240043 - System Dynamics

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control
Academic year: 2018
Degree: BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 4.5

Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: PEDRO CAMINAL MAGRANS

Degree competences to which the subject contributes

Specific:
1. Knowledge on automatisms' fundaments and control methods.

Teaching methodology

There are two types of attendance sessions: theory and practical classes. In the theory lectures (2 hours per week) the basic concepts are exposed from real examples and with the minimum mathematical tools necessary for the monitoring of concepts. The lectures often sandwich exercises or discussions among the students about the subject.
In the practical lectures (2 hours per week) problems and case studies are solved with the help of statistical software. Students must carry out teamwork where some data will have to be analysed and take decisions depending on the information obtained.

Learning objectives of the subject

General objective

Providing students the generalising concept of dynamic system, applicable in almost all fields of engineering, and the concept of signal as a variable of this system evolving through time.

Specific objectives
- Providing tools for temporal analysis and frequency systems
- Presenting different methodologies to analyse systems' stability
- Supplying basic concepts of continuous time control system
- Initiating into analysing systems modelled with internal representation
- Learning how to design compensators which improve working specifications of systems
- Learning fundamentals of automatisms and control methods.
## Study load

<table>
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<tr>
<th></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
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<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>112h 30m</td>
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<td>Hours large group:</td>
<td>37h 30m</td>
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<td>Hours medium group:</td>
<td>0h</td>
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<td>Hours small group:</td>
<td>7h 30m</td>
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<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study:</td>
<td>67h 30m</td>
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# Content

## Topic I. Introduction
**Learning time:** 2h 30m  
Theory classes: 1h 30m  
Self study: 1h  
**Description:**  
Object and range of the subject. Definitions. Examples of dynamic systems.

## Topic II. Modelling systems and external presentation
**Learning time:** 17h  
Theory classes: 3h 30m  
Practical classes: 1h 30m  
Laboratory classes: 2h 30m  
Self study: 9h 30m  
**Description:**  

## Topic III. Temporal response
**Learning time:** 20h 30m  
Theory classes: 5h  
Practical classes: 2h  
Laboratory classes: 2h 30m  
Self study: 11h  
**Description:**  

## Topic IV. Systems' stability
**Learning time:** 8h 30m  
Theory classes: 1h  
Practical classes: 1h 30m  
Self study: 6h  
**Description:**  
### Topic V. PID controllers

**Learning time:** 13h 30m  
- Theory classes: 1h  
- Practical classes: 2h  
- Laboratory classes: 2h 30m  
- Self study: 8h

**Description:**  
Basic control actions. Proportional, integral and derivative control. Effects of PID controls actions. Design of PID controllers.

### Topic VI. Frequency response

**Learning time:** 17h  
- Theory classes: 4h  
- Practical classes: 2h  
- Self study: 11h

**Description:**  

### Topic VII. Stability in the frequency dominion

**Learning time:** 15h  
- Theory classes: 2h  
- Practical classes: 3h  
- Self study: 10h

**Description:**  
Nyquist's stability criterion. Simplified or Bode's criterion. Gain margin and phase margin.

### Topic VIII. Controllers design in the frequency's dominion

**Learning time:** 18h 30m  
- Theory classes: 3h  
- Practical classes: 4h 30m  
- Self study: 11h

**Description:**  
Controllers design with phase advance. Controllers design with phase delay.
### Planning of activities

| LABORATORY PRACTICES | Hours: 11h  
Laboratory classes: 9h  
Self study: 2h |
|----------------------|-------------------------|

#### Description:
Execution of practical work is compulsory. There are four sessions in the laboratory or in the computer room (L1, AI2, L2, Av) with a total of 7.5 h. And a session of 2 h. of autonomous learning in the computer room (AI1).

AI1. Introduction to Matlab's software to analyse and design systems. Functional block schemes. Time response. Analysis of system's stability. It must be executed in the computer rooms as autonomous learning, without professors in the room, previous to execution of AI2 practice.

L1. Identifying and modelling an experimental position and speed control system.

AI2. Study by means of Matlab's software package of experimental control system behaviour analysed in session L1.

L2. Experimental study of the control system behaviour analysed in sessions L1, once PID controllers have been incorporated.

#### Support materials:
Before executing practices AI1, L1, AI2, L2 it is necessary to prepare them with the practices handbook: Villà R., Riera J., Caminal P., Giraldo B. "Dinàmica de sistemes. Pràctiques". Campus digital Atenea.

#### Descriptions of the assignments due and their relation to the assessment:
During the execution of each practice L1, AI2 i L2 a chart must be filled with the obtained results and deliver them once the session is over.

Evaluation of the practice period. In this session each student will have to orally answer question made by professors.

### CONTINUOUS EVALUATION

#### Description:
Assessment of knowledge.

### PARTIAL EXAM

#### Description:
Assessment of knowledge.

#### Descriptions of the assignments due and their relation to the assessment:
Solved exam.

### FINAL EXAM

#### Description:
Assessment of knowledge.
Descriptions of the assignments due and their relation to the assessment:

Solved exam.

Qualification system

The final mark will consist in four 'inputs':
1) Mark of continuous evaluation (AC)
2) Mark of teamwork (NT)
3) Partial exam (EP)
4) Final exam (EF)

\[ NF = 0.2 \times AC + 0.2 \times NT + 0.15 \times EP + 0.45 \times EF \]

Re-assessment of knowledge is considered..

Bibliography

Basic:


Complementary:


Villà, Ricard ; Robert Griñó ; Mañanas Miguel Angel Mañanas ; Pere Caminal ; Enric Fossas ; Jordi Riera. Dinàmica de sistemes: problemes d'exàmen. Barcelona: Serveis Gràfics Copisteria Imatge, 2011.

Others resources: