Degree competences to which the subject contributes

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

General:
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.
8. CG-1. Show knowledge and proficiency in the use of mathematical language.
10. 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.
11. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
12. 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:
13. ENTREPRENEURSHIP AND INNOVATION: Knowing about and understanding how businesses are run and the sciences that govern their activity. Having the ability to understand labor laws and how planning, industrial and marketing strategies, quality and profits relate to each other.
14. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and
sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.  
15. 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.  
16. 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.  
17. 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**

Lectures, solution of exercises and computer laboratory sessions.

Lectures will be taught in English.

**Learning objectives of the subject**

Solid theoretical basis in numerical methods for solving Partial Differential Equations (PDEs), with emphasis in the solution of second order PDEs that usually arise in applied sciences and engineering.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 30h</td>
<td>20.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 90h</td>
<td>60.00%</td>
</tr>
<tr>
<td>Content</td>
<td>Learning time:</td>
<td>Description:</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Introduction and basic concepts</strong></td>
<td>3h</td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td><strong>FDM solution of parabolic and elliptic problems</strong></td>
<td>15h</td>
<td>Theory classes: 9h</td>
</tr>
<tr>
<td><strong>FEM solution of parabolic and elliptic problems</strong></td>
<td>24h</td>
<td>Theory classes: 10h</td>
</tr>
<tr>
<td><strong>Problems with 1st order operators: convection</strong></td>
<td>8h</td>
<td>Theory classes: 4h</td>
</tr>
</tbody>
</table>

Problems in applied sciences and engineering usually solved with numerical methods for Partial Differential Equations (PDEs). 2nd order PDEs: classification, physical interpretation, basic concepts for the numerical solution, boundary conditions.

Description:

Description:

Description:
1st order hyperbolic equations: time integration and stability. The convection-diffusion equation: numerical oscillations, analysis and Péclet number, introduction to FEM consistent stabilization techniques.
Quality assessment and reliability: error estimation and adaptivity

<table>
<thead>
<tr>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 6h</td>
</tr>
</tbody>
</table>

**Description:**
Basic concepts on quality assessment, verification & validation, error estimation, output oriented error estimation, remeshing and adaptivity.

**Qualification system**
Exams, exercises and computer laboratory tasks.

**Bibliography**

**Basic:**

**Complementary:**