Advanced Mathematics II

Academic Year: (2023 / 2024) **Review date: 11-05-2023**

Department assigned to the subject: Mathematics Department

Coordinating teacher: ARVESU CARBALLO, JORGE

Type: Electives ECTS Credits : 6.0

Year : Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear algebra, Calculus I

OBJECTIVES

1. Basic numerical skills to solve problems in Engineering.
2. The use of MATLAB to solve numerical problems.
3. Basic solving skills to solve counting problems.
4. Basic solving skills to solve discrete mathematics.

DESCRIPTION OF CONTENTS: PROGRAMME

0: Algorithms and Complexity
0.1 The Growth of Functions
0.2 Complexity of Algorithms
0.3 Representations of Integers

1: Floating-Point Numbers and Errors
1.1 Floating-Point Numbers
1.2 Floating-Point Numbers in Matlab
1.3 Floating-Point Arithmetic

2: Integers
2.1 Divisibility and Modular Arithmetic
2.2 Integer Representations and Algorithms
2.3 Primes and Greatest Common Divisors
2.4 Solving Congruences. The Chinese Reminder Theorem

3: Counting
3.1 The Basics of Counting
3.2 The Pigeonhole Principle
3.3 Permutations and Combinations

4: Linear Equations
4.1 Solving Linear Systems
4.2 LU Factorization
4.3 Pivoting and Permutation Matrices
4.4 Effect of Roundoff Errors
4.5 lutx

5: Interpolation
5.1 The Interpolating Polynomial
5.2 Piecewise Linear Interpolation
5.3 Piecewise Cubic Interpolation
5.4 splinetx y pchiptx

6: Zeros and Roots
6.1 Bisection
6.2 Convergence Rates
6.3 Newton's and Secant methods
6.4 Inverse cuadratic interpolation
6.5 Brent¿s algorithm and fzerotx

7: Quadrature
7.1 Simple and composite quadrature rules
7.2 Adaptive Quadrature. quadtx
7.3 Gaussian Quadrature

8: Least Squares
8.1 Models and Curve Fitting
8.2 Least Squares and QR

LEARNING ACTIVITIES AND METHODOLOGY

There will be two weakly sessions:
- Theory sessions: the teacher will explain the fundamental concepts and results of the theory.
- Exercise/Lab sessions: the students will work in solving exercises or writing codes to solve problems proposed by the teacher.

ASSESSMENT SYSTEM

Final exam: 50%
Midterm exams: 25%
Homeworks: 25%

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

BASIC BIBLIOGRAPHY

- C. Moler Numerical Computing with MATLAB, SIAM, 2004
- D. J. Higham N. J. Higham Matlab Guide, SIAM, 2000
- J.H. Mathews y K.D. Fink Mumerical Methods with Matlab, 3rd ed, Prentice Hall, 2000
- K.H. Rosen Discrete Mathematics and applications, McGraw-Hill, 2004
- T. Sauer Análisis Numérico 2ed, Pearson, 2013

ADDITIONAL BIBLIOGRAPHY

- B. Kolman, R. C. Busby, S. Ross Discrete Mathematical Structures (6th Edition), Pearson Educación, 1997
- G. W. Stewart Afternotes on Numerical Analysis, SIAM, 1996
- G. W. Stewart Afternotes goes to Graduate School, SIAM, 1998
- J.M. Sanz-Serna Diez Lecciones de Cálculo Numérico, Universidad de Valladolid, 2010
- R. Johnsonbaugh Discrete Mathematics, 4rd ed., Prentice-Hall, 1999