Universidad Zaragoza

26914 - Differential Equations

Syllabus Information

Academic year: 2024/25
Subject: 26914 - Differential Equations
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 6.0
Year: 2
Semester: First semester
Subject type: Compulsory
Module:

1. General information

This subject is part of the Mathematical Methods module of the Physics degree. The knowledge of the topics covered in this subject is essential to be able to follow the development of the other teachings of physics, since these equations are used in all its branches.

The objective of this subject is to learn the basic tools for solving differential equations and their applications in Physics. The concept of differential equation, particular or general solution, differential equations of first order, higher order and different special types are included. In addition, several problems from the theory of systems of differential equations and solutions of equations in partial derivatives will be included.

It is recommended to have taken and passed Algebra I, Algebra II, Mathematical Analysis and Differential Calculus.

2. Learning results

The learning results required to be demonstrated in this subject are:

- Recognize the type of differential equation and the appropriate strategy for solving it.

- Find the solution of first order equations using the most common methods: separation of variables, integrating factor, change of variable, etc.

- Solve homogeneous and non-homogeneous linear equations, and understand the nature of the space of their solutions.

- Recognize the symmetry properties of an equation and know how to exploit them to reduce the order.

- Know how to apply power series developments to solve differential equations and establish the domain of validity of the solution.

- Understand the equivalence between higher order differential equations and systems of first order equations

- Apply algebraic methods to solve systems of linear equations.

- Know the ordinary differential equations most commonly used in Physics, the form of their solutions and the method to obtain them.

- Solve simple problems of the most common partial derivative equations (wave equation, diffusion equation , Laplace equation, etc.). Know how to apply initial and boundary conditions.

- Solve problems in Physics or other fields by posing the associated differential equation.

3. Syllabus

- First order differential equations. General solution. Separable equations. Exact equations, integrating factors . Variable changes.

- Linear equations with constant coefficients. Method of indeterminate coefficients. Laplace Transform.

- Linear equations with variable coefficients. Euler and Legendre equations. Parameter variation method. Green functions.

- Non-linear equations. Methods to simplify or reduce the degree of the equation. Symmetries.

- Power series solution of differential equations. Regular and singular points. Hermite, Legendre and Bessel equations.

- Systems of differential equations. Systems of linear equations of first order.

- Partial Differential Equations (PDE). PDE in Physics. General solution and particular solution. boundary conditions and existence of solutions. Separation of variables.

4. Academic activities

- Theory classes: 40 hours of lectures, which should provide students with the structure of contents that will allow them to face the resolution of problems and practical work proposed.
- Types of problems: 20 hours in each group, where proposed problems will be solved. Students shall have studied and solved them previously.
- Practical work: a total of 6 hours in which work will be done to provide greater depth in specific topics of interest only to some of the students
- Tutoring: Students will receive the support they need to complete their training.

5. Assessment system

The student must demonstrate that they has achieved the intended learning results through the following assessment activities:

- Continuous evaluation of the student's learning through the resolution of problems, questions, theoretical and practical tests and other activities proposed by the teacher (30% of the final grade).
- Completion of a theoretical-practical test throughout the term (70% of the final grade).

It will be necessary to achieve a grade of 5 out of 10 in the activities and evaluations proposed during the term as well as in the theoretical-practical test in order to pass the subject.

Passing the subject by means of a single global test.

In the event that the student chooses not to carry out the activities proposed by the teacher mentioned above, there will be a single global test at the end of the term on the dates published by the Faculty of Sciences

6. Sustainable Development Goals

4 - Quality Education