1. OVERVIEW

Subject area	Differential Equations in Physics
Degree	Bachelor's Degree in Physics
School/Faculty	School of Architecture, Engineering and Design
Year	second
ECTS	6
Type	compulsory
Language(s)	Spanish
Delivery mode	On campus
Semester	First semester

2. INTRODUCTION

The main aim of this subject area –belonging to the module Mathematical Methods in Physics on the Bachelor's Degree– is to provide students will a solid theoretical/practical understanding of first order and higher order ordinary differential equations, systems of differential equations and partial differential equations. It focuses on how this field is applied in different branches of physics and highlights the importance of mathematical rigour.

3. SKILLS AND LEARNING OUTCOMES

Basic skills and general skills (CB and CG, respectively, by their acronym in Spanish):

- CB3: Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.

Transversal skills (CT, by the acronym in Spanish):

- CT4: Written communication/Oral communication: Ability to communicate and gather information, ideas, opinions and viewpoints in order to understand and be able to act upon them, whether they are through spoken word and gestures, or through written word and/or visual aids.

- CT5: Problem solving: Be able to critically evaluate information, separate complex situations into their constituent parts, recognise patterns, and consider alternatives, different approaches and perspectives in order to find optimal solutions and negotiate efficiently.

Specific skills (CE, by the acronym in Spanish):

- CE04: To understand the laws and principles of physics, to identify their logical and mathematical structure, their experimental basis and the phenomena described through them.

- CE05: To understand and know how to use the mathematical and numerical methods used in physics and in handling experimental data.

Learning outcomes (RA, by the acronym in Spanish):

- RA1: To know how to classify and solve, using the right techniques, different types of ordinary differential equations.
- RA2: To understand the origins of fundamental physics equations (heat equations, wave equations and Laplace equations) and how to solve them using the separation of variables and the Fourier trigonometric series.
- RA3: To understand the relevance of the Sturm–Liouville problems in physics and their resolution in the form of eigenfunction expansions.
- RA4: To understand the integral transform methods and their diverse application in physics.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CB3, CT5, CE05	RA1
CB3, CT4, CT5, CE04, CE05	RA2
CB3, CT4, CT5, CE04, CE05	RA3
CT4, CT5, CE04, CE05	RA4

4. CONTENTS

1. First order ODEs
2. Higher order ODEs
3. Linear systems
4. Series solutions
5. Contour problems for ODEs
6. Partial differential equations

5. TEACHING/LEARNING METHODS

Collaborative learning: Students learn to collaborate with other people (classmates and professors) to find creative, comprehensive and constructive solutions to questions and problems that arise from the given case studies, using all relevant knowledge and material resources available.

Problem-based learning: Students are given problems and asked to solve them, working individually and/or in groups.

Lectures: Presentations by the professor with the necessary technological tools to maximise comprehension of the learning content.

Workshop-based learning: Students acquire knowledge through learning to use the tools and equipment needed in their profession. In other words, "learning by doing".

Guided academic activities: Individual and group work that is more independent, including information searches, written summaries, debates and the public defence of projects.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time students are expected to spend on each activity, are as follows:

Type of learning activity (AF, by the acronym in Spanish)	Number of hours	On campus (%)
Lectures	25	100
Oral presentations of projects and debates	6	100
Report writing	23	0
Assessment	6	100
Practical activities (Problems, written work, projects, workshops and/or lab work)	23	100
Group tutorials	10	100
Independent working	45	0
Asynchronous lectures	12	0

7. ASSESSMENT

The assessment system for this subject includes the following elements:

SE1. Individual on-campus knowledge tests (theory and/or practice)	50%
SE2. Oral defence	5%
SE3. Submission of group and/or individual reports, written work, projects or exercises	30%
SE4. Performance observation	15%

The following table shows the assessable tasks (modules) for the course, the assessment criteria and the weighting of each task in the final grade for the subject area. The final column shows the distribution of the assessment system percentages presented in the table above.

Assessable task (module)	Assessment criteria	Weighting (%)	Assessable elements
Final integrative test	• The student understands the relevant physical/mathematical concepts and knows how to apply them properly. • The student correctly uses the methodologies studied during the course to solve the given problems. • The student organises results in a logical way and communicates with precision.	30%	30% SE1
Midterm test		20%	20% SE1
Group project	• The student actively participates in the task or experience together with the other members of their team. • The student demonstrates teamwork skills. • The activity is completed correctly and includes explanations and conclusions that make the work easy to read and understand. • understand. The student participates effectively in the oral defence of the activity.	20%	5% SE2 10% SE3 5% SE4
Activities (individual/group)	• The results of the activity are submitted on time. • The results of the activity are presented clearly, either orally or in writing. The techniques studied in the unit to which the activity belongs are applied correctly. • The problem solving is correct and includes explanations and conclusions that make the work easy to read and understand.	30%	20% SE3 10% SE4

Further details about the assessable tasks (including submission dates and assessment procedures) will be provided on the Virtual Campus.

8. BIBLIOGRAPHY

The main bibliography for the subject area is as follows:

- George F. Simmons, John S. Robertson, *Ecuaciones diferenciales: con aplicaciones y notas históricas*. McGraw-Hill, 2a ed. (1997).
- Francisco Marcellán, Luis Casasus, Alejandro Zarzo, *Ecuaciones diferenciales: problemas lineales y aplicaciones*. McGraw-Hill (1991).