27029 - Numerical Simulation in Ordinary Differential Equations

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	453 - Degree in Mathematics
ECTS	6.0
Year	4
Semester	First semester
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

This is a six-credit, optional course in the degree of Mathematics. Its aim is to present the most important concepts and properties of one-step methods, multi-step ones for solving differential problems (Initial Value Problems and Boundary Value Problems).

1.2.Recommendations to take this course

The attendace to the class lectures and the computer laboratory sessions is highly recomended, as well as the individual work on the problems posed along the course.
It is highly convenient to have passed the subjects "Análisis matemático", "Ecuaciones Diferenciales", "Informatica",

"Análisis Numérico I" y "Análisis Numérico II.

1.3.Context and importance of this course in the degree

The subject belongs to the module "Cálculo Científico y Simulación Numérica". To take this subject

it is highly convenient to have passed the matters "Análisis matemático", "Ecuaciones Diferenciales", "Informatica",

"Análisis Numérico I" y "Análisis Numérico II.

1.4.Activities and key dates

Problems and homework tasks will be posed during the course, allowing to pass the subject.
There will be a final exam of the subject during the oficial period set by the Faculty of Science.

2.Learning goals

2.1.Learning goals

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At the end of this course students should be able to:

- Know criteria to compare and evaluate several numerical methods taking into account the computational cost.
- Evaluate the numerical results obtained and draw conclusions
- Know how approximate numerically the solution of an initial value problem and estimate the error committed by the numerical method.
- Know the limitations and advantage s of the numerical methods under consideration.
- Know some commercial software (e.g. matlab, *Mathematica* , ...) and free software (e.g. ipython,...) for the numerical solution
- of differential problems.

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

This is an optional course in the degree of Mathematics. Its goal is to present the essentials of methods for the numerical solution of differential problems

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

As a general rule, the module can be passed either showing a regular work along the academic year, or by a final exam.

- Regular work. During the course, the student results will be evaluated through a periodical supply of exercises or short tasks, together with their active participation during the course. The use of LaTeX in written presentations is recommended; the evaluation include an oral presentation using Beamer. These evaluations will constitute the final mark.
- Final exam. The aforementioned procedure does not exclude the right, according to the current regulations, to a final exam which, by itself, allows to pass the module.

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The learning process designed for this course is based in the following:

- Explanation of the theoretical contents of the subject in class lectures.
- Practical application of the theoretical results by software tools in computer laboratories.
- Individual work on problems and homework assignments.

5.2.Learning tasks

- Class lectures for explaining the theoretical results.
- Computer laboratory sessions using software tools (ipython, ...) to illustrate applications of the theoretical results seen in class lectures.
- Individual problem and homework task assignment.
- Individual tutorization.

5.3.Syllabus

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The contents of the course are:
- One-step methods. Consistency, stability and convergence
- Linear multistep methods.
- Boundary Value Problems. Shooting methods
- Implementation of the numerical schemes and numerical simulation

5.4.Course planning and calendar

- As a general rule, this subject has four presential hours per week. The schedule is set and made public by the Faculty of Science well before the beginning of the academic year.
- The computer laboratory sessions will be scheduled according to the general calendar in coordination with the class lectures.
- Problems or homework tasks, and their deadlines, will be posed in coordination with the class lectures.
- The dates of the exams are set and made public by the Faculty of Science well in advance before the beginning of the academic year.

5.5.Bibliography and recommended resources

- Hairer, Ernst. Solving ordinary differential equations. I, Nonstiff problems / E. Hairer, S.P. Nrsett, G. Wanner. - 2nd rev. ed., 2nd corr. print. Berlin [etc.] : Springer-Verlag, 2000
- Hairer, Ernst. Solving ordinary differential equations. II, Stiff and differential-algebraic problems / E. Hairer, G. Wanner. - 2nd rev. ed, 2nd corr. print. Berlin [etc.] : Springer-Verlag, 2002
- Ascher, Uri M.. Numerical solution of boundary value problems for ordinary differential equations / Uri M. Ascher, Robert M.M. Mattheij, Robert D. Russell New Jersey : Prentice Hall, cop. 1988