320039 - II - Industrial Informatics

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 Compulsory)
ECTS credits: 6
Teaching languages: Catalan

Teaching staff
Coordinator: RAMON SARRATE ESTRUCH
Others: FERRAN SANABRIA - BERNARDO MORCEGO SEIX - JOSEP CUGUERO ESCOFET

Prior skills
Foundations of Informatics.

Degree competences to which the subject contributes
Specific:
1. ELO: Applied knowledge of industrial computing and communications.

Teaching methodology
- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

Learning objectives of the subject
- Students will acquire a basic theoretical, technological and practical grounding that will enable them to apply their knowledge to computers and communication networks in industrial automation and control processes.

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>6h</td>
<td>4.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
</tr>
</tbody>
</table>
TOPIC 1: INDUSTRIAL COMPUTERS: COMPONENTS AND ARCHITECTURE

Description:
1.1. Computers for the control and monitoring of industrial processes
1.2. Open systems
1.3. Levels of abstraction in computers
1.4. The architecture of hardware
1.5. The architecture of software
1.6. The programming interface (API)
1.7. The concept of the platform
1.8. Embedded systems

Related activities:
Lectures, laboratory practicals, examinations and directed learning activities

Specific objectives:
For students to:
Define an industrial computer, an open system, an API, a platform and an embedded system.
List and justify the most relevant aspects related to the use of computers for the control and monitoring of processes that have been examined as part of the coursework.
Determine whether a system is open based on its description.
Differentiate between the levels of abstraction in computers.
Interpret the computer as a set of hardware and software subsystems interconnected by interfaces.
Interpret the computer in terms of high level language APIs.
Explain how the size of a computer is affected by the development of applications.
Illustrate the above ideas using the most suitable technologies and, more specifically, those used in the practicals.
# TOPIC 2: CONTROL- AND MONITORING-ORIENTED PROGRAMMING

<table>
<thead>
<tr>
<th>Learning time: 55h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 11h</td>
</tr>
<tr>
<td>Laboratory classes: 11h</td>
</tr>
<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study: 31h</td>
</tr>
</tbody>
</table>

## Description:
- 2.1. Aspects of object-oriented programming
- 2.2. Interaction through surveys and events
- 2.3. Concurrence
- 2.4. Exceptions
- 2.5. Interaction with operators
- 2.6. Interaction with file systems
- 2.7. Interaction with other applications
- 2.8. Interaction with processes

## Related activities:
- Lectures, laboratory practicals, examinations and directed learning activities

## Specific objectives:
For students to:
- Use object-oriented mechanisms to write control and monitoring applications.
- Implement the execution of an application in concurrent tasks and/or tasks caused by events.
- Implement the execution of tasks in an application based on the nature of its interactions.
- Use programming mechanisms that enable an application to interact with an operator.
- Use programming mechanisms that enable an application to interact with file systems.
- Use programming mechanisms that enable an application to interact with other applications.
- Use programming mechanisms that enable an application to interact with the process to be controlled or monitored.
- Analyse the code structure of an application.
- Analyse the execution code of an application step-by-step.
- Infer the external behaviour of an application from its code.
- Develop a control and monitoring application based on operating specifications and give a reasoned account of the choice made.
# TOPIC 3: INDUSTRIAL COMMUNICATIONS: INDUSTRIAL NETWORKS AND FIELDUSES

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. Introduction to industrial communications.</td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td>3.2. Industrial automation and control system architectures: centralised, distributed, hierarchical and CIM.</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>3.3. Reference models in communications systems: OSI and TCP/IP models.</td>
<td>Guided activities: 1h</td>
</tr>
<tr>
<td>3.4. Industrial networks and fieldbuses: classification, component parts and characteristics.</td>
<td>Self study: 12h</td>
</tr>
</tbody>
</table>

## Related activities:
Lectures, laboratory practicals, examinations and directed learning activities.

## Specific objectives:
For students to:
- Identify the benefits of communications networks in industrial automation and control processes.
- Compare the various industrial automation and control processes.
- Ascertain the hierarchical layer structure in communications systems.
- Differentiate the various types of industrial networks and their characteristics.
- Recognise the component parts of industrial networks.
- Choose an industrial communications standard.
- Configure an industrial network device.
TOPIC 4: COMMUNICATION PROTOCOLS

Learning time: 55h
- Theory classes: 10h
- Laboratory classes: 13h
- Guided activities: 2h
- Self study: 30h

Description:
- 4.1. Aspects of physical layers
- 4.2. Aspects of data link layers
- 4.3. Aspects of application layers

Related activities:
Lectures, laboratory practicals, examinations and directed learning activities.

Specific objectives:
For students to:
- Identify the problems associated with the propagation of signals in data transmission.
- Compare data transmission media.
- Differentiate data coding schemes.
- Compare the typology of industrial networks.
- Recognise message formats in communication standards.
- Distinguish the various processes of synchronisation (or delimitation) involved in the reception of a message.
- Compare the various access control mechanisms in the medium.
- Distinguish the various error detection and control mechanisms.
- Differentiate the cooperation models in distributed applications.
- Recognise the communications services provided by an industrial communications standard.
- Use programming mechanisms and components that enable an application to interact with an industrial device through a communications protocol.
- Use network monitoring tools.
### Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LECTURES</strong></td>
<td>Theory classes: 30h</td>
</tr>
<tr>
<td><strong>LABORATORY SESSIONS</strong></td>
<td>Laboratory classes: 26h</td>
</tr>
<tr>
<td><strong>EXAMS</strong></td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td><strong>DIRECTED LEARNING</strong></td>
<td>Guided activities: 6h</td>
</tr>
<tr>
<td><strong>SELF STUDY</strong></td>
<td>Self study: 84h</td>
</tr>
</tbody>
</table>

### Qualification system

Written exams: 60% (25% mid-term exam, 35% final exam)
Laboratory: 30%
Other deliveries: 10% (directed learning)
The final exam reassesses knowledge, since it allows for assessing again the knowledge that corresponds to the mid-term exam. In this sense, if the grade of the final exam exceeds that of the mid-term exam, the written exams breakdown will be as follows: 0% mid-term exam, 60% final exam.
If no directed learning is scheduled, Laboratory scoring will be 40%.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

### Regulations for carrying out activities

Attendance to laboratory and directed learning sessions is mandatory.
Bibliography

Basic:


Complementary:


