320040 - FARI - Automated Manufacture and Industrial Robotics

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, Spanish

Teaching staff

Coordinator: Laureano Tinoco
Jan Pascual
Eduard Bergés

Prior skills

Students will be expected to have passed the following subjects: Electronic Systems. Electrical Systems. Mechanical Systems. Programming. Industrial automation.

Degree competences to which the subject contributes

Specific:
5. ELO: Ability to design and control automation systems.
6. ELO: Understanding of the principles and applications of robotic systems.

Transversal:
1. 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.
2. 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.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

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.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.

Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set.
# Learning objectives of the subject

### Specific learning objectives

- Mastery of the basics of automated production and manufacturing systems.
- Applied knowledge of automated production and manufacturing systems.
- Mastery of the principles and applications of robotic systems.
- The ability to design and automate machines, processes and systems.
- The ability to analyse and solve problems in the field of automated manufacturing.
- The ability to select elements for a robotic process.
- Design and programme automated industrial processes.
- The ability to analyse and solve problems within a distributed environment for automated manufacturing that involves industrial communication and process monitoring.

## Study load

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

Degree competences to which the content contributes:

**TOPIC 1: VERTICAL COMMUNICATIONS: LEVELS 1, 2 AND 3 OF THE CIM PYRAMID**

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 6h</th>
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</thead>
<tbody>
<tr>
<td>1.1. Fundamental concepts of automated manufacturing systems.</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>1.2. The CIM pyramid.</td>
<td>Self study: 4h</td>
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**Specific objectives:**

- Familiarity with automated manufacturing systems featuring industrial communications and information flows.
- Mastery of the communication and information elements that make up an automated manufacturing process.

**TOPIC 2: MONITORING SYSTEM ARCHITECTURE**

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 32h</th>
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<tbody>
<tr>
<td>2.1. Logical redundancy.</td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>2.2. Functional redundancy.</td>
<td>Laboratory classes: 10h</td>
</tr>
<tr>
<td>Related activities:</td>
<td>Self study: 18h</td>
</tr>
<tr>
<td>Configuration and development of systems for monitoring automated manufacturing processes.</td>
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**Specific objectives:**

- The ability to select and connect monitoring systems.
- The ability to analyse and solve monitoring problems in automated manufacturing systems.
### TOPIC 3: DATA LOGGING AND STORAGE SYSTEMS

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>3.1. Concept of data logger.</td>
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<tr>
<td>3.2. Data logging methods.</td>
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<tr>
<td>3.3. Data storage design.</td>
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<tr>
<td>3.4. Compression and distribution of data.</td>
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<table>
<thead>
<tr>
<th>Related activities:</th>
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</thead>
<tbody>
<tr>
<td>Setup and configuration of data-logging systems in an automated manufacturing process.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific objectives:</th>
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</thead>
<tbody>
<tr>
<td>The ability to select and connect data-logging systems in an automated process.</td>
</tr>
<tr>
<td>The ability to analyse and solve problems in data-logging systems.</td>
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<thead>
<tr>
<th>Learning time: 22h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Laboratory classes: 5h</td>
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<tr>
<td>Self study : 13h</td>
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### TOPIC 4: TRACKING, TRACEABILITY AND GENEALOGY

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>4.1. Tracking.</td>
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<tr>
<td>4.2. Traceability.</td>
</tr>
<tr>
<td>4.3. Genealogy.</td>
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<table>
<thead>
<tr>
<th>Specific objectives:</th>
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<tbody>
<tr>
<td>Mastery of the basic concepts of production monitoring.</td>
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<tr>
<td>The ability to outline and solve problems in the field of industrial automation and control.</td>
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<table>
<thead>
<tr>
<th>Learning time: 6h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Self study : 4h</td>
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### TOPIC 5: REPORTING

**Learning time:** 6h  
Theory classes: 2h  
Self study: 4h

**Description:**  
5.1. Introduction to reporting.  
5.2. Reporting systems.  
5.3. Automatic reporting systems.

**Specific objectives:**  
Mastery of the basic concepts of reporting.  
The ability to analyse and solve problems related to automatic reporting.

### Industrial robotics

**Degree competences to which the content contributes:**

### TOPIC 7: BASIC CONCEPTS

**Learning time:** 6h  
Theory classes: 2h  
Self study: 4h

**Description:**  
1.1. Background and evolution of robotic automation.  
1.2. Fields of application.

**Specific objectives:**  
An understanding and command of the basic concepts of automation.
### TOPIC 8: MANIPULATORS AND ROBOTS

**Description:**
- 2.1. Manipulators and robots: basic concepts
- 2.2. Types of robots: basic characteristics.
- 2.3. Proprioceptive and exteroceptive sensors.
- 2.4. Actuators.

**Specific objectives:**
- An understanding of the basic principles of robotic systems.
- The ability to analyse and select robotic systems for a robotic process.

**Learning time:** 12h
- Theory classes: 4h
- Self study: 8h

### TOPIC 9: TERMINAL ELEMENTS

**Description:**
- 3.1. Basic characteristics of terminal elements.
- 3.2. Types of terminal elements.
- 3.3. Specific design of terminal elements.

**Specific objectives:**
- The ability to select or design and connect the appropriate terminal elements according to the tasks to be carried out.

**Learning time:** 6h
- Theory classes: 2h
- Self study: 4h
### TOPIC 10: ROBOT PROGRAMMING

| Description: | 4.1. Introduction to robot programming.  
4.2. Types of programming: teach-in and textual.  
4.3. Programming languages.  
4.4. Basic and advanced features. |
| Related activities: | Programming robots to carry out specific tasks as part of an automated manufacturing system. |
| Specific objectives: | Mastery of the basic concepts of robot programming.  
The ability to program integrated industrial robots that form part of manufacturing processes. |

| Learning time: 29h |
| Theory classes: 3h |
| Laboratory classes: 10h |
| Self study : 16h |

### TOPIC 11: TASK ROBOTISATION

| Description: | 5.1. Introduction to task robotisation.  
5.2. Adapting the environment to a robot.  
5.3. Adapting a robot to its environment: sensory control. |
| Related activities: | Integration of robots to carry out specific tasks as part of an automated manufacturing system. |
| Specific objectives: | The ability to analyse robotic tasks.  
The ability to analyse and solve problems in industrial robotics. |

| Learning time: 16h |
| Theory classes: 2h |
| Laboratory classes: 5h |
| Self study : 9h |
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**TOPIC 12: SECURITY**

**Description:**
6.1. Protection and safety elements.
6.2. Safety rules in robotic environments.

**Specific objectives:**
Mastery of safety-related concepts in industrial robotics.
A basic understanding of safety systems and rules in robotic systems.

**Learning time:** 4h
- Theory classes: 1h
- Self study: 3h

**TOPIC 13: INDUSTRIAL APPLICATION**

**Description:**
7.1. Presentation of a case study.

**Specific objectives:**
An understanding of automated manufacturing systems by examining a case study.

**Learning time:** 6h
- Theory classes: 2h
- Self study: 4h

**Qualification system**
- Automation examination: 30%
- Robotics examination: 30%
- Laboratory: 40%

All those students who fail, want to improve their mark or cannot attend the partial exam, they will have the opportunity to be examined the same day of the final exam. If due to the circumstances it is not viable to do it the same day of the final exam, the teacher responsible for the subject will propose, via the platform Atenea, that the mentioned recovery exam will be carried out another day, in class schedule.
The new mark of the recovery exam will substitute the previous one, unless it is lower.

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.
Bibliography

Basic:

