Numerical Methods and Programming

ECTS: 6 ECTS

COORDINATOR: Francisco José Pena Brage (fran.pena@usc.es)

UNIVERSITY WHERE THE COORDINATOR IS: USC

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

LECTURER 1: José Antonio García Rodríguez (jagrodriguez@udc.es)

UNIVERSITY WHERE THE LECTURER 1 IS: UDC

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

LECTURER 2: Duarte Santamarina Ríos (duarte.santamarina@usc.es)

UNIVERSITY WHERE THE LECTURER 2 IS: USC

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

SUBJECT CONTENTS

Part I: Introduction to Programming

1. Introduction to Matlab. Basic commands and functions.

2. Vectors and Matrices in Matlab. Sparse matrices. Plots.

3. Files. M and programming. Data Structures in Matlab.

4. Introduction to Fortran 90: Data types and control flow.

5. Arrays in Fortran 90. Procedures, modules and interfaces.

6. Input / Output data in Fortran 90.

Part II. numerical Methods

7. Numerical solution of systems of linear equations: Condition of a system of linear equations. Direct methods: LU, LL^t, LDL^t and QR. Classical iterative methods: Jacobi, Gauss-Seidel, SOR and SSOR. Convergence criteria.

8. Numerical solution of systems of non-linear equations: Review of methods for solving non-linear equations. Fixed-point iteration. Newton's method. Computational considerations.

9. Interpolation, numerical differentiation and integration: Lagrange interpolation. Hermite interpolation. Runge effect. Spline approximation. Numerical differentiation of polynomial interpolating type. Numerical quadrature of polynomial interpolating type. Newton-Cotes formulas. Gauss formulas. Composite quadrature.

9. Interpolation. Lagrange interpolation. Hermite interpolation. Runge effect. Spline approximation.

10. Numerical differentiation and integration. Numerical differentiation of polynomial interpolating type. Numerical quadrature of polynomial interpolating type in a single variable. Newton-Cotes formulas. Gauss formulas. Composite quadrature.

11. Numerical interpolation and integration in several variables.

METHODOLOGY

Theory will be taught in order for students to build small computer programs under guidance as an introduction to programming. Students will also carry out other tasks by themselves to strengthen their knowledge.

Students will work individually on numerical methods in order to deepen their knowledge on the subject.

LANGUAGE USED IN CLASS: It will depend on the audience.

IS IT COMPULSORY TO ATTEND CLASS? Students can attend via conference system.

BIBLIOGRAPHY

Basic bibliography:

T. Aranda, J.G. García, Notas sobre Matlab. Universidad de Oviedo, Servicio de Publicaciones, 1999.

J.F. Epperson. An introduction to numerical methods and analysis. Edición revisada. John Wiley & Sons, 2007.

M. Metcalf, J.K. Reid. Modern Fortran Explained Oxford University Press, 2011.

Additional bibliography:

S.J. Chapman, Fortran 90/95 for scientists and engineers. WCB/McGrawHill, 2004.

P.G. Ciarlet. Introducción á análise numérica matricial e á optimización. Universidade de Santiago, 2011.

J.D. Faires, R. Burden. Análisis Numérico. Thomson 2011.

G.H. Golub, C.F. van Loan, Matrix Computations. John Hopkins, University Press, 1996.

MathWorks Programming Guide in Matlab:
http://www.mathworks.com/access/helpdesk/help/techdoc/matlab_prog/matlab_prog.html

D.C. Hanselman, B.L. Littlefield. Mastering Matlab 7. Prentice Hall, 2004.

J.A. Infante del Río, J.M. Rey Cabezas, Métodos numéricos: teoría, problemas y prácticas con Matlab.Piramide, 2007.

C.T. Kelley. Solving Nonlinear Equations with Newton's Method. SIAM, 2003.

D. Kincaid, W. Cheney. Análisis numérico. Las matemáticas del cálculo científico. AddisonWesley Iberoamericana, 1994.

J.H. Mathews, K.D. Fink, Métodos Numéricos con Matlab. Prentice Hall, 2000.

M. Metcalf, J.K. Reid. Fortran 90/95 explained. Oxford University Press, 1999.

W.H. Press. Numerical Recipes in Fortran 90: Volume 2. Cambridge University Press, 1996.

A. Quarteroni, F. Saleri. Cálculo Científico con MATLAB y Octave. Springer, 2006.

J.M. Viaño, M. Burguera. Lecciones de métodos numéricos. 3. Interpolación. Tórculo Edicións, 1999.

J.M. Viaño. Lecciones de métodos numéricos. 2. Resolución de ecuaciones numéricas. Tórculo Edicións, 19

SKILLS

Basic:

CG2: To be able to apply the acquired knowledge and abilities to solve problems in new or unfamiliar environments within broader contexts, including the ability to integrate multidisciplinary R & D in the business environment;

CG4: To have the ability to communicate the findings to specialist and non-specialist audiences in a clear and unambiguous way.

CG5: To have the appropriate learning skills to enable them to continue studying in a way that will be largely self-directed or autonomous, and also to be able to successfully undertake doctoral studies.

Specific:

CE4: To be able to select a set of numerical techniques, languages and tools, appropriate to solve a mathematical model.

Numerical Simulation specialization:

CS2: To adapt, modify and implement software tools for numerical simulation.

WILL YOU BE USING A VIRTUAL PLATFORM? Yes. Google Groups

WILL YOU BE USING ANY SPECIFIC SOFTWARE? Yes. Matlab GNU Fortran

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CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

50% of the total qualification will consist on the evaluation of the theoretical content, Matlab and Fortran practical works.

50% of the subject will correspond to the exam, where the concepts acquired in the part II of the subject will be evaluated.

Students should pass both parts in order to pass the subject. If one of the parts is not passed the qualification will be 4 out of 10.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

The same as for the first opportunity. The deadline for handing in the tasks will be adapted to the date of the second exam.
