240IBI33 - Modelling and Simulation of Biomedical Systems

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control
Academic year: 2017
Degree: MASTER’S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)
ECTS credits: 4,5
Teaching languages: English

Teacher staff
Coordinator: Vallverdu Ferrer, Maria Montserrat

Opening hours
Timetable: Hours of individualized attention will be requested by e-mail

Prior skills
No prerequisites are required

Degree competences to which the subject contributes

Specific: CEEBI05. Acquire concepts and techniques related to the modelling and simulation of the biological systems.

Teaching methodology
This course uses participative lectures, project-based learning and teamwork. The entire course will be held in a computer laboratory.

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 biomedical system modeling, with the aim of being applied to solve problems in the field of biomedical engineering as well as in general engineering.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group: 27h 24.00%</th>
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</thead>
<tbody>
<tr>
<td>Hours small group:</td>
<td>13h 30m 12.00%</td>
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<tr>
<td>Guided activities:</td>
<td>0h 0.00%</td>
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<tr>
<td>Self study:</td>
<td>72h 64.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time</th>
<th>Practical classes</th>
<th>Laboratory classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T1: Mathematical Modeling of Biomedical Systems using Linear Models</strong></td>
<td>10h 30m</td>
<td>7h 30m</td>
<td>3h</td>
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<tr>
<td><strong>T2: Identification of Biomedical Control Systems</strong></td>
<td>10h</td>
<td>6h 30m</td>
<td>3h 30m</td>
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<tr>
<td><strong>Description:</strong></td>
<td>Identification methods. Identification of physiological systems. Parameter estimation.</td>
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<tr>
<td><strong>T3: Optimization in Biomedical System Control</strong></td>
<td>10h</td>
<td>6h 30m</td>
<td>3h 30m</td>
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<tr>
<td><strong>Description:</strong></td>
<td>Application to models of biomedical systems: Optimization in systems with negative feedback; Single-parameter optimization; Constrained optimization.</td>
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<tr>
<td><strong>T4: Nonlinearities in Biomedical Control Systems: Complex Dynamics</strong></td>
<td>10h</td>
<td>6h 30m</td>
<td>3h 30m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Nonlinear versus linear systems. Nonlinear oscillators. 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.</td>
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Qualification system

The evaluation will be performed through the assessment of the following parts:
Deliverables (SDL): 35%
Final exam (SFE): 25%
Final work (SFP): 40%
Final score = 0,35 SDL + 0,25 SFE + 0,40 SFP

Attendance at labs is compulsory and the presentation of the final work.

Examination of Re-Evaluation (ReE) replaces the final exam (SFE) failed. In no case replaces the note of the assessment of SDL and SFP.

Re-Evaluation (ReE): 25%. therefore,
Final mark with Re-Evaluation = 0,35 SDL + 0,25 ReE + 0,40 SFP

Students with an NP in SDL or SFP and NP in the ordinary exam, that is SFE = NP, have not option for being re-evaluated.

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.
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Bibliography

Basic:


Complementary:


