COURSE DATA

Data Subject	
Code	34944
Name	Advanced automation
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1404 - Degree in Industrial Electronic Engineering	School of Engineering	4	Second term

Subject-matter

Degree	Subject-matter	Character
1404 - Degree in Industrial Electronic Engineering	18 - Industrial automation and control	Obligatory

Coordination

Name	Department
FRANCES VILLORA, JOSE VICENTE	242 - Electronic Engineering
ROSADO MUÑOZ, ALFREDO	242 - Electronic Engineering

SUMMARY

This course covers advances topics in industrial automation, covered topics go beyond those PLC-based automation systems.

In modern automation systems, it is very common to find different specialized equipment working in integrated manufacturing systems together with PLCs and SCADA systems. As previous courses in the degree covered a wide range of automation principles, this course is focused in the study of automation equipment which is able to perform complex tasks accurately, safely and fast. In most of the cases, this equipment will work side by side with PLC, SCADA, using industrial fieldbuses, etc.

From the wide range of existing equipment, this course will cover in detail those related to industrial robotics, artificial vision systems, and tooling machines as CNC (Computer Numerical Control) or multi-axis systems. The proper knowledge of these systems and the integration in the factory is a key factor in the successful implementation of automation processes.

On the other side, this course will cover the security aspect required in automation. Different regulation requirements will be discussed so that a proper risk evaluation is done, especially for those related to human safety when working with an automation system. A second security concern is related to explosion-risk ambient (ATEX) as mines, chemical industries, etc. The description of this regulations and the type of devices required to work safely in an ATEX environment will be described.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

In order to successfully follow the course contents, the students should have taken the following courses:
34941 Industrial Automation
34942 Integrated manufacturing systems

OUTCOMES

1404 - Degree in Industrial Electronic Engineering

- CG3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- CG4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering (with specific industrial electronics technology).
- CG6 - Ability to deal with specifications, regulations and mandatory standards.
- CE7 - Knowledge and capacity for systems modeling and simulation.
- CE8 - Knowledge of automatic regulation and control techniques and their application in industrial automation.
- CE9 - Knowledge of the basics and applications of robotic systems.
- CE10 - Applied knowledge of industrial computing and communications.
- CE11 - Ability to design control and automatic industrial systems.

LEARNING OUTCOMES

Once received, this matter, the student:

- Will owe knowledge about industrial informatics and communications (CE10).
- He will know how to program an articulated robot to follow a preset trajectory (CE7, CE8, CE9).
- It will be known a language for robot programming (CE9, CE10).
- It will be having knowledge about CNC controllers and its programming (CE10, CE11).
- It will be known to analyze, design, program and select artificial vision systems when applied to industrial inspection (CE10, CE11).

The students will develop the following skills:

- To know the type of robot needed, according to the target application.
- Choose the adequate robot characteristics according to the target application.
- Define movements and trajectories of a robot.
- Program an industrial robot.

- Communicate a robot with other devices, integrating them into the global automation system and adding external signal for the control of the automation process.
- Use a simulation tool for industrial robots.
- To know when a tooling machine must be used in an application and detailing the required hardware to implement such application.
- Program a CNC system using standard ISO language.
- Program multi-axis movement control systems.
- Determine if an industrial vision system is needed in a target application.
- Identify all required elements in an industrial automation system.
- Select all adequate elements in an industrial automation system.
- Apply different image processing to obtain different features of acquired images.
- Evaluate safety risks in an automation machine.
- Define solutions in an automation system to meet the safety regulations.
- Identify ATEX environments.
- Define solutions for automation devices inside an ATEX environment.

In addition, other social and techinal skills must be obtained when taking this course:

1. Take initiative to solve problems, take decisions, creativity, critical reasoning and capacity to transmit and communicate knowledge and ideas.
2. Work under multidisciplinary groups.
3. Use technical documentation and equipment manuals.
4. Use technical documentation in English.

