320045 - PSSP - Planning, Simulation and Supervision of Industrial Processes

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6  Teaching languages: English

Teaching staff
Coordinator: Albert Masip-Alvarez
Others: Albert Masip-Alvarez

Opening hours
Timetable: The office hours will be published in the Digital Campus at the beginning of the course.

Prior skills
Basic programming.

Degree competences to which the subject contributes

Specific:
CE25. ELO: skills for The modelling and simulation of systems.

CE28. ELO: Applied knowledge of industrial computing and communications.

CE1. (ENG) Capacitat per a la resolució dels problemes matemàtics que puguin platenjar-se a l'enginyeria. Aptitud per aplicar els coneixements sobre: àlgebra lineal; geometria, geometria diferencial; càlcul diferencial i integral; equacions diferenciales i amb derivades parcials; mètodes numèrics; algorítmica numèrica; estadística i optimització.

Transversal:
04 COE N3. 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.
07 AAT N3. 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

- On-site lectures for the explanation of the contents.
  The lecturer introduces the theoretical basis of the subject during on-site lectures. Basic concepts, methodology and results are developed during the sessions, being illustrated by means of examples in order to make them more understandable.
- On-site sessions for practice.
  The students will board the tasks in the laboratory by means of a computer.
- Autonomous work and exercises solving.
  The students, autonomously, shall assimilate the main concepts and resolve the stated exercises.
- Preparation and implementation of evaluable group activities.
  Student groups will make two oral presentations on its resolution of certain exercises in order to contribute to the assessment of the oral part of generic competence Third Language (English). The assessment of these presentations will be carried out by means of peer-to-peer techniques under lecturer's supervision.

Learning objectives of the subject

The final objective of the subject is to integrate the different themes that are developed on a real mobile robot in the laboratory. To achieve this goal on the robot, specific partial learning objectives are defined:
- Understanding and mastery on basic skills, principles and applications of systems planning, simulation and process monitoring and supervision.
- The ability for the analysis, synthesis and troubleshooting of planning, simulation and process monitoring and supervision.
- The ability for the selection of the elements involved in the process of planning, simulation and monitoring.
- Design and programming of planners, supervisors and process simulators.
- The ability to integrate planning systems, simulation and monitoring within the industrial production environments.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>30h</td>
<td>20.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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</tbody>
</table>
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## Content

### Process description. Petri Nets

<table>
<thead>
<tr>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Self study : 12h</td>
</tr>
</tbody>
</table>

**Description:**
Petri Nets for process description, Dependencies, Conditions, Parallel Tasks, States and Transitions.

**Related activities:**
Describe the classic problem of the "Dining Philosophers" and discuss about the implications of resource sharing.

**Specific objectives:**
Describe several example processes by means of Petri Nets.

### Modelling and Simulation. Discrete events models.

<table>
<thead>
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<th>Learning time: 20h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Self study : 12h</td>
</tr>
</tbody>
</table>

**Description:**

**Related activities:**
Build simulation models for discrete events systems. Simulate the problems of the philosophers and the emergency stage at the hospital.

**Specific objectives:**
Translate Petri Nets into simulation models for discrete event systems.

### Discrete Optimisation

<table>
<thead>
<tr>
<th>Learning time: 35h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td>Laboratory classes: 7h</td>
</tr>
<tr>
<td>Self study : 21h</td>
</tr>
</tbody>
</table>

**Description:**

**Related activities:**
Workplace Assignment; Tasks Assignment; Automatic Solving of SUDOKUS.
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| Planning | Learning time: 40h  
|          | Theory classes: 8h  
|          | Laboratory classes: 8h  
|          | Self study: 24h |

**Description:**
Path planning. Production planning.

**Related activities:**
Programming of the GREEDY pathfinding algorithm.

**Specific objectives:**
Greedy, Dijkstra and A* algorithms for pathfinding. Production planning by means of optimisation techniques.

| Supervision | Learning time: 35h  
|             | Theory classes: 7h  
|             | Laboratory classes: 7h  
|             | Self study: 21h |

**Description:**

**Related activities:**
Coding of supervision systems: one for the emergency stage simulation model and another one for a real application with a specific mobile robot in the laboratory.

**Qualification system**
- Exams (theoretical and laboratory contents): 50%
  - midterm: 25%
  - final: 25%
- Theoretical and laboratory deliverables: 30%
- Two video presentations: 10% each (10% + 10% = 20%)

In order to return the unsatisfactory results of the midterm exam you have the chance of doing, in the act of evaluation of the second exam, a final exam that includes the contents of the first and second parts of the subject. All the students can accede to this modality. The grade of this final exam corresponding to the issues of the first part will replace that obtained in the first part only if it is higher.

Whoever wants to opt for this mechanism of renewal can do it by previous enrollment in the Digital Campus of the subject until 48 hours before the date of the final examination. Laboratory practice marks are excluded from this re-engaging mechanism.

**Regulations for carrying out activities**
Written exams will be individually resolved.
The rest of activities that contribute to the assessment of the subject will be performed gathered in groups; the marks obtained by the group members may differ in those cases where their efforts and performances are manifestly different.
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Bibliography

Basic:


Others resources:

Not defined

Hyperlink

MATLAB. Creating Graphical User Interfaces