**820092 - NSAE - Numerical Simulation Applied to Engineering**

**Coordinating unit:** 295 - EEBE - Barcelona East School of Engineering

**Teaching unit:** 748 - FIS - Department of Physics

**Academic year:** 2018

**Degree:**
- BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)

**ECTS credits:** 6  
**Teaching languages:** English

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### Teaching staff

**Coordinator:** Domingo García Senz

**Others:** Domingo García Senz

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### Opening hours

**Timetable:** consensuated with the professor.

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### Prior skills

Ability to work with the computer and a basic knowledge of a programming language.

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### Requirements

Basic knowledge of algebra, calculus and physics. The main teaching language of the course will be English.

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### Degree competences to which the subject contributes

**Transversal:**

1. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

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### Teaching methodology

40% Expositive methodology plus 35% individual work plus 25% working in group.

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### Learning objectives of the subject
820092 - NSAE - Numerical Simulation Applied to Engineering

To introduce the student into basic techniques of numerical simulation and their application to solve basic engineering problems.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group</th>
<th>Hours small group</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time: 150h</td>
<td>45h</td>
<td>15h</td>
<td>90h</td>
</tr>
</tbody>
</table>

- Hours large group: 45h, 30.00%
- Hours small group: 15h, 10.00%
- Self study: 90h, 60.00%
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## Content

<table>
<thead>
<tr>
<th>1. Chapter: A primer on numerical calculus.</th>
<th>Learning time: 60h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related activities: A fraction of the laboratori sessions will be devoted to write easy programs of numerical calculus using MatLab.</td>
<td>Self study : 36h</td>
</tr>
<tr>
<td>Specific objectives: To introduce the student to the basic numerical techniques addressed to simulate physical and engineering systems</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Chapter: Applications to several engineering disciplines.</th>
<th>Learning time: 60h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related activities: During the laboratory sessions and using MatLab the student will implement several of the algorithms developed at the theory sessions. A simulation program dealing to a physical system linked to engineering has to be written by the interested students as a part of the evaluation of the course. There will be a public exposition of the work done.</td>
<td>Self study : 36h</td>
</tr>
<tr>
<td>Specific objectives: Apply the main concepts already learnt in the previous chapter. Applications to interesting engineering problems will be carefully described.</td>
<td></td>
</tr>
</tbody>
</table>

**Learning time:** 30h
- Theory classes: 12h
- Self study: 18h

**Description:**
Discrete simulation. The game of life. Application to the study of virus replication. Fractal geometry and applications.

**Related activities:**
The interested students have to write a simple program based on the discrete simulation methods as a main work of the course. There will be a specific session devoted to the exposition of the works done by the students at the end of the course.

**Specific objectives:**
To introduce the student to this special class of simulation techniques, where a set of empirical rules drive the evolution of a complex system settled in a 2D grid. This approach is often useful in biology and natural sciences.

**Qualification system**
Two classroom exams P1 and P2 and a practical work, T, consisting in planify and devise a computer algorithm aimed at solving a particular engineering problem.

Final qualification: 0.25 P1 + 0.25 P2 + 0.5 T.
NSAE does not have a final reevaluation exam.

The generic competence will be evaluated taking into account: 1) The ability of the student to apply the concepts explained in the classroom to practical engineering problems, 2) the self-study abilities of the students, improvement and collective work, 3) abilities to make a public presentation and defend the work done. The weight of the generic competence within the evaluation of the course will be of 10%.

**Bibliography**

**Basic:**