UAB
Universitat Autònoma de Barcelona

Numerical Methods

Code: 100097
ECTS Credits: 12

2025/2026

Degree	Type	Year
Mathematics	OB	2

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

As previous knowledge the students must know the basic results on continuity, derivability and integrability of real functions in one and several variables, on linear algebra and matrix calculus, and basic notions about algorithms and the C programming language. This knowledge is part of the the contents of the subjects: linear algebra, functions of a real variable, computer tools for mathematics, of the first year of the mathematics degree, and calculus in several variables, from the first semester of the second year.

Objectives and Contextualisation

Science and technology are supported by mathematical models of real phenomena, developed for predictive purposes. A minimum of realism gives rise to models that are difficult to solve in a completely analytical way. A way to study them is by calculating approximate solutions. The study of techniques (numerical methods) to obtain these approximations is the goal of numerical analysis, of which this subject is an introduction. Numerical methods require a computing effort that depends on the complexity of the model and the desired precision. In accordance with today's standards, this computing effort requires the use of computers.

The subject's goals are two-sided. On the one hand, the course aims to train the students in general mathematics, as any other subject of the degree. On the other, this course aims to prepare the students to solve the numerical problems that they can find in their professional practice. This implies both the precise knowledge of several methods, together with their suitability in various situations, and the necessary skills in their application to the resolution of specific problems with the help of a computer.

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
- Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
- Calculate and reproduce certain mathematical routines and processes with agility.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Use computer applications for statistical analysis, numeric and symbolic calculus, graphic display, optimisation or other purposes to experiment with Mathematics and solve problems.
- When faced with real situations of a medium level of complexity, request and analyse relevant data and information, propose and validate models using the adequate mathematical tools in order to draw final conclusions

Learning Outcomes

1. Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
2. Analyse the convenience of one or other numeric method for a specific problem.
3. Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
4. Evaluate the results obtained and draw conclusions after a computation process.
5. Implement algorithms in a structured programming language.
6. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
7. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
8. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
9. Use algorithms for numerical resolution, program numerical methods on a computer and apply them effectively.
10. Use mathematical formalism in the design and verification of computer programmes.

Content

Error analysis.

Root finding.

Polynomial interpolation.

Numerical differentiation and integration.

Linear systems.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercise classes	30	1.2	2, 3, 4, 1, 8, 6, 7
Theoretical classes	45	1.8	2, 3, 4, 8, 6, 7
Type: Supervised			
Practical classes with computer	28	1.12	2, 3, 4, 1, 5, 8, 6, 7, 9, 10
Type: Autonomous			
Personal work	188	7.52	2, 3, 4, 1, 5, 8, 6, 7, 9, 10

The problem classes will consist in solving problems on the board with active participation of students.

Several practical (computer) works will be assigned along the course. These practical works will be graded from two submissions: one not-in-person, whose deadline will be announced, and another in-person, that will take place at a computer classroom temporarily disconnected from the Internet. The not-in-person submission will consist of C code and a report. At the in-person submission, students will be required to run their code and/or a small moficiation of it and submit the results produced. The use of generative artificial intelligence will not be allowed in any of the submissions. The dates of the in-person submissions will be announced in advance.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First test	0.245	3	0.12	2, 3, 1, 8, 6
Practical (computer) works	0.3	0	0	2, 3, 4, 5, 7, 9, 10
Recovery exam	0.7	3	0.12	3, 8, 6
Second Test	0.455	3	0.12	2, 3, 1, 8, 6

The course will be graded from four activities:

- First test (EP). Problems similar to those worked during problem classes and some theoretical questions must be solved.
- Second test (EF). Problems similar to those worked during problem classes and some theoretical questions must be solved.
- Practical (computer) work (Prac). In order to pass the course, it is a requirement that the Prac grade is equal to or greater than 3.5 out of 10.

- Recovery test (ER). The two tests will be recovered together with a single exam.

The course grade (QFJ) will be obtained using the formula,

QFJ := 0.7 max(0.35 EP + 0.65 EF, EF) + 0.3 Prac

Students who obtain Prac >= 3.5, max(0.35 EP + 0.65 EF, EF)>=3.5 and QFJ>=5 will pass the subject without further exams.

For students who do not pass by course grade, there will be a recovery test on all the subject matter of the course. From its grade over 10, call it ER, the course grade will be recalculated by changing max(...) by ER. In order to pass the course, it is a requirement that ER is greater than or equal to 3.5 over 10. The practical (computer) work is not recoverable.

Unique assessment

Students who have selected the single assessment modality will have to take a final test which will consist of a theory and problems test. In order to be able to take this test, students will be required to hand in the not-in-person submissions corresponding to all the practical (computer) works assigned along the course, and these will be evaluated in an oral exam. In order to pass, it is a requirement that both the practical grade and the exam one are >=3.5. In this case, the final grade will be a weighed average of the two previous grades, with weighs 70% exam and 30% practical work.

If the final grade does not reach 5, the student has another opportunity to pass the subject through a new exam that will be held on a date set by the coordinator of the degree. With this test, the 70% of the grade corresponding to theory can be recovered. The practical work is not recoverable.

The criterion for obtaining the "non-avaluable" qualification is: all students that submit 2 practical works or attend and submit one of the exams EP or EF will be considered presented.

Honor grades will be awarded once the EP and EF exams have been graded.

Bibliography

Basic bibliography:

- J.M. Mondelo: Apunts de Mètodes Numèrics. Accessibles a traves del Campus Virtual.
- A. Aubanell, A. Benseny, A. Delshams: Eines bàsiques de càlcul numèric, Manuals de la UAB 7, Publ. UAB, 1991.
- R. Burden, J.D. Faires: Numerical analysis, 6a ed., Brooks/Cole, 1997. En castellà: Análisis numérico, 6a ed., International Thomson, 1998.

Other bibliography:

- M. Grau, M. Noguera: Càlcul numèric, Edicions UPC, 1993.
- D. Kincaid, W. Cheney: Numerical analysis, 2a ed., Brooks/Cole, 1996. En castellà: An´alisis numérico, Addison-Wesley Iberoamericana, 1994.
- P. Henrici: Elements of numerical analysis, Wiley, 1964. En castellà: Elementos de anàlisis numérico, Trillas, 1968.
- G. Dahlquist, A Björk: Numerical methods, Prentice Hall, 1964.
- E. Isaacson, H.B. Keller: Analysis of numerical methods, Wiley, 1966.
- J. Stoer, R. Bulirsch: Introduction to numerical analysis, 2a ed., Springer, 1993.

Programming:

- B. Kernighan and D.M. Ritchie: The C programming language, 2a ed., Prentice-Hall 1998. En castellà: El lenguaje de programación C, Prentice-Hall Hispanoamericana, 1991.
- B.W. Kernighan, R. Pike: The practice of programming, Addison-Wesley 1999. En castellà: La pràctica de la programación, Pearson Educación, 2000.

Software

The practical (computer) works will be developped in C.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan/Spanish	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	3	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed