Degree competences to which the subject contributes

Transversal:

1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

Learning objectives of the subject

At the end of the course, the student will be able to:

· Analyze the behavior of a dynamical system; use software tools; design models to understand its performance; evaluate various strategies for its operation.

· Apply proper working methods of modeling biomedical systems, so that can be applied to solve problems in the field of biomedical engineering but also in general engineering.
## Study load

| Total learning time: 150h | Hours large group: 45h 30.00% | Hours small group: 15h 10.00% | Self study: 90h 60.00% |
### Content

<table>
<thead>
<tr>
<th>T1: Mathematical Modeling</th>
<th><strong>Learning time:</strong> 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 7h 30m</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 4h 30m</td>
</tr>
<tr>
<td></td>
<td>Self study : 18h</td>
</tr>
</tbody>
</table>

**Description:**
Generalized system properties. Linear models of biomedical systems. Computer analysis and simulation using MATLAB and SIMULINK.

**Related activities:**
Lectures and laboratory work in computer lab room including guided projects.

<table>
<thead>
<tr>
<th>T2: Analysis of Biomedical Systems Using Linear Models</th>
<th><strong>Learning time:</strong> 22h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study : 14h</td>
</tr>
</tbody>
</table>

**Description:**

**Related activities:**
Lectures and laboratory work in computer lab room including guided projects.

<table>
<thead>
<tr>
<th>T3: Identification of Biomedical Control Systems</th>
<th><strong>Learning time:</strong> 26h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 7h 30m</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 4h 30m</td>
</tr>
<tr>
<td></td>
<td>Self study : 14h</td>
</tr>
</tbody>
</table>

**Description:**

**Related activities:**
Lectures and laboratory work in computer lab room including guided projects.
### T4: Optimization in Biomedical System Control

**Learning time:** 18h  
- Theory classes: 2h 30m  
- Laboratory classes: 1h 30m  
- Self study: 14h

**Description:**  
Application to models of biomedical systems: Optimization in systems with negative feedback; Single-parameter optimization; Constrained optimization.

**Related activities:**  
Lectures and laboratory work in computer lab room including guided projects.

### T5: Nonlinear Analysis of Biomedical Control Systems: Complex Dynamics

**Learning time:** 16h  
- Theory classes: 2h 30m  
- Laboratory classes: 1h 30m  
- Guided activities: 0h  
- Self study: 12h

**Description:**  

**Related activities:**  
Lectures and laboratory work in computer lab room including guided projects.

### T6: Application of modeling techniques to biomedical systems

**Learning time:** 38h  
- Theory classes: 12h 30m  
- Laboratory classes: 7h 30m  
- Self study: 18h

**Description:**  
Several models of biomedical systems will be developed in Matlab and Simulink. Tools of modeling and simulation will be applied. Various strategies for its operation will be evaluated.

**Related activities:**  
Lectures and laboratory work in computer lab room including guided projects.
Qualification system

La evaluación se realizará mediante la valoración por parte del profesorado de las siguientes partes:

Entregables correspondientes a la parte de teoría (NLL): 30%
Prácticas de Laboratorio incluyendo los informes entregados de cada sesión (NLab): 30%
Trabajo final realizado en grupo (NTF): 35%
Evaluación de la competencia genérica (NCG): 5%

No habrá pruebas de exámenes parciales ni finales

Nota final = 0,3 NLL + 0,3 NLab + 0,35 NTF + 0,05 NCG

Regulations for carrying out activities

· In theory class, deliverables guided exercises will be developed, conducted individually or in groups of 2 students
· The lab will be assessed based on class attendance and delivery of practice reports. Practices can be individual or in groups of 2 students.
· The final work will take place individually or in groups of 2 students. Students may choose the final work with the advice and approval of the teacher. It will be presented orally with audiovisual support. Generic competence will be evaluated.

If it is not done any of the activities of the laboratory or deliverable of continuous assessment, it will be considered as not scored.

Bibliography

Basic:


