Advanced methods for nonlinear differential equations

Academic Year: (2021 / 2022) **Review date: 22-07-2021**

Department assigned to the subject: Mathematics Department

Coordinating teacher: ORTEGA GARCIA, ALEJANDRO

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The course is aimed at master's students with a basic knowledge of the theory of differential equations and analysis. It is recommended to have passed the introductory courses:

-Differential Calculus
-Ordinary differential equations
-Partial Differential Equations
-Real Analysis
-Functional Analysis

OBJECTIVES

The course focuses on the development of the theory of nonlinear differential equations with the aim of familiarising the student with important techniques and results in this nonlinear context.
In particular, it is intended that the student understands the intrinsic problems of nonlinear problems and acquires advanced skills in: fixed point theory and bifurcation theory and their applications to differential equations; in the theory of change of scale and self-similar solutions.
Basic skills: CB6, CB7, CB10
General skills: CG4, CG5, CG6
Specific skills: CE2, CE8

DESCRIPTION OF CONTENTS: PROGRAMME

1. Fixed point Theory: Contraction mappings and Fixed Point Theorems.
2. Bifurcation Theory: Bifurcation types. Global bifurcation.
3. Scaling and Self-similarity: Classification of self-similarity. Transformation groups.
4. Applications: Periodic and traveling waves, nonlinear eigenvalue problems, porous media equation, quasilinear equations.

LEARNING ACTIVITIES AND METHODOLOGY

1. THEORETICAL-PRACTICAL CLASSES, where the knowledge that the students must acquire is explained and developed. Students will have basic reference texts to facilitate the understanding of the classes and the development of follow up work. The teacher and the students will solve exercises and practical problems, previously suggested by the teacher.

2. TUTORING SESSIONS. Individualized attendance for students with a teacher.

3. STUDENT INDIVIDUAL OR GROUP WORK. Each student's individualized study, understanding of results and proofs, and exercise and problem-solving is fundamental in mathematics, both for learning and for self-evaluation of acquired competencies and skills.

ASSESSMENT SYSTEM

-For each topic there will be a list of exercises to be presented/delivered in class.

-In addition, a theoretical work will be proposed in which the student has to apply the knowledge acquired in the course. The theoretical work will have to be presented at the end of the course.

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

BASIC BIBLIOGRAPHY

- A. Ambrosetti, A. Malchiodi Nonlinear Analysis and semilinear elliptic problems, Cambridge University Press, 2007
- G. Barenblatt Scaling, self-similarity, and intermediate asymptotic, Cambridge University Press, 1996
- M. S. Berge Nonlinearity and Functional Analysis, Academic Press, 1977

ADDITIONAL BIBLIOGRAPHY

- K. Deimilin Nonlinear Functional Analysis, Dover, 2009
- P. Drábek, J. Milota Methods on Nonlinear Analysis, Springer, 2013