Numerical Computing

Academic Year: (2023 / 2024) **Review date: 07/06/2023 14:56:48**

Department assigned to the subject: Mathematics Department

Coordinating teacher: GONZALEZ RODRIGUEZ, PEDRO

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Algebra, Calculus I, Programming, Calculus II, Statistics, Calculus III

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Analyze, formulate and solve problems with initiative, decision-making, creativity,critical reasoning skills and ability to efficiently communicate and transmit knowledge, skills and abilities in the Energy Engineering field
CG2. Apply computational and experimental tools for analysis and quantification of energy engineering problems
CG10. Being able to work in a multi-lingual and multidisciplinary environment
CE1 Módulo FB. Ability to solve the mathematic problems arising in engineering. Aptitude for applying knowledge on: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives in differential equations; numerical methods; numerical algorithms; statistics and optimization.
CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.
CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.
CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.
CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

By the end of this content area, students will be able to have:
RA1.1 knowledge and understanding of the mathematical principles underlying the branch of energy engineering.
RA2.1 the ability to apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods.
RA4.2 the ability to interpret the data and draw conclusions
RA5.1 the ability to select and use appropriate tools and methods.
RA5.2 the ability to combine theory and practice to solve engineering problems.
RA5.3 an understanding of applicable techniques and methods, and of their limitations.

OBJECTIVES

1- Basic numerical techniques for solving problems in engineering.
2- The mathematical foundations of the algorithms implemented in the most usual commands of the software MATLAB.
3- To learn how to use MATLAB both at the level of direct use of basic commands and at programming level.
4- To be able of solving numerically different practical problems by combining the algorithms introduced in this course and the software MATLAB.
5- To acquire the needed knowledge for understanding and implementing in practice in the future mathematical algorithms more sophisticated than the ones introduced in this course.

DESCRIPTION OF CONTENTS: PROGRAMME

1- Introduction to MATLAB and to floating point arithmetic.
2- Numerical solution of linear systems and least squares problems in MATLAB.
3- Interpolation in MATLAB.
4- Numerical solution of nonlinear equations in MATLAB.
5- Quadrature in MATLAB.
6- Solving ordinary differential equations in MATLAB.

LEARNING ACTIVITIES AND METHODOLOGY

This is a "hands on" course. Students follow the explanations of the instructor performing in real time the exercises, examples and other proposed activities in the computer. Thus the course takes place in the computer Lab while the students run MATLAB simultaneously to the explanations of the instructor.

In addition, every three weeks, a computing long problem related to the subject will be proposed to the students. The students will have one week to solve it using MATLAB and return it to the instructor for evaluation.

Officce hours will follow the rules of Universidad Carlos III de Madrid and intend to solve doubts of individual students.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

Final Exam: 40%.
Computational problems proposed along the course: 60%.
To pass the course it is needed to get at least an score of 3 out of 10 in the final exam.

BASIC BIBLIOGRAPHY

- Cleve Moler Numerical Computing with MATLAB, SIAM, 2004

- John H. Mathews and Kurtis K. Fink Numerical Methods using MATLAB (4th Edition), Pearson, 2004

ADDITIONAL BIBLIOGRAPHY

- G. W. Stewart Afternotes on Numerical Analysis, SIAM, 1996

- G. W. Stewart Afternotes goes to graduate school, SIAM, 1998

- Uri M. Ascher and Chen Greif A first course in Numerical Methods, SIAM , 2011