205250 - RA - Advanced Robotics & Highly Automation Production Systems

**Coordinating unit:** 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
**Teaching unit:** 707 - ESAII - Department of Automatic Control  
**Academic year:** 2018  
**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:** RITA MARIA PLANAS DANGLA  
**Others:** LAUREANO TINOCO

### Teaching methodology

The course is divided into parts:

- Theoretical and work group sessions  
- Laboratory sessions  

Self-study (including proposed exercises and activities) will be also contemplated.

In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with examples appropriate to facilitate their understanding. Student , working in groups will use the new concepts to specify its solution in order to solve the laboratory tasks.

In the lab sessions, teachers guide students in applying theoretical concepts to solve problems, always using critical reasoning.

For the first lab work, students will be able to integrate a robotized and automated solution in order to obtain the complete and correct operation of the system consisting of a robot, a process station and a supervision and control system emulating an Industrial task. At lab, students will work in pairs, in order to promote contact and use the basic tools needed to solve problems.

For the second lab work, students will be able to be comfortable working on a Highly Automated Production System and must be able to implement a correct solution in order to obtain the complete and correct operation of the system consisting of a small flexible production line composed by 4 different stations emulating an Industrial task. At lab, students will work in groups (8-10 students), in order to promote contact and use the basic tools needed to solve problems. Students, independently, need to work on the materials provided by teachers in order to fix and assimilate the concepts.

The teachers provide the syllabus and monitoring of activities (by ATENEA)

### Learning objectives of the subject

This course is based in the practical development of a "hands-on" application of a Robotics and Highly Automated Systems real case study.

The applications must be proposed by lecturers and includes a different set of technologies all of them often used in industrial environments (PLCs, OPC, SCADA systems, Industrial Robots, Industrial Communications, Vision Systems, User Interfaces, etc.).

Depending on the lab work, applications will be developed by pairs or by groups (-10 students),
and in both cases, teachers will assess and supervise each student’s teamwork in order to help them in the project development and to solve possible doubts.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 150h</th>
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<tbody>
<tr>
<td></td>
<td>Hours large group: 60h</td>
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<td>40.00%</td>
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<td>Hours medium group: 0h</td>
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<td>Hours small group: 0h</td>
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<td>Self study: 90h</td>
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<td>60.00%</td>
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# Module 1: ROBOTICS

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<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>Introduction.</td>
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<tr>
<td>Robot Elements: Drive System, Control System, Sensors, End Effectors, Robot Coordinate Systems: Robot coordinate system representation, transformation, homogeneous transform, relating the robot to its world</td>
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<td>Robotic Programming: language based programming.</td>
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<td>Applications: application of robots to a specific tasks.</td>
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<table>
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<tr>
<th>Related activities:</th>
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<tbody>
<tr>
<td>To develop a Robot program in order to solve the given robotized task</td>
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<tr>
<td>To develop a PLC program in order to solve the complete automation of a given production station</td>
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<td>To develop a SCADA application in order to supervise the complete industrial task.</td>
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<table>
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<tr>
<th>Learning time:</th>
<th>25h</th>
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<tbody>
<tr>
<td>Theory classes:</td>
<td>10h</td>
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<tr>
<td>Self study:</td>
<td>15h</td>
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### Module 2: AUTOMATION

<table>
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<tr>
<th>Description:</th>
<th>Learning time: 100h</th>
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<tbody>
<tr>
<td>Basics of industrial Automation Systems.</td>
<td>Theory classes: 40h</td>
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<tr>
<td></td>
<td>Self study: 60h</td>
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**Flexible manufacturing Systems (FMS):** Definition, Needs, General considerations and FMS types,
Composition of FMS:
- hierarchy of computer control
- Control software and Hardware components: PLCs
- System Communications
- Automated material movement (AGVs) and automated storage and retrieval systems (Highly automated warehouses)
- Automated Inspection Systems
- Safety components and Safety Automation

**CIM Database and Database Management Systems:**
- DDBB Types,
- Management Information System,
- Manufacturing data collection systems
- Reporting KPIs

**Supervision, Control and Data Acquisition (SCADA):** SCADA Introduction, Elements of SCADA, Features of SCADA, SCADA communications, SCADA development for any one typical application.

**Related activities:**
## Module 3: COMMUNICATIONS

**Learning time:** 12h 30m  
Theory classes: 5h  
Self study: 7h 30m

**Description:**
- LAN Connectivity; Bridges, Routers and Switches  
- Solving Distance and Capacity Problems with Full Duplex Ethernet  
- Principles of The TCP/IP Architecture  
- Features of The Internet Computing Architecture  
- Key Elements of The Internet Protocol

**Related activities:**
- Working in groups, to decide the right data structure in order to automatize a small FMS composed by 4 different stations.  
- Working in groups, to realize the right control automation of each one of the fourth FMS line, including the artificial vision process, and a MMI (Man Machine Interface) as a user interface and interaction panel.

## Module 4: SYSTEM INTEGRATION

**Learning time:** 12h 30m  
Theory classes: 5h  
Self study: 7h 30m

**Description:**
- content english

**Related activities:**
- To configure an OPC server in order to make possible the complete system integration  
- Working in groups, to configure system communications and realize the right data base implementation in order to extract different reports related with the production of the FMS automatized line  
- To establish the needed data and its structure in order to fully integrate the robot operation, the process station operation and the SCADA supervisory system. To configure an OPC server in order to make possible the complete system integration  
- Working in groups, to configure system communications and realize the right data base implementation in order to extract different reports related with the production of the FMS automatized line
Qualification system

Laboratory test (individually): 20%
Project results (in group): 50%
Small project modification (individually): 30%

Bibliography

Basic:
