UAB
Universitat Autònoma de Barcelona

2019/2020

Numerical Methods II

Code: 103951
ECTS Credits: 5

Degree	Type	Year	Semester
2500097 Physics	OB	3	1

Contact

Name: Carles Navau Ros

Email: Carles.Navau@uab.cat

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

Prerequisites

It it highly recommended to have passed the subject "Mètodes Numèrics I".

it is recommended to have a good knowledge in calculus.

Objectives and Contextualisation

Deepening knowledge in phisical systems modeling.

Deepening knowledge in the basic concpets of numerical methods: precisión, discretization, numerical error, conditioning, normalization...

To set and solve complex physical problems, using numerical techniques.

To know the theoretical basis of error estimation in the numerical simulations.

Competences

- Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, and before both specialist and general publics
- Develop critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- Develop strategies for analysis, synthesis and communication that allow the concepts of physics to be transmitted in educational and dissemination-based contexts
- Respect the diversity and plurality of ideas, people and situations
- Use computer tools (programming languages and software) suitable for the study of physical problems

Learning Outcomes

1. Analyse and describe clearly the strategy in addressing a particular problem from the numerical point of view.
2. Analyse and describe physical problems from an approximate perspective, modelling complex physical systems and solving them in an approximate manner.

3. Apply finite element methods to solving specific problems in some of the most common problems.
4. Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, in front of both specialist and general publics.
5. Control errors produced in the various numerical methods, giving a fuller analysis of these.
6. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
7. Develop independent learning strategies.
8. Develop programmes in a specific programming language.
9. Develop programming strategies that allow the collaborative use of the programmes developed.
10. In pseudocode, design and implement programmes for solving calculations in a real variable: integration, derivation, solving equations, solving ordinary differential equations.
11. Present numerical results accurately, including the processing of statistical errors.
12. Respect diversity in ideas, people and situations.
13. Use distinct numerical methods to solve computational problems in a real variable and evaluate the numerical error in implementing these within a particular problem.
14. Use the most common numerical methods to describe complex systems and to solve some of the most usual problems.

Content

1. Basic concepts.

- Numerical error.
- Discretization.
- Normalization.

2. Solving non-linear equations

- Newton-Raphson method.
- Systems of non-linear equations.

3. Numerical derivation.

4. Numerical integration.

5. Solving differential equations.

- Euler method.
- Runge-Kutta method.
- Other methods (shooting, ...)

6. Solving equation with partial derivatives

- Finite elements and differences.
- Implícit andi explícits schemes.
- Systems of linear equations.

7. Modeling of complex systems.

- Concepts of modeling and simulation
- Simulation of physical systems. Examples.

Methodology

Developtment of reports. Students have to report on the practices and simulations, checking and analizing the obtained simulations and reporting the main results.

Personal study. It is necessary to study, personally, the theory, and to prepare the practices.

Theoretical lectures. Guided lectures, the lecturer will give the key aspects of the different parts of the course. Also, the main lines to follow using bibliography. A complete and ordered description of the course is pretended.

Simulation work. It is pretented that students start developing the several simulations and/or practices. Likely, students will have to finish the work autonomously.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Simulation tasks	21	0.84	
Theoretical lectures	20	0.8	
Type: Autonomous			
Personal study	10	0.4	
Reports preparation	71	2.84	

Assessment

Practice 1 (guided problem). It will be valued the written report, taking into account the approach to the problems, its resolution and the presenteation of the results.

Practice: Simulation A. It will be valued the written report, taking into account the approach to the problems, its resolution and the presenteation of the results.

Practice: Simulation B. It will be valued the written report, taking into account the approach to the problems, its resolution and the presenteation of the results.

Theory exam. It will be valued the relevant theoretical concepts

To access to the recuperation, student has to be previously evaluated to a set of activities, whose weigh is at least 2/3 of the total qualification. Recuperation consists in the resubmission of the practice report or in the relization of a recuperation exam (for the theory part). The maximum qualification in the resubmitted reports is 6 over 10.

We consider that we do not have enough evaluation evidences (thus the qualification will be "not avaluable") when we evaluate a maximum of one practice.

In the case of irregularities that would produce a significant variation in an avaluation item, this item will be qualified as 0, independently on the disciplinary process that could be started. In the case of several irregularities, the final qualification will be 0.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Practice 1. Guided problem	25	0	0	1, 2, 4, 5, 7, 6, 10, 8, 12, 13
Simulation Practice A	25	0	0	4, 5, 7, 6, 10, 8, 11, 12, 13, 14

Simulation Practice B	25	0	0	1, 2, 3, 4, 5, 7, 9, 6, 10, 8, 11, 12, 13, 14
Theory exam	25	3	0.12	1, 2, 3, 4, 5, 7, 9, 6, 11, 12, 14

Bibliography

1. Introducción al Análisis Numérico. A. Ralston, Limusa-Wiley.

2. Análisis numérico. Las matemáticas del cálculo científico, D. Kinkaid, D. Cheney, Wesley Iberoamericana.

3. Mètodes numèrics per a la física, R. Guardiona, E. Higón, J. Ros, Materials 9, Universitat de València.

4. Métodos numéricos para la Física i la Ingeniería. Luis Vázquez, Salvador Jiménez, CarlosAguirre, Pedro José Pascual, McGraw Hill.