DESCRIPTION OF CONTENTS

1. Introduction to advanced automation

General introduction to the course.
What does it mean advanced automation
Automation tasks where the use of specific equipment is required
Special industry environaments: regulations

DURATION: 2 HOURS

2. Industrial robots

Introduction to Robotics. Spatial geometry. Trajectory planification. Industrial robots types.
Robot programming: specific languages and software.
Simulation

DURATION:
10 hours theory (5 sessions)
2 hours problem solving (1 session)
9 hours in laboratory (3 sessions)

3. Computer Numerical Control (CNC)

Computer Numerical Control and other multiaxes control systems.
Hardware components in a CNC
Control and programming for CNC and multiaxes systems.

DURATION:
6 hours theory (5 sessions)
2 hours problem solving (1 session)

4. Artificial Vision

Artificial Vision Systems.
Main components of an artificial vision system: optics, cameras, lighting, etc.
Basic feature extraction in images for indsutrail applications
Basic image processing for industrial applications.

DURATION:
10 hours theory (5 sessions)
4 hours problem solving (2 sessions)
9 hours in laboratory (3 sessions)

5. Regulation and safety in automation systems

CE marking
Machine safety. Risk evaluation
Explosive environments ATEX classified. Equipment selection and installation guidelines for ATEX equipment.

DURATION:
10 hours theory (5 sessions)
4 hours problem solving (2 sessions)

9 hours in laboratory (3 sessions)

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	20,00	0
Development of individual work	20,00	0
Study and independent work	20,00	0
Readings supplementary material	10,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	5,00	0
TOTAL	150,00	

TEACHING METHODOLOGY

The teaching methodology will differ according to the teaching unit, the specific topic discussed and the activities proposed in the lecture sessions, both in theory classroom and laboratory.

Specifically, initial **theory lessons** (CE7, CE9, CE10, CE11, CG3) will be taught, supported by a debate proposal to students concerning different practical issues for the topic. After first theory lessons, some **work development** (CE8, CE9, CE11, CG4, CG6) will be proposed to the student to be done outside classroom and further explained in class (some of these tasks will be evaluated). In the problem solving hours students will provide solutions to previously introduced industrial problems. At this point, the active participation of students solving problems, adding new ideas and solutions is very relevant.

Concerning **laboratory sessions** (CE7, CE8, CE9, CE10, CE11), they consist on simulation and hardware equipment control previously covered in theory classes. Each laboratory session has its own lab guide where all tasks that the student must perform are detailed, the objectives to be achieved and the previous work to be done by the student in order to take the most of the lab sessions.

Lab sessions are evaluated. The criteria is based on achieved goals, active participation and the required reports to be shown to the teacher after the session.

In order to obtain an optimal progress, the student must attend the classes, both theory and laboratory.

EVALUATION

The global evaluation for this course is based on the addition of all different aspects evaluated during the lectures.

At least one personal or group report will be required to hand over along the semester.

The final score will be obtained according to the following formula and applied to all students:

FINAL qualification = (20% individual and group projects handed over during the semester, PACT) +

+ (60% theory and problems exam, ETEO)

+ (20% laboratory exam, ELAB)

Each of the parts' score is saved during the semester for obtaining the final value. If some of the exams is failed, a second chance is given.

To calculate the global evaluation is needed to obtain minimum 4.5 mark in both theory and problems exam (ETEO) and laboratory exam (ELAB). On the other hand, the evaluation of individual and group projects (PACT) will be not retrievable.

PACT evaluate outcomes CG6, CE7, CE8, CE9, CE10 i CE11. ETEO evaluate outcomes CG3, CE7, CE8, CE9, i CE11. ELAB evaluate outcomes CG6, CE7, CE8, CE9, CE10, i CE11.

In any case, the evaluation system will be subordinate to the Evaluation and Qualification Regulation of the University of Valencia for Masters and Degrees.

REFERENCES

Basic

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- Andrew Glaser. Industrial Robotics: How to Implement the Right System for Your Plant. 2008. Industrial Press, Inc. ISBN-10: 0831133589. ISBN-13: 978-0831133580.
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Additional

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  Text referència.
- P. Smid. CNC Programming Handbook, Second Edition. 2003, Industrial Press. ISBN: 0-8311-3158-6.
- Geoffrey Bottrill, Derek Cheyne, and G Vijayaraghavan. Practical Electrical Equipment and Installations in Hazardous Areas. 2005. Newnes. ISBN-10: 0750663987. ISBN-13: 978-0750663984.