Universitat de Lleida

DEGREE CURRICULUM

NUMERICAL METHODS

Coordination: SOTO BALLESTEROS, EDUARDO

Academic year 2021-22

NUMERICAL METHODS 2021-22

Subject's general information

Subject name	NUMERICAL METHODS
Code	102322
Semester	1st Q(SEMESTER) CONTINUED EVALUATION
Typology	

Degree	Course	Character	Modality
Bachelor's degree in Industrial Organization and Logistics Engineering	2	COMMON	Attendance-based
Not informed	2	COMMON	Attendance-based

Course number of credits (ECTS)	6
Type of activity, credits, and groups	

Activity type	PRALAB	PRAULA	TEORIA
Number of credits	1	2	3
Number of groups	2	2	1

Coordination	SOTO BALLESTEROS, EDUARDO
Department	MATHEMATICS
Teaching load distribution between lectures and independent student work	40% classroom 60% homework
Important information on data processing	Consult this link for more information.
Language	Catalan
Distribution of credits	3 theoretical credits and 3 practical credits

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Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
SOTO BALLESTEROS, EDUARDO	eduardo.soto@udl.cat	9	

Subject's extra information

We recommend a good basis for the subjects of first year courses Calculus and Linear Algebra.

The course requires continuous work throughout the semester to achieve their goals. It is also necessary critical thinking and capacity for abstraction.

You can find the following materials in the Virtual Campus: Collection set of exercises, tests resolutions for previous years; Statements of Practice lab.

Learning objectives

- To use constructive methods to approximate solutions of real problems.
- To design methods to approximate efficiently, solutions to problems previously formulated mathematically.
- To study constructive methods and algorithms that allow us to obtain the solution of a problem with arbitrary precision in a finite number of steps.
- To model engineering problems that could be solved with Numerical Methods.
- To analyze effective numerical methods to approximate solutions of equations.
- To write programs in the language Octave / Matlab.

Competences

CG4. Solve problems with initiative, make decisions, creativity, critical reasoning, and communicate and transmit knowledge, abilities, and skills in the field of Chemical/ Industrial Organization and Logistic Engineering.

CE1. Develop the ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives; numerical methods; numerical algorithmic; statistics and optimization.

Subject contents

1. Errors, Stability and Conditioning.
    - 1.1. Preliminaries.
    - 1.2. Errors.
    - 1.3. Stability.
2. Polynomial Interpolation.
    - 2.1. Introduction.
    - 2.2. Polynomial Interpolation.
3. Numerical Integration.
    - 3.1. Introduction.
    - 3.2. Newton-Cotes formulas.
    - 3.3. Romberg method.

4. Ordinary Differential Equations.

    4.1. Introduction.

    4.2. One step methods.

5. Nonlinear Equations.

    5.1. Introduction.

    5.2. Some iterative methods.

    5.3. Nonlinear systems and Newton-Raphson method.

6. Approximation of Functions.

    6.1. Introduction and Theoretical Foundations.

    6.2. Overdetermined linear systems.

    6.3. Data linearization.

Methodology

This course consists of theoretical lessons, classes and practical problems with the help of a computer. The lectures will present content, demonstrate
some of the key results, and also will emphasize learning objectives. Moreover, the problem classes are designed for problem solving and discussion of
specific points that the student must first work independently. In practical classes will be resolved (through teamwork) engineering problems with the
implementation of programs written in code Octave / Matlab. Both problem classes and practical classes will be held with the small groups.

Development plan

Timing of the contents of the subject:

NOTE: Every week include small group classes.

WEEK	METHODOLOGY	AGENDA	TIME (IN HOURS) IN THE CLASSEROOM	TIME (IN HOURS) HOMEWORK
1-2	Theoretical lessons/practical problems	Item 1. Errors, stability and conditioning	8	12
3-5	Theoretical lessons/practical problems	Item 2. Polynomial Interpolation	12	18
6-8	Theoretical lessons/practical problems	Item 3. Numerical Integration	12	18
10-12	Theoretical lessons/practical problems	Item 4. Ordinary Differential Equations	12	18
13-14	Theoretical lessons/practical problems	Item 5. Nonlinear Equations	8	12
15-16	Theoretical lessons/practical problems	Item 6. Approximation of functions	8	12

Evaluation

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EVALUATION OF THE COURSE NUMERICAL METHODS
Degree in Industrial Organisation and Logistics Engineering
Degree in Chemical Engineering

The course consists of two parts, a theoretical (with exercises) and a practical one. The theoretical part has a weight of 80%, and the remaining 20% is the practical one.

Theoretical part: It consists of two written partial exams based on the resolution of problems. Each exam has the same weight (40%) and the note of theory
is obtained by calculating the average value of the notes of both exams. If this theory mark is equal to or greater than 5 then, and only then, the mark
of practices can be added.
Practical part: Each pair of students (classmates) must submit a report for each or, in which an engineering problem is solved by calculations using the computer and
programming in the language Octave / Matlab.
Resit: You can resit the exam only for the theoretical part. The resit will be made by an exam. The student has the right (not the obligation) to resit each of the failed partial exams. In addition, the student can not resit to climb a control mark if it is already passed. Finally, remember that
the obtained mark in the resit is the final mark regardless of whether it is superior or not to the initially failed mark.

To pass have access to the resit, the partial exams must have 2.5 as a minimum mark (over 10).

Calculation of Final Mark: All the following marks are given on the interval [0, 10].
P1 = Mark of Partial 1
P2 = Mark of Partial 2
Pr = Practical mark
M = Final Mark
If (P1 + P2) / 2 >= 5, then M = 0.8 * (C1 + C2) / 2 + 0.2 * Pr

Timing and load percentage evaluation activities:
Week 9. Partial exam 1 of the content developed in class from week 1 through 8. This activity contributes 40% of the total mark for the course.
Week 15. Delivery of reports from the practical part. This activity contributes 20% of the total mark for the course.
Week 16. Partial exam 2 of the class content developed from week 10 through 15. This activity contributes 40% of the total mark for the course.

Bibliography

Basic bibliography:

· Javier Chavarriga, Isaac A. García, Jaume Giné. *Manual de Métodos Numéricos.* Edicions de la Universitat de Lleida, Eines 35, 1999.

· Isaac A. García, Susanna Maza. *Métodos Numéricos: Problemas Resueltos y Prácticas*. Edicions de la Universitat de Lleida. Eines 62, 2009.

· David Kincaid, Ward Cheney. *Análisis numérico*. Ed. Addison-Wesley, Delaware, 1994.

Advanced bibliography:

· Germund Dahlquist, Ake Björck. *Numerical methods*. Ed. Prentice-Hall, Englewood Cliffs, 1974.

· Eugene Isaacson, Herbert B. Keller. *Analysis of Numerical Methods*. John Wiley, New York, 1966.