230860 - CBS - Complexity in Biological Systems

**Coordinating unit:** 230 - ETSETB - Barcelona School of Telecommunications Engineering

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

**Academic year:** 2019

**Degree:** MASTER'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2018). (Teaching unit Optional)

**ECTS credits:** 4

**Teaching languages:** English

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## Teaching staff

- **Coordinator:** Alonso Muñoz, Sergio
- **Others:** Pons Rivero, Antonio Javier

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## Teaching methodology

Master class, written work, problem resolutions, practical exercises, search of information, practices

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## Learning objectives of the subject

- Understand what a complex system is and how to characterize it.
- Obtain a basic knowledge in biological phenomena, from the molecular/cellular scale to the macroscale.
- Dominate numerical techniques and use specific software related with the subject.
- Be able to include the theoretical knowledge to solve biological problems.
- Be able to present the results of a project in a written text and orally, using a precise language and putting the results in the correct context.

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## Study load

<table>
<thead>
<tr>
<th>Total learning time: 100h</th>
<th>Hours large group:</th>
<th>36h</th>
<th>36.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self study:</td>
<td>64h</td>
<td>64.00%</td>
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</tbody>
</table>

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## Content

<table>
<thead>
<tr>
<th>Module</th>
<th>Learning time: 25h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complex spatio-temporal dynamics in biology</strong></td>
<td>Theory classes: 9h</td>
</tr>
<tr>
<td></td>
<td>Self study: 16h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Oscillations, excitability, bistability</td>
<td></td>
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<tr>
<td>Synchronization in biological systems</td>
<td></td>
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<tr>
<td>Spatio-temporal chaos: Cardiac fibrillation</td>
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</tbody>
</table>

| **Analisi of complex biosignals**           | Theory classes: 9h  |
|                                            | Self study: 16h    |
| **Description:**                            |                    |
| Deterministic and stochastic signals       |                    |
| Statistical properties                     |                    |
| Nonlinear analysis of temporal series      |                    |

| **Self-organization in biological systems** | Theory classes: 9h  |
|                                            | Self study: 16h    |
| **Description:**                            |                    |
| Self-assembling: protein folding, and membrane formation | |
| Growing processes: chemotaxis, tumor growing and morphogenesis | |
| Flocking, swarming y gregarious behavior   |                    |

| **Biological networks**                    | Theory classes: 9h  |
|                                            | Self study: 16h    |
| **Description:**                            |                    |
| Metabolic networks, interactome, regulatory and signal networks | |
| Neural networks, functional networks and conectome             | |
| Networks in ecology and epidemiology           | |

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Qualification system

Written test (30%)
Oral test (40%)
Works done by the student (30%)

Bibliography