Numerical computing

Academic Year: (2019 / 2020) **Review date: 29-01-2020**

Department assigned to the subject: Mathematics Department

Coordinating teacher: TERAN VERGARA, FERNANDO DE

Type: Electives ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Algebra, Calculus I and Calculus II

OBJECTIVES

The student is expected to acquire and develop the ability to solve efficiently basic computational problems as those encountered in engineering by using MATLAB. More precisely:

- Learning the basics of programming with MATLAB.
- Computing accurately quadratures.
- Design and use Runge-Kutta numerical integrators to solve ordinary differential equations.
- Interpolate data by using splines.
- Discuss the existence and uniqueness of solutions of a system of linear equations.
- Solve a consistent system of linear equations using the LU factorization of a matrix.
- Obtain an orthonormal basis from an arbitrary basis of a subspace.
- Solve least-squares problems and use the QR and SVD factorizations of a matrix.
- Compute zeros of functions and solutions of nonlinear equations.
- Compute the FFT of a function.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Numbers, vectors and matrices with MATLAB.
2. Solving linear systems.
3. Interpolation.
4. Zeros of functions and roots of nonlinear equations.
5. Least squares problems.
6. Quadrature.
7. Ordinary differential equations
8. Fourier transform.

LEARNING ACTIVITIES AND METHODOLOGY

This is a "hands on" course. Students are supposed to follow the explanations of the instructor performing in real time the exercises, examples and other proposed activities. Thus the course takes place in the computer Lab and students must become acquainted with MATLAB.

The course will start learning how to program MATLAB. After that general introduction, every two weeks, one of the topics of the course will be discussed in the classroom and practices related to these topics will be proposed to the students. The students will have one week to solve and return it to the teacher. Usually the practices involve to solve a simple problem by writing the appropriate code.

ASSESSMENT SYSTEM

There will be 4-5 practices proposed to the students starting the third week of the course. These practices must be worked out by the students alone or in small groups (four people at most) and handled back to the teacher. They will contribute 50% of the final grade.

There will be a final exam that will contribute the remaining 50% of the final grade. Part of this exam will consist of questions about the practices mentioned above.

In order to pass the subject, it is mandatory to pass the final exam and to get, ate least, half of the marks in the part corresponding to the practices in the final exam.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- Cleve Moler Numerical Computing with Matlab, SIAM, 2004
- Desmond Higham y Nicholas Higham MATLAB Guide, SIAM, 2017
- Jesús M. Sanz-Serna Diez lecciones de cálculo numérico, Universidad de Valladolid, 2010

ADDITIONAL BIBLIOGRAPHY

- G. W. Stewart Afternotes on numerical analysis, SIAM, 1996
- G. W. Stewart Afternotes goes to graduate school, SIAM, 1998
- Uri M. Ascher y Chen Greif A first course in numerical methods, SIAM, 2011