Universidad Zaragoza

Academic Year/course: 2024/25

26913 - Integral Calculus and Geometry

Syllabus Information

Academic year: 2024/25
Subject: 26913 - Integral Calculus and Geometry
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 6.0
Year: 2
Semester: First semester
Subject type: Basic Education
Module:

1. General information

This subject is part of the Mathematical Methods module of the Physics degree and constitutes, together with Differential Equations, Mathematical Methods and Computational Physics, the subgroup of the second year of the Degree in Physics with contents specifically related to Mathematics.

The objective of this subject in particular is to acquire basic knowledge of Geometry of Varieties and the Integral Calculus in several variables.

They will be addressed in the order indicated above.

2. Learning results

Upon completion of the subject, students will be able to:

- Calculate the tangent vector, normal vector, curvature and torsion of a curve in space.
- Obtain the coordinate vectors, the metric tensor, the normal vector and the area element of a surface in different coordinates.
- Calculate multiple integrals with changes of limits of integration and use of the Jacobian. Apply the theory of multiple integrals to the calculation of areas, volumes, masses, centres of mass, moments, inertia tensor, etc.
- Use oriented line and surface integrals to calculate different physical quantities (work, flow,...) Apply the integral theorems of vector calculus for the computation of integrals in varieties.

3. Syllabus

Geometry:

- **Geometry of curves**. Tangent, normal vectors and curvature of a curve in space. Relation of these concepts with tangent and normal acceleration. Frénet-Serret equations.
- **Geometry of surfaces**. Parameterization and tangent plane to a surface. Metric tensor. Tensor calculus. Normal vector and volume form. Second fundamental form. Main curvatures.

Integral Calculus:

- Integrals of several variables over vector spaces. Change of variables and changes of limits of Jacobian Integration Calculation of volumes and masses, center of mass, moments and products of inertia, etc.
- Line integral Circulation of a vector field. Green's Theorem. Application to area calculation.
- Surface integral. Flow of a vector field. Stokes' Theorem. Conservative forces and potential.
- Volume integrals. Gauss's theorem and other integral theorems. Continuity equation.

4. Academic activities

The subject consists of theoretical-practical sessions and problem sessions. The distribution according to the credits, of the different programmed activities is done in such a way that the theoretical-practical classes represent approximately 75% of the teaching time and the problem sessions the remaining time.

The classes are taught during the first semester (September-December) of the second year of the Degree in Physics.

5. Assessment system

The evaluation of the subject is presented in two modalities:

- Face-to-face:

- 25% of the student's final grade is obtained from the evaluation of the student's activity during the term. Participation during classes and tutorials and the presentation of written work throughout the term will be valued.
- 75% of the final grade will be obtained from the completion of the final theoretical-practical exam scheduled by the Faculty. Efforts will be made to conduct a midterm exam if possible. If it is taken, students who pass the exam with a 5 out of 10 can eliminate the evaluated contents from the final exam of the subject, including the grade of the midterm exam if it has been passed.

- Non-face-to face:

The total of the evaluation will be obtained from the result obtained in the final theoretical-practical exam scheduled by the Faculty.

6. Sustainable Development Goals

4 - Quality Education
5 - Gender Equality