Course guide
320039 - II - Industrial Informatics

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: 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

Type	Hours	Percentage
Hours small group	30,0	20.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

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

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.

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

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 4h
Guided activities: 1h
Self study : 11h

TOPIC 2: CONTROL- AND MONITORING-ORIENTED PROGRAMMING

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

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.

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

Full-or-part-time: 55h
Theory classes: 11h
Laboratory classes: 11h
Guided activities: 2h
Self study : 31h

TOPIC 3: INDUSTRIAL COMMUNICATIONS: INDUSTRIAL NETWORKS AND FIELDBUSES

Description:
3.1. Introduction to industrial communications.
3.2. Industrial automation and control system architectures: centralised, distributed, hierarchical and CIM.
3.3. Reference models in communications systems: OSI and TCP/IP models.
3.4. Industrial networks and fieldbuses: classification, component parts and characteristics.

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.

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

Full-or-part-time: 20h
Theory classes: 5h
Laboratory classes: 2h
Guided activities: 1h
Self study : 12h

TOPIC 4: COMMUNICATION PROTOCOLS

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

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.

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

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

ACTIVITIES

LECTURES

Full-or-part-time: 30h
Theory classes: 30h

LABORATORY SESSIONS

Full-or-part-time: 26h
Laboratory classes: 26h

EXAMS

Full-or-part-time: 4h
Laboratory classes: 4h

DIRECTED LEARNING

Full-or-part-time: 6h
Guided activities: 6h

SELF STUDY

Full-or-part-time: 84h
Self study: 84h

GRADING 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.

EXAMINATION RULES.

Attendance to laboratory and directed learning sessions is mandatory.

BIBLIOGRAPHY

Basic:
- Castro Gil, Manuel-Alonso. Comunicaciones industriales: principios básicos. Madrid: UNED, 2007. ISBN 9788436254600.
- Castro Gil, Manuel-Alonso. Comunicaciones industriales: sistemas distribuidos y aplicaciones. Madrid: UNED, 2007. ISBN 9788436254679.
- Stallings, William. Comunicaciones y redes de computadores [on line]. Madrid: Prentice Hall, 1997 [Consultation: 09/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1245. ISBN 8489660018.
- Meyer, Bertrand. Construcción de software orientado a objetos. 2ª ed. Prentice Hall, 1999. ISBN 8483220407.
- Olsson, Gustaf; Piani, Gianguido. Computer systems for automation and control. New York: Prentice Hall, 1992. ISBN 0134575814.
- García de Jalón, J. Aprenda Java como si estuviera en primero [on line]. San Sebastián: Universidad de Navarra. Escuela Superior de Ingenieros Industriales, 2000 [Consultation: 05/04/2022]. Available on: https://ocw.uc3m.es/cursos-archivados/programacion-java/manuales/java2-U-Navarra.pdf/view.

Complementary:
- Pimentel, Juan R. Communication networks for manufacturing. Englewood Cliffs, NJ: Prentice Hall, 1990. ISBN 0131544020.
- Tanenbaum, Andrew S. Redes de computadoras [on line]. 5ª ed. Harlow: Pearson, 2013 [Consultation: 30/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6206. ISBN 9781292024226.
- Halsall, Fred. Comunicación de datos, redes de computadores y sistemas abiertos. 4ª ed. Buenos Aires: Addison-Wesley Iberoamericana, 1998. ISBN 0201653079.
- Tanenbaum, A.S.; Steen, M.V. Sistemas distribuidos. 2ª ed. México: Pearson Educación, 2008. ISBN 9789702612803.