### Degree competences to which the subject contributes

**Specific:**
1. **RESEARCH.** Read and understand advanced mathematical papers. Use mathematical research techniques to produce and transmit new results.
2. **CALCULUS.** Obtain (exact or approximate) solutions for these models with the available resources, including computational means.
3. **CRITICAL ASSESSMENT.** Discuss the validity, scope and relevance of these solutions; present results and defend conclusions.

**Transversal:**
5. **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.
6. **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.
7. **THIRD LANGUAGE.** Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
8. **TEAMWORK.** Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
9. **EFFECTIVE USE OF INFORMATION RESOURCES.** Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
Teaching methodology

Theoretical sessions (presence of the students is necessary) and weekly practical tutorized assignments.

Learning objectives of the subject

- To reach an advanced formation in using numerical methods applied to dynamical systems
- Carry out numerical simulations of particular examples
- To relate different aspects of the dynamics in order to have a global picture of the behavior of a given problem
- To learn different tools to analyse and deal with a problem
- Ability in programming algorithms designed to solve particular problems in dynamical systems

Study load

<p>| Total learning time: 187h 30m | Hours large group: 60h 32.00% | Self study: 127h 30m 68.00% |</p>
<table>
<thead>
<tr>
<th>Content</th>
<th>Learning time:</th>
<th>Theory classes:</th>
<th>Practical classes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerical (preliminary) tools for practical purposes: integrators for ODE and graphical interfaces. Examples.</td>
<td>4h</td>
<td>2h</td>
<td>2h</td>
</tr>
<tr>
<td>Dynamical systems: introduction, definitions. Continuous and discrete dynamical systems. Orbit generation. Numerical computation of Poincare maps. Examples.</td>
<td>6h</td>
<td>3h</td>
<td>3h</td>
</tr>
<tr>
<td>Computation and stability of fixed points. Vector fields and maps. Implementation and examples.</td>
<td>10h</td>
<td>5h</td>
<td>5h</td>
</tr>
<tr>
<td>Computation and stability of periodic orbits. Implementation, continuation of families, bifurcations. Multiple shooting.</td>
<td>10h</td>
<td>5h</td>
<td>5h</td>
</tr>
<tr>
<td>Computation of tori: representation, computation and continuation. Implementation and examples.</td>
<td>15h</td>
<td>7h 30m</td>
<td>7h 30m</td>
</tr>
<tr>
<td>Analysis of bifurcations. Some examples.</td>
<td>15h</td>
<td>7h 30m</td>
<td>7h 30m</td>
</tr>
</tbody>
</table>

Degree competences to which the content contributes:
Qualification system

100% of the qualification will be obtained from the practical assignments done.

Regulations for carrying out activities

No rules, in principle.

Bibliography

Basic:


Particular articles related to the topics of the course and some notes from suitable web pages.