

Differential Equations

Code: 100152
ECTS Credits: 8

Degree	Type	Year	Semester
2500097 Physics	OB	2	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

José María Crespo Vicente
Sergio Gonzalez Fernandez
Lindber Ivan Salas Escobar
Carlo Marconi

Prerequisites

It is advisable to have a good knowledge of calculus in one variable

Objectives and Contextualisation

Give tools to solve the most common types of ordinary differential equations and equations with partial derivatives that appear in Physics. Learn to model different physical phenomena.

Competences

- Develop critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- Develop the capacity for analysis and synthesis that allows the acquisition of knowledge and skills in different fields of physics, and apply to these fields the skills inherent within the degree of physics, contributing innovative and competitive proposals.
- Respect the diversity and plurality of ideas, people and situations
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation

Learning Outcomes

1. Applying Sturm-Liouville theory to physical problems with boundary conditions.
2. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
3. Develop independent learning strategies.
4. Respect diversity in ideas, people and situations.
5. Solve Laplace and Poisson equations for simple geometries.
6. Solve the equations of simple harmonic, damped and forced motion.
7. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
8. Use the mathematical tools developed in this subject for the quantitative study of advanced problems in any branch of knowledge.

Content

1. Introduction to ordinary differential equations (ODEs)
 - Definition of EDO
 - Flat curves and EDOs
3. ODEs of first order
 - Theorem of existence and uniqueness
 - Picard method
 - Separation of variables
 - ODES reducible to separate variables
 - Exact ODES
 - Integrating factors
 - Linear ODEs
 - Higher degree EDOs; Clairaut ODE. Envelope.
5. ODEs of higher order
 - Linear ODEs
 - Reduction of order
 - Linear ODEs, with constant coefficients and homogeneous
 - Linear ODEs, with constant coefficients and inhomogeneous
 - OR from Cauchy-Euler
7. Solutions in power series
 - Review of power series
 - Ordinary points
 - Regular singular points. Frobenius Method
9. Transformed by Laplace
10. Sturm-Liouville Theory
 - Regular Sturm-Liouville eigenvalue problem
 - Generalized Fourier Series
12. Introduction to differential equations with partial derivatives

Methodology

The subject is structured as follows:

- Theory lectures. The definitions, theorems, and methods of resolution of differential equations are presented, also solving some examples.
- Problem solving classes. Some of the problems of the lists that are made available to students at the beginning of the course through the Virtual Campus are resolved
- Supervised problem solving classes. Students try to solve problems in the classroom under the supervision of a teacher
- Homework assignments. Problems of more complexity and extension that are periodically posted throughout the course. The students must solve and submit before their correction in class in previously agreed dates. The objective is to encourage self-learning.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem solving classes	22	0.88	
Theory lectures	44	1.76	
Type: Autonomous			
Homework assignments	18.5	0.74	
Problem solving	60	2.4	
Study of the theoretical concepts and methods	47	1.88	

Assessment

- Midterm exam (45%)
- Final exam (45%)
- Homework assignments (10%)
- Students with a resultant grade below 5, or students wishing to improve their grades, can take a reassessment exam. They have to have taken both the midterm and the final exams to qualify for reassessment.
- Reassessment exam (100%)

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final Exam	45%	2.5	0.1	1, 3, 2, 7, 5, 8
Homework assignments	10%	0	0	1, 3, 2, 7, 5, 6, 4, 8
Midterm exam	45%	2.5	0.1	3, 2, 7, 6, 8
Reassessment exam	100%	3.5	0.14	1, 3, 2, 7, 5, 6, 8

Bibliography

- Notes on the subject by Dr. Marià Baig which are made available to students through the Virtual Campus
- *Teoría y Problemas de Ecuaciones Diferenciales Modernas*, Schaum, McGraw-Hill
- *Ecuaciones Diferenciales y sus Aplicaciones*, M. Braun, Grupo Editorial Iberoamericana