours per week. The theoretical contents of the subject will be presented.
- **Types of problems**: 1 hour per week. The proposed practical problems will be solved, with the participation of students.
- **Study and personal work**: 60 hours.
- **Assessment tests:** 5 hours.

## 5. Assessment system

**Continuous evaluation of the student's learning**: it will be carried out through the resolution of problems, questions and other activities proposed by the teacher (20% of the final grade).

Completion of a theoretical-practical test throughout the term (80% of the final grade). The grade of this written test will be composed of two parts, the problems (75% of the grade) and the theory (25% of the grade). In the case of students who opt for continuous evaluation, it will be necessary to achieve a minimum grade of 4 out of 10 in the theoretical-practical test to be able to average with the grade of the continuous evaluation.

**Passing the subject by means of a single global test:** it will be possible to obtain the highest grade by taking a single final exam that will cover all the contents seen in the subject.

## 6. Sustainable Development Goals

4 - Quality Education
5 - Gender Equality