Course guides
200213 - SD - Dynamical Systems

Unit in charge: School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics.
Degree: BACHELOR’S DEGREE IN MATHEMATICS (Syllabus 2009). (Optional subject).
Academic year: 2020  ECTS Credits: 6.0  Languages: Catalan

LECTURER
Coordinating lecturer: GEMMA HUGUET CASADES
Others: Primer quadrimestre: GEMMA HUGUET CASADES - M-A
JOAQUIM PUIG SADURNI - M-A

PRIOR SKILLS
Basic knowledge about the theory of ordinary differential equations (developed in the course of Differential Equations).
Basic knowledge about the numerical resolution of ordinary differential equations (developed in the course of Numerical Calculus).

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
4. CE-4. Have the ability to use computational tools as an aid to mathematical processes.
5. Ability to solve problems from academic, technical, financial and social fields through mathematical methods.
13. CE-1. Propose, analyze, validate and interpret simple models of real situations, using the mathematical tools most appropriate to the goals to be achieved.
14. CE-3. Have the knowledge of specific programming languages and software.

Generical:
1. CB-4. Have the ability to communicate their conclusions, and the knowledge and rationale underpinning these to specialist and non-specialist audiences clearly and unambiguously.
2. To have developed those learning skills necessary to undertake further interdisciplinary studies with a high degree of autonomy in scientific disciplines in which Mathematics have a significant role.
6. CG-1. Show knowledge and proficiency in the use of mathematical language.
7. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
8. CG-3. Have the ability to define new mathematical objects in terms of others already known and ability to use these objects in different contexts.
9. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
10. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:
11. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
12. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one’s knowledge.
**TEACHING METHODOLOGY**

The course consists of four hours a week that will include the theoretical and practical aspects of dynamical systems, as well as problem solving and elaboration of individual or group projects.

To encourage the students to learn independently, they will be assigned, during the course, selected problems from the list of problems, small projects during the course and a final synthesis project of the subject. Problems and projects should be presented to other students.

There will be a content review exam at the end of the course where it can appear both theoretical questions and problems similar to those performed in class.

**LEARNING OBJECTIVES OF THE SUBJECT**

One aims that at the end of the course the student has a set of techniques and results that allow him/her to address the basic aspects of the description and analysis of dynamical systems, whether they are discrete or modeled through differential equations. Additionally, one aims at providing a broad vision of the different lines of applications and research that dynamical systems have (such as celestial mechanics, invariant objects, or mathematical biology and epidemiology) and the basic skills for their simulation and quantitative study through computational tools.

**STUDY LOAD**

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

**CONTENTS**

**One-dimensional Chaotic Dynamics**

**Description:**

**Full-or-part-time:** 17h
Theory classes: 4h
Laboratory classes: 4h
Self study : 9h

**Lineal Systems**

**Description:**

**Full-or-part-time:** 17h
Theory classes: 4h
Laboratory classes: 4h
Self study : 9h
### Invariant objects of Flows and Diffeomorphisms

**Description:**

**Full-or-part-time:** 59h  
Theory classes: 10h  
Laboratory classes: 10h  
Self study: 39h

### Planar Flows

**Description:**

**Full-or-part-time:** 17h  
Theory classes: 4h  
Laboratory classes: 4h  
Self study: 9h

### Global Dynamics

**Description:**

**Full-or-part-time:** 40h  
Theory classes: 8h  
Laboratory classes: 8h  
Self study: 24h

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### GRADING SYSTEM

There will be an exam at the end of the course. The grade of the exam will correspond to 20% of the final grade.

The oral presentation and the written resolution of the problems and projects assigned during the course will be evaluated. This grade will correspond to 60% of the final grade.

The final project execution, the written report and its oral presentation will be evaluated. This grade will correspond to 20% of the final grade.

### EXAMINATION RULES.

The assigned problems and projects will be done individually. The final project can be done in groups of up to two people.
BIBLIOGRAPHY

Basic: