COURSE DATA

DATA SUBJECT

Code: 34171
Name: Partial 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	3	Second quarter
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	3	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1107 - Degree in Mathematics	Differential equations	COMPULSORY
1928 - Double Degree Program Physics-Mathematics	Tercer Curso (Obligatorio)	COMPULSORY

COORDINATION

SEGURA DE LEON SERGIO

MULET MESTRE PEP

YAÑEZ AVENDAÑO DIONISIO FELIX

SUMMARY

Students are introduced to partial differential equations (PDE) using conservation laws and other classic examples of Mathematical Physics. Cauchy's problem is studied for first and second order linear equations s, as well as some boundary conditions for second order equations. The basic methods for the resolution of PDEs are developed, based on characteristics, separation of variables, Fourier series and convolutions.

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 for the beginning of this subject will have been taken in the previous subjects of Mathematical Analysis and Ordinary Differential Equations.

COMPETENCES / LEARNING OUTCOMES

1107 - Degree in Mathematics

Ability to work in teams.

Capacity for analysis and synthesis.

Capacity for criticism.

Capacity of abstraction and modeling.

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. Introduction to PDEs
- Examples
- Parametric EDO
- Variable changes

2. Caucy's problem of the first order.
- Characteristic curves.
- Constant coefficients.
- Variable coefficients.
- Linear advection: existence, uniqueness and stability.
- Non-homogeneous.
- The Cauchy-Kovalevskaya Theorem

3. Second-order Cauchy problem
- Classification of second-order linear EDPs
- Reduction to canonical hyperbolic and parabolic forms.
- Cauchy's problem for the homogeneous wave equation.

4. Separation of variables
- Separable solutions without boundary conditions.
- Separable solutions with boundary conditions: Sturm-Liouville problems.
- Trigonometric series.

5. Formal solutions of problems by separation of variables
- Formal solution of the heat equation with periodic boundary conditions and Dirichlet.
- Formal solution of Laplace's equation squared and circle with Dirichlet boundary conditions.
- General Formal Solution of Mixed Problems: Sturm-Liouville Problems.

6. Problem solving by separation of variables
- Solution of the heat equation with periodic boundary conditions and Dirichlet.
- Solution of Laplace's equation to the square, the circle, and the sphere with Dirichlet border conditions

7. Laplace's and Poisson's equations
- Properties of harmonic functions
- Definition and properties of the Green function for the Laplacian operator
- Calculation of the Green function of a half-plane, a circle and a semi-circle

8. Fourier transform
- Definition.
- Convolutions.
- Linear EDP formal solutions for Fourier transforms.

9. Numerical Methods
- Poisson's equation 2D and 3D.
- 2D, 3D heat equation: d'Euler and implicit and Crank-Nicolson methods.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Other activities	7,50
Classroom practices	22,50
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

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

TEACHING METHODOLOGY

The development of the subject is structured around three axes: theory sessions, practical classes and tutorials and seminars.
With regard to the former, the teacher will develop the main points of the syllabus. The student will have to abide by the time of preparation of the classes foreseen for their optimal use. The practical classes will serve for the student to verify the degree of knowledge acquired, facing relatively complex problems and analyzing the results obtained. As before, the student will have to prepare these sessions to be able to carry out the theoretical/practical exercises in the scheduled time.

EVALUATION

The evaluation of the learning of knowledge and acquisition of skills by students will be made by:
1. A written theoretical/practical exam (80% of the final grade)
2. Partial controls (10%)
3. Participation in seminars (10%)

REFERENCES

- Coleman, M. P., An Introduction to Partial Differential Equations with Matlab, Chapman&Hole/CRC, 2013.
- Evans, L. C., Partial Differential Equations. Graduate Texts in Mathematics. Vol. 19. American Mathematical Society. Providence. 1998.
- Myint-U. T., Partial Differential Equations of Mathematical Physics, North-Holland, 1984.
- Haberman, R., Ecuaciones en Derivadas Parciales con Series de Fourier y Problemas de Contorno, Prentice Hall, 2003.
- John, F., Partial Differential Equations. Applied Mathematical Sciences (1), 4ª edición, Springer, 1981.
- Zill, D. G. and Cullen, M. R., Ecuaciones Diferenciales con Problemas de Valores en la Frontera. International Thomson, 2002.