COURSE DATA

DATA SUBJECT

Code: 34182
Name: Consolidation of differential equations
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Facultat de Ciències Matemàtiques	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1107 - Degree in Mathematics	Expansion of differential equations	ELECTIVES

COORDINATION

MULET MESTRE PEP

CORDERO CARRION ISABEL

SUMMARY

This subject deepens the knowledge of the solutions of elliptic equations that has been obtained in the subject of partial differential equations, where this has been limited to the solution of the Laplace equation in rectangles and circles with sufficiently regular boundary conditions.

In the first part we will study the need to introduce the notion of weak solution to deal with the solution of the Poisson equation with non-smooth data. We will see that in this case the Dirichlet problem of the Poisson equation with a smooth boundary and adequate boundary data has a unique solution.

We will also deal with the case of elliptic problems with variable coefficients in divergence form, the Poisson problem with Neumann boundary conditions and problems of eigenvalues and eigenfunctions.

In the second part, the Poisson problem with Dirichlet boundary conditions will be solved numerically.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

The basic notions necessary to start this subject will have been taken in the previous subjects of Ordinary Differential Equations and Partial D

COMPETENCES / LEARNING OUTCOMES

-

Ability to work in teams.

Adapting to new situations.

Apply the knowledge in the professional world.

Capacity for analysis and synthesis.

Expressing mathematically in a rigorous and clear manner.

Knowing the time and the historical context in which occurred the great contributions of women and men in the development of mathematics.

Learn autonomously.

Possess and understand the mathematical knowledge.

Solve problems that require the use of mathematical tools.

Visualize and interpret the solutions obtained.

DESCRIPTION OF CONTENTS

1. Solution of elliptic problems.

¿ Variational formulation of Poisson's equation.
¿ Sobolev spaces
¿ Existence and uniqueness of weak solutions to Poisson's equation.
¿ Regularity of weak solutions to Poisson's equation.
¿ Extension to variable coefficients.

2. The finite element method.

¿ Relationship with variational formulation of Poisson's equation.
¿ One-dimensional case.
¿ Two-dimensional case.
¿ Software: Matlab, FreeFEM++.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	24,00
Other activities	6,00
Classroom practices	30,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	30,00
Independent study and work	0,00
Preparation of lessons	40,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The course is structured around three axes: theory sessions, practical classes, and tutorials and seminars.

There will be theoretical-practical sessions, with individual and group work, and master classes. The practical sessions will be carried out using computers.

EVALUATION

The assessment of the learning of the knowledge and skills acquired by the students will be done continuously throughout the course and will consist of the following assessment blocks:

- Submission of theoretical-practical exercises (30%)

- Exam consisting of the presentation of a topic chosen by the student (60%)

- Joint educational innovation activity at the end of the subject (10%)

REFERENCES

-
- Apuntes de ecuaciones en derivadas parciales, Enrique Zuazua, http://paginaspersonales.deusto.es/enrique.zuazua/documentos_public/archivos/personal/notes/Apuntes-EDP-2020.pdf
- Casas Rentería, Eduardo. Introducción a las Ecuaciones en Derivadas Parciales. Ed. Universidad de Cantabria, 1992.
- Lectura notes Functional Analysis and Qualitative Theory of PDEs, Enrique Zuazua, http://paginaspersonales.deusto.es/enrique.zuazua/documentos_public/archivos/personal/notes/Notas-Qualitative-PDE-2019.pdf

Complementary references:

- Brezis, H. Functional Analysis, Sobolev Spaces and Partial Differential Equations. Springer. 1983 (última edición, 2010).

- Folland. G. B. Introduction to Partial Differential Equations. Princeton University Press, 1976.
- Zill, D. G. and Cullen, M. R., Ecuaciones Diferenciales con Problemas de Valores en la Frontera. International Thomson, 2002.