Course Guide
34942 Integrated manufacturing systems

COURSE DATA

Data Subject	
Code	34942
Name	Integrated manufacturing systems
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1404 - Degree in Industrial Electronic Engineering	School of Engineering	3	Second term

Subject-matter

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

Coordination

Name	Department
AMOROS LOPEZ, JULIA CARMEN	242 - Electronic Engineering
GOMEZ SANCHIS, JUAN	242 - Electronic Engineering

SUMMARY

Integrated Manufacturing Systems is a four-month course that is taught in the second semester of the third year of the Degree in Industrial Electronics Engineering. The course is framed in the block “automation and industrial control”. The course has a teaching load of 6 ECTS credits.

During the course we review the concept CIM (Computer Integrated Manufacturing), and the tools and knowledge available to the engineer to carry out implementations based on the use of industrial distributed systems. We will show the concept of standard and will present the main global standardization organizations. In this context, ISO/OSI communication model will be shown.

A vital element in any integrated manufacturing system are industrial communication buses. During the course we will show industrial communication buses classified by the level of hierarchy in the automation pyramid. Communication system must be integrated into systems called SCADA. This kind of systems can be used for supervising and controlling the industrial processes by the management department. A review of the main features of SCADA and HMI systems will be done. In recent years systems based on industrial PCs have experienced a boom in automation systems for complex tasks. Thus, it is necessary to describe the main technologies related to the use of industrial PCs. Finally, knowing all the aspects involved in the integrated manufacturing systems, design methodologies of this kind of systems will be discussed.

The course is divided into blocks of content. The blocks and their contents are as follows:

BLOCK I. Communication systems in industrial processes.

Introduction to integrated manufacturing systems.

Network topology an logical structure.

Industrial communication networks.

BLOCK II. Supervisory and control systems.

Supervisory and control systems.

Industrial PCs.

BLOCK III. Industrial processes and pneumatic systems.

Industrial processes based on distributed automation using PLC.

Introduction to pneumatic automation.

BLOCK IV. Integrated manufacturing systems laboratory.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

It is highly recommended to have attended previous courses related to industrial automation.

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.
- CE10 - Applied knowledge of industrial computing and communications.
- CE11 - Ability to design control and automatic industrial systems.

Learning result after taking the course is summarized in the following knowledge:

- Applied knowledge on industrial informatics and communications (CG3, CG4, CG6, CE7, CE10, CE11).

As a result of this course, the student will acquire the following skills:

- Choose the appropriate communication bus for each part of the automation processes.
- Choose the appropriate automation strategy (distributed vs. centralized) depending on the characteristics of the automation processes.
- Be able to design properly a decentralized I/O systems bus based.
- Be able to implement an SCADA or HMI system for control and monitoring an automation process.
- Be able to implement and plan an industrial process on a pneumatic installation.

In addition to the previous objectives, the course will encourage the development of several skills, among which include:

- Ability to solve problems with initiative, decision making, creativity and critical thinking.
- Communicate and transmit knowledge.
- Work in teams.
- Use and understand technical documentation and user manuals.
- Use English documents.

DESCRIPTION OF CONTENTS

1. Communication systems in industrial processes

Introduction to integrated manufacturing systems.
1.1. Computer Integrated Manufacturing. Concept CIM.
1.2. Industrial control systems. Centralized vs distributed strategies.
1.3. Communication hierarchy: Automation pyramid.
1.4. Standardized systems.

Network topology, links and logical structure.
2.1. Industrial local networks. ISO/OSI Model.
2.2. Network topology.
2.3. Medium access control.
2.4. Transmission mediums.

Industrial communication networks.
3.1. Basic communication standards.
3.2. Industrial networks. Classification by hierarchy level.
3.3. Sensor actuator bus. ASi.
3.4. Device oriented buses. CAN bus and MODBUS.
3.5. Fieldbuses. Profibus.
3.6. Unification of automation levels. Profinet y Modbus TCP.

Industrial processes based on distributed automation using PLC.
4.1. Processes and task that can be assigned to a PLC.
4.2. Distributed model on automation systems.
4.3. Choice of communication systems between PLCs.
4.4. Choice of communication systems between PLCs and field devices. Decentralized I/O.

2. Supervisory and control systems

5.1. Introduction to SCADA systems
5.2. SCADA´s Architecture.
5.3. SCADA´s Modules.
5.4. Dinamic information Exchange. OPC.
5.5 Human-Machine Interface (HMI)

Industrial PCs.
6.1. Industrial PC vs PLC. Advantages and Drawbacks.
6.2. Characteristics of a industrial PC.
6.3. Industrial PC´s peripherals
6.4. Industrial PC based systems.
6.5. Operating systems.

3. Industrial processes and pneumatic systems

Introduction to pneumatic automation.
7.1. Pneumatic systems in industrial automation.
7.2. Teoría del aire comprimido.
7.3. Compressed air theory.
7.4. Control valves.
7.5. Regualtion and control valves.
7.6. Linear actuators.
7.7. Rotary actuators.

4. Integrated manufacturing systems laboratory

Practical sessions:
Stacking system of biscuits using Modicon 340.
Biscuit stamping system. Communication between PLCs using Modbus TCP.
Mixing and kneading system controlled with Modbus TCP I/O.
Introduction to HMI systems.
HMI system based on screen Schneider Magelis.
Introduction to pneumatic control.
Individual exam.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	25,00	100
Laboratory practices	20,00	100
Classroom practices	15,00	100
Development of group work	20,00	0
Development of individual work	5,00	0
Study and independent work	5,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	25,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The methodology is structured around the theory, problems and laboratory sessions that will be evaluated during the course. As teaching methodology for lessons of theory and practice, “lecture” will be used as a teaching model. In particular, in the practice sessions, the teacher will conduct a series of example problems and after this they will solves similar problems in the area of the proposed work. Additionally, the student will carried out a project in groups of 2-4 students using a Siemens PLC.

These activities will be guided by the lecturer through tutorial classes to verify the proper development of the student during the course.

The labs are divided into lab groups consisting of pairs of students to promote social skills of teamwork and mutual participation. Students should prepare the laboratory sessions at home by reading the educational material prepared for this purpose. A series of questionnaires will be answered by the students in order to verify the minimum knowledge required for a successful implementation.

Occasionally, depending on the planning and availability, seminars will be organized by industry experts on a specific topic. These seminars will be developed in class or in the industrial environment, so that the student knows in first person the real working environment and specific technologies implemented in a real environment.

The proposed methodology and activities will encourage the development of all the skills specified for this course (CG3, CG4, CG6, CE7, CE10, CE11).

EVALUATION

The evaluation will be conducted during the entire course, evaluating theory, practice and laboratory sessions in order to have global idea of knowledge and skills of the student.

a) Theory:

A theoretical written exam will be done by the student. This test will be done in date and time indicated in the official ETSE agenda (web information available). Additionally, a midterm exam and some exercises will be proposed during the subject.

b) Practice:

The student will perform one practice case or project that will be proposed by the teacher in line with specific educational needs of the student.

c) Laboratory:

A continuous evaluation of each session together with a laboratory exam will evaluate the skills achieved during the course by the student.

It will be necessary that the student will get a score of 5 at least in each part (theory, practice and laboratory) in order to pass de course.

The global score will be obtained using the next formula:

Global_Score = (Theory_Score + Practice_Score + Laboratory_Score) / 3

In any case, the system of evaluation will be ruled by the Regulation of Evaluation and Qualification of the University of Valencia for Degrees and Master's degree

(https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639)

REFERENCES

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- Computer Integrated Manufacturing. Regh, J.A., Kraebber, H.W. Prentice Hall, ISBN 0-13-087553-8
- Fieldbus and Networking in Process Automation. Sunit Kumar Sen.CRC Press, 2014 (Print ISBN-13: 978-1-4665-8676-5, Web ISBN-13: 978-1-4665-8677-2). Libro electrónico disponible online en la biblioteca de la UV. http://proquest.safaribooksonline.com/book/electrical-engineering/communications-engineering/9781466586765
- Advanced Industrial Control Technology, Peng Zhang. Publisher: William Andrew. 2010. (Print ISBN-13: 978-1-4377-7807-6, Web ISBN-13: 978-1-4377-7808-3). Libro electrónico disponible online en la biblioteca de la UV. http://proquest.safaribooksonline.com/book/engineering/9781437778076

Additional

- Automating with SIMATIC. Berger, Hans.