VNIVERSITAT DE VALÈNCIA

Course Guide
34181 Advanced numerical methods

COURSE DATA

Data Subject	
Code	34181
Name	Advanced numerical methods
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Faculty of Mathematics	4	Second term

Subject-matter

Degree	Subject-matter	Character
1107 - Degree in Mathematics	19 - Numerical methods	Optional

Coordination

Name	Department
MARTI RAGA, MARIA CARMEN	363 - Mathematics
YAÑEZ AVENDAÑO, DIONISIO FELIX	363 - Mathematics

SUMMARY

This subject, located in the second semester of the fourth year of the degree, has an optional character and is taught after the subject of numerical calculation.

The purpose of this subject is to study in depth the numerical resolution of partial differential equations by means of discretizations in finite differences. The theoretical and practical difficulties involved in the proposed methods will be studied, as well as their computational complexity. Computationally efficient iterative methods will be studied for the numerical resolution of systems of linear equations that result from some discretizations of linear elliptic 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

Las nociones básicas necesarias para el inicio de esta asignatura se habrán cursado en las asignaturas de EDO, EDP, AN, MNAL. Es fundamental haber cursado provechosamente la asignatura CN.

OUTCOMES

1107 - Degree in Mathematics

- Capacity for analysis and synthesis.
- Capacity for organization and planning.
- Solve problems that require the use of mathematical tools.
- Ability to work in teams.
- Learn autonomously.
- Adapting to new situations.
- Expressing mathematically in a rigorous and clear manner.
- Reason logically and identify errors in the procedures.
- Participate in the implementation of software and learn mathematical software.
- Knowing the time and the historical context in which occurred the great contributions of women and men in the development of mathematics.
- Visualize and interpret the solutions obtained.

LEARNING OUTCOMES

- Comprehension of the finite difference technique for the discretization of partial differential equations.

- Convergence analysis of the numerical approximation to the sought solution

- Estimation of the computational complexity of an algorithm and the necessity of computational efficiency in complex computations.

- Use of iterative methods for the resolution of linear systems with inverse matrices of high dimension.

WORKLOAD

ACTIVITY	Hours	% To be attended
Computer classroom practice	30,00	100
Theory classes	24,00	100
Other activities	6,00	100
Preparation of evaluation activities	25,00	0
Preparing lectures	32,50	0
Preparation of practical classes and problem	32,50	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The subject is structured in theoretical and practical classes. In the first ones, the basic ideas and the big strokes of the theory are given. The theoretical details that have been pointed out in the theory sessions are developed in some of the practical ones, while other practical sessions are devoted to putting into operation and analyzing the proposed numerical methods.

The exercises proposed in the theoretical-practical sessions can be done in pairs and must be written with LaTeX. For each activity that must be submitted, a period of no less than ten days will be set from the end of the last session dedicated to that activity.

EVALUATION

The student's evaluation will be done continuously throughout the course and will consist of the following blocks:

1. Evaluation of the work sent at the end of each session and reports of submitted practices (25%)

2. Presentation of some sections of the theoretical-practical activities, partially chosen by the student. In the presentation, the students' synthetic capacity and the quality of their answers will be evaluated. The material of the presentation must contain everything necessary to make the assessment of this section (theoretical contents, code, results, comments, if applicable) (65 %)

3. Participation in class and presentations (10%)

REFERENCES

Basic

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Referencia b1: G. H. Golub y C. F. van Loan, Matrix Computations, Johns Hopkins University Press, 1996.

Referencia b2: J. C. Strikwerda, Finite difference schemes and partial differential equations. . Wadsworth & Brooks/Cole Advanced Books & Software, 1989.

Referencia b3: G. Strang, Introduction to applied mathematics. Wellesley-Cambridge Press, Wellesley, MA, 1986.

Additional

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Referencia c1: R. D. Richtmyer, K. W. Morton, Difference methods for initial-value problems. Second edition, Interscience Publishers John Wiley & Sons, Inc., 1967.

Referencia c2: Y. Saad, Iterative methods for sparse linear systems. Second edition. Society for Industrial and Applied Mathematics, 2003.

Referencia c3: J. W. Demmel, Applied numerical linear algebra. SIAM, 1997.

Referencia c4: S. Larsson, V. Thomée, Partial differential equations with numerical methods. Springer-Verlag, 2009.

Referencia c5: R. J. LeVeque, Finite difference methods for ordinary and partial differential equations. Steady-state and time-dependent problems. SIAM, 2007.