Modeling Techniques

Academic Year: (2022 / 2023) **Review date: 31-05-2022**

Department assigned to the subject: Mathematics Department

Coordinating teacher: CUERNO REJADO, RODOLFO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Algebra (Course 1- Semester 1)
Differential Calculus (Course 1 - Semester 1)
Programming (Course 1 - Semester 1)
Integral Calculus (Course 1 - Semester 2)
Numerical Methods (Course 2 - Semester 1)
Ordinary Differential Equations (Course 3 - Semester 1)

DESCRIPTION OF CONTENTS: PROGRAMME

1. Dimensional analysis
2. Ordinary differential equations as models
3. Regular and singular perturbation methods
4. Calculus of variations
5. Stability and bifurcation
6. Deterministic chaos: properties and characterization
7. Models based on difference equations
8. Agent-based models

LEARNING ACTIVITIES AND METHODOLOGY

AF1.THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students must acquire. Student receive course notes and will have basic reference texts to facilitatefollowing the classes and carrying out follow up work.Students partake in exercises to resolve practical problems and participatein workshops and an evaluation tests, all geared towards acquiring the necessary capabilities.Subjects with 6 ECTS are44 hours as a general rule/ 100% classroom instruction
AF2.TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3.STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8.WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1.THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning.
MD2.PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group.
MD3.TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6.LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

SE1.FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation varies for each subject between 60% and 0%.
SE2.CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.

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

BASIC BIBLIOGRAPHY

- M. H. Holmes Introduction to the foundations of applied mathematics, Springer LLC, 2019
- N. Boccara Modeling complex systems, Springer LLC, 2010
- S. H. Stogatz Nonlinear dynamics and chaos, Perseus books, 2015

ADDITIONAL BIBLIOGRAPHY

- C. L. Dym Principles of mathematical modeling, Elsevier, 2004
- C. Misbah Complex dynamics and morphogenesis, Springer, 2017
- H. Sayama Introduction to the modeling and analysis of complex systems, Open SUNY textbooks (textbooks.opensuny.org), 2015
- J. D. Logan Applied mathematics, Wiley interscience, 2006
- S. Heinz Mathematical modeling, Springer-Verlag, 2011