COURSE DATA

DATA SUBJECT

Code: 34163
Name: Numeric calculus
Cycle: Undergraduate Studies
ECTS Credits: 9
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Facultat de Ciències Matemàtiques	4	First quarter
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	5	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1107 - Degree in Mathematics	Numerical methods	COMPULSORY
1928 - Double Degree Program Physics-Mathematics	Quinto Curso (Obligatorio)	COMPULSORY

COORDINATION

MULET MESTRE PEP

BAEZA MANZANARES ANTONIO

MARTI RAGA MARIA CARMEN

SUMMARY

This course, located in the first semester of the fourth year of the Degree in Mathematics and the fifth year of the Double Degree in Physics and Mathematics, is compulsory and taught after studying the subjects of Ordinary Differential Equations, Partial Differential Equations and Numerical Approximation.

The purpose of this course is to introduce students to the main concepts, results and basic algorithms of numerical differentiation, numerical methods for solving differential equations and basic numerical methods for partial differential equations.

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 knowledge required for this course has been taught in the following courses: Computer Science, Computer Tools (Degree in Mathematics), Mathematical Analysis I, Numerical methods for linear algebra (Degree in Mathematics), Numerical Methods (Double Degree in Physics and Mathematics), Ordinary Differential Equations, Partial Differential Equations and Numerical Approximation.

COMPETENCES / LEARNING OUTCOMES

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Ability to work in teams.

Capacity for analysis and synthesis.

Capacity for organization and planning.

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.

Participate in the implementation of software and learn mathematical software.

Possess and understand the mathematical knowledge.

Reason logically and identify errors in the procedures.

Solve problems that require the use of mathematical tools.

DESCRIPTION OF CONTENTS

1. Numerical differentiation

. Basic rules.
. Optimal rules.

2. Numerical methods for ODE

1. Introduction to ODEs.

2. Numerical methods for initial value problems
- Explicit one-step methods: Explicit Euler, Taylor and Runge-Kutta.
- Convergence and absolute stability.
- Implicit one-step methods: Implicit Euler and Trapezium.
- Multi-step methods. Predictor/corrector methods.
- Variable-step methods.

3. Numerical methods for boundary value problems
- Convergence and stability

3. Introduction to numerical methods for PDE.

1. Numerical methods for parabolic PDE:
- Explicit and implicit methods for the heat equation.
- Convergence and stability.

2 Numerical methods for elliptic PDE:
- Finite element method for the Poisson equation.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	45,00
Other activities	11,00
Computer classroom practice	34,00
Total hours	**90,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	40,00
Independent study and work	11,00
Preparation of lessons	50,00
Preparation for assessment activities	34,00
Resolution of case studies	0,00
Total hours	**135,00**

TEACHING METHODOLOGY

The course is structured in theory sessions, practical sessions (in the classroom, with computers) and tutorials and seminars.

On the theory sessions, the professor will explain the main agenda items, using the classroom's computer if necessary to illustrate any particular point. Students must respect the time of preparation of the classes scheduled for their optimal profit. The practical classes and seminars are prepared so that students will check their level of knowledge by facing and solving relatively complex problems and analyzing the results. As it was said before, students must prepare such sessions to solve the problems proposed on the scheduled time.

EVALUATION

Students will be continuously evaluated throughout the course. Said evaluation will follow the following blocks:

1. Theory and practice evaluation: since the objectives of the course focus on learning the theory on numerical calculation as well as on programming the numerical techniques learnt, the evaluation of this part will be conducted in two stages:

i. Continuous evaluation of the subject, carried out through periodic controls and/or delivery of proposed practices or exercises: Up to 4 points, that is, 40% of the final grade.

ii. Final evaluation, consisting of a theoretical-practical exam scored up to 5 points, that is, 50% of the final grade.

2. Seminars and tutorials evaluation: attendance and active participation in these sessions will be rated with a maximum of 1 point, i.e., 10% of the final grade.

To pass the course it is required that the score of subfield 1.i exceeds the 40% of their maximum score and the score of subfield 1.ii exceeds the 50% of their maximum score.

The scores obtained for blocks 1.i and 2 will be valid only in the two examination calls of the academic year in which they are received. Its evaluation can only be done continuously during the term and never in the extraordinary examination call.

REFERENCES

- J. D. Faires y R. Burden, Métodos numéricos, 3ª edición, Thomson, 2004.

- R. J. LeVeque, Finite difference methods for ordinary and partial differential equations. Steady-state and time-dependent problems. SIAM, 2007.

- F. Aràndiga y P. Mulet. Càlcul Numèric, Publicacions de la Universitat de València, 2008.

- G. Strang, Introduction to applied mathematics. Wellesley-Cambridge Press, Wellesley, MA, 1986.

- A. Quarteroni, F. Saleri, P. Gervasio, Scientific computing with MATLAB and Octave. Third edition, Springer-Verlag, 2010.

- C. W. Gear, Numerical initial value problems in ordinary differential equations. Prentice-Hall, Inc., 1971

- J. D. Lambert, Numerical methods for ordinary differential systems. The initial value problem. John Wiley & Sons, 1991.