Advanced numerical methods

Academic Year: (2020 / 2021) **Review date: 25-07-2020**

Department assigned to the subject: Department of Mathematics

Coordinating teacher: BAYONA REVILLA, VICTOR

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

STUDENTS ARE EXPECTED TO HAVE COMPLETED

- Numerical methods at basic level.
- Knowledge of Mathematical Analysis in one an several variables.
- Basic knowledge of ordinary differential equations.

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

- Understanding of basic numerical concepts.
- Ability to develop algorithms to solve advanced problems numerically, normally not treated in introductory courses of numerical analysis.
- Understanding of Matlab.
- Ability to adapt the theoretical methods to solve real world problems.

DESCRIPTION OF CONTENTS: PROGRAMME

- Approximation and Interpolation of functions: Polynomial approximation and interpolation; Approximation and Interpolation through splines and piecewise functions; Approximation and Interpolation in several variables.
- Numerical Quadrature: Classical Methods; Gaussian Quadrature, Romberg Integration, Adaptative Integration.
- Numerical solution for Nonlinear Systems: Fixed point iteration; Newton and Quasi-Newton Methods; Boyden's Method; Steepest Descent Method.
- Numerical Solution for Ordinary Differential Equations: Euler's Method; Runge-Kutta's Method; Multistep methods; Estimation of the error.

LEARNING ACTIVITIES AND METHODOLOGY

The docent methodology will include:

* Master classes, where the knowledge that the students must acquire will be presented. To make easier the development of the class, the students will have written notes and also will have the basic texts of reference that will facilitate their subsequent work.

* Resolution of exercises by the students, in which proposed problems are discussed and developed (by the professor and by the students). These classes allow to the students to acquire the necessary skills.

* Additionally, 1.4 ECTS will be used for tutorial learning activities. These tutorial activities will be supervised and they will have theoretical and practical content.
3.2 ECTS will be used for the personal study of the students, which will have access to computer rooms.

ASSESSMENT SYSTEM

Oral presentations and written theoretical and practical (with MatLab) problem solving throughout the course. Two mid term exams. Final Exam.

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

BASIC BIBLIOGRAPHY

- C. Moler Numerical Computing with Matlab, SIAM, 2004
- K. Atkitson Elementary Numerical Analysis, Wiley, 2003
- Richard L. Burden; J. Douglas Faires Numerical Analisis, Cengage Learning Editores S.A, 2015
- Uri M. Ascher, Chen Greif A first course in Numercal Methods, SIAM, Computational Science and

Engineering, 2011

- Uri M. Ascher, Chen Greif A first course in Numercal Methods, SIAM, Computational Science and Engineering, 2011

ADDITIONAL BIBLIOGRAPHY

- J.M. SANZ-SERNA DIEZ LECCIONES DE CALCULO NUMERICO, UNIVERSIDAD DE VALLADOLID. SECRETARIADO DE PUBLICACIONES E I, 2010