Course guide
220615 - 220615 - Data Processing, Storage, Validation and Automated Production Management

Unit in charge:	Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	707 - ESAII - Department of Automatic Control.
Degree:	MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012). (Optional subject).

Academic year: 2025   **ECTS Credits:** 5.0   **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer:	Bachiller Matarranz, Alejandro
Others:	Miquel Angel Cugueró Escofet
	Miguel Delgado Prieto

PRIOR SKILLS

It is assumed that the student has the fundamental concepts of calculus, algebra and systems theory/differential equations acquired in the degree that provides access to the Master's Degree in Automatic Systems Engineering and Electronics.

REQUIREMENTS

No requirements.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Research, analysis, design and implementation of ISA88, ISA 95 or ISA97 standards in automated production systems to manage all the data associated to the global management of the manufacturing plant.
5. Identify, select, design and implement Information systems solution and algorithm implementation for data managing in different levels of automation.

Transversal:
2. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
4. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
6. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

TEACHING METHODOLOGY

The development of the class sessions follows a double methodology, on the one hand a methodology close to the master classes will be applied, where the teacher will teach the subject of the course, and will be combined with a methodology close to the practical classes, where students will work with laboratory plants and/or simulation problems posed by the teacher to reinforce and deepen the methodologies taught previously.

LEARNING OBJECTIVES OF THE SUBJECT

This subject aims to introduce the student to the field of data processing, validation, reconstruction and storage systems and, in general, to the management of information systems in industry.

The student who has taken this subject should be able to:

- To know how to design systems for the treatment and validation of data from industrial process supervision systems.
- To know how to implement systems for the reconstruction of invalid data.
- To design and implement data models and make use of databases.
- To know the techniques for information management.
- To know the basis of industrial communication.

STUDY LOAD

Type	Hours	Percentage
Hours large group	31,0	24.80
Self study	80,0	64.00
Hours small group	14,0	11.20

Total learning time: 125 h

CONTENTS

1. Information Systems and Databases Description:

Description:
This module focuses on the main concepts of an information system and its organisation, storage and retrieval in a database. Nowadays, the role of data analytics is becoming more and more important in an organisation, which means that it is necessary to make decisions based on data analysis. Which data sets are important in an organisation, how these data sets are modelled and how best to store and retrieve the necessary information are key concepts for good information systems management. This module will focus on the information system, provide knowledge on data access languages and technologies, database management system selection and database design.

Specific objectives:
To know the basic principles related to:
- Introduction to information systems.
- Data models: entity-relational model and relational model.
- Implementation of relational DB systems (DBMS).
- Knowing the language to manipulate and make SQL queries in a DB.
- Non-SQL database systems.

Related activities:
Activity 1, Activity 2 y Activity 3

Full-or-part-time: 41h
Theory classes: 11h
Laboratory classes: 4h
Self study : 26h

2. PROCESSING, RECONCILIATION, VALIDATION AND RECONSTRUCTION OF DATA

Description:
From the information available in the large amount of data available both within an industry and from the industrial environment, a series of conclusions can be drawn to support decision making. The first step is to validate the original data and prepare it for analysis. This process may require the use of reconciliation or reconstruction techniques for further use. Finally, this data can be used to train predictive models that give the necessary insight to make decisions based on the available information. In this last point, tools derived from big data analysis and artificial intelligence (AI) techniques can be used.

Specific objectives:
The contents covered in this module include:
- Introduction to data mining
- Data reconciliation, validation and reconstruction techniques.
- Application of sophisticated data analysis techniques.

Related activities:
Activities 1, 2, 3 and 4

Full-or-part-time: 42h
Theory classes: 10h
Laboratory classes: 5h
Self study : 27h

3. Industrial automation and communications:.

Description:
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Specific objectives:
The contents covered in this module include:
- Introduction to MES systems and their relationship with information processing, validation and management systems.
- Introduction to the OPC communications system.
- Development of an OPC communications system.

Related activities:
Activities 1,2 and 4

Full-or-part-time: 42h
Theory classes: 10h
Laboratory classes: 5h
Self study : 27h

ACTIVITIES

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Description:
The teacher explains the basic concepts of the subject in the classroom, emphasising the most important topics for the understanding of the subject. To achieve this objective, the teacher will solve standard exercises and examples with specific calculation codes.

Specific objectives:
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Material:
Notes and subject material, problems, scientific articles.

Delivery:
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Full-or-part-time: 76h
Theory classes: 26h
Self study: 50h

ACTIVIDAD 2. LABORATORIO WORK

Description:
In this activity, students will work in pairs or individually to carry out a practical study and a practical implementation and application of the concepts obtained in the theory on real case studies.
The practical work consists of 6 practicals of 2 face-to-face hours. The practices will have a theme related to the contents presented in the master classes:
- Practice 1: Data model definition
- Practice 2: SQL Querys
- Practice 3: Data reconciliation
- Practice 4: Data validation and reconstruction
- Practice 5: Configuration of an OPC network
- Practice 6: Communications within an industrial network

Specific objectives:
- Understand the concepts acquired in theory and apply them to real or simulated cases.
- Work in groups or individually.

Material:
Statements of the practices to be carried out, industrial control laboratory equipment and use of the specific programmes.

Delivery:
At the end of the activity, a report will be handed in with the solution proposed and the results obtained, and the teacher will hand in the evaluation at the next practical session.

Full-or-part-time: 44h
Laboratory classes: 14h
Self study: 30h

ACTIVIDAD 3: PARCIAL EXAM

Description:
This activity involves the performance of two written tests after the first 6 class sessions to evaluate, individually, the degree of assimilation of the concepts of the subject.

Specific objectives:
- Evaluate the degree of assimilation of the contents of the subject.

Material:
Written test statement.
Class notes.

Delivery:
The completed test will be handed in to the teacher with the corresponding files and programmes.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 4: FINAL EXAMEN

Description:
This activity involves a written test at the end of the course to individually assess the degree of assimilation of the concepts of the subject.

Specific objectives:
- Evaluate the degree of assimilation of the contents of the subject.

Material:
Statement of the written test.
Class notes.

Delivery:
The solved test will be handed in to the teacher with the corresponding files and programmes.

Full-or-part-time: 3h
Theory classes: 3h

GRADING SYSTEM

The evaluation is based mainly on the degree and level of student participation throughout the course in the class sessions (contribution to the discussion of topics, approach and resolution of issues, ...), and in the development, conclusions and Presentation of their practical work. In addition, two written tests of all the parts of the subject will be carried out.

The weighting of each of these evaluation activities in the final grade will be 35% for the written test of the first part, 35% for the written test of the final exam and 30% for the overall mark of the practical reports submitted to the final exam. End of each practice session.

In order to revert the unsatisfactory results of the theory examination of the first part, the possibility of doing, in the act of evaluating the second part, is made a final theoretical examination that includes the contents of the first and second partial. To this modality can accede all the students of the subject. The grade of this final exam of theory corresponding to the agenda of the first part will replace that obtained in the first part only if it is higher.

Anyone who wishes to opt for this renewal mechanism can do so by prior enrollment in the Digital Campus of the subject (or simply by sending an email to the teacher) up to 48 hours before the final exam date. The notes of the laboratory practices are exempt of this mencanisme of redemption.

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.

The test will be carried out individually with the authorised material and on the date established in the Master's calendar.

BIBLIOGRAPHY

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- Narasimhan, S.; Jordache, C. Data reconciliation and gross error detection: an intelligent use of process data [on line]. Houston: Gulf Publishing, 2000 [Consultation: 15/06/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780884152552/data-reconciliation-and-gross-error-detection. ISBN 0884152553.
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