Course guide
330068 - CIA - Industrial Control and Automation

Last modified: 25/04/2024

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2016). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: XAVIER GAMISANS NOGUERA

Others: SERGI GRAU TORRENT - TERESA ESCOBET CANAL

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge of the basics of automation and control techniques.

Transversal:
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
5. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

The hours of directed learning that are carried out in a medium group, consist, on the one hand, in doing lectures in which the teacher makes a brief presentation to introduce the general learning objectives related to the basic concepts of the subject, which are combined with cooperative learning techniques, in which the resolution of practical exercises is proposed from which it is tried to motivate and involve the student to actively participate in their learning. Students can access all support material via ATENEA.

The hours of directed learning that are carried out in a small group, consist of carrying out 6 laboratory practices, which are done in pairs, and allow the development of basic instrumental skills in a control and automation laboratory, as well as initiating students into the application of the scientific method in problem solving.

In general, after each session, assignments are proposed outside the class, which have to be done either individually or in groups and which are the basis of the directed activities. It is also necessary to consider more hours of autonomous learning, such as those dedicated to oriented reading, solving the proposed problems or self-learning questionnaires of the different contents through the virtual campus ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the Industrial Control and Automation course, the student must be able to:

- Understand and master the basic concepts of continuous control and industrial automation.
- Properly use modeling and simulation tools, both for continuous systems and for discrete events.
- Characterize the model of a linear continuous system from its temporal response.
- Explain the stability of a feedback system and study different criteria to evaluate it.
- Determine the values of the parameters of a PID regulator to achieve certain operating specifications.
- Solve basic automation problems with different tools available.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Self study	90,0	60.00
Hours large group	45,0	30.00

Total learning time: 150 h

CONTENTS

1. INTRODUCTION TO INDUSTRIAL CONTROL AND AUTOMATION

Description:
1.1. Basic concepts.
1.2. Regulation systems.
1.3. Automated systems.
1.4. Regulation towards automation.

Specific objectives:
- Know how to identify the basic elements of automated systems.
- Understand the objectives of a continuous control system and an automated system.

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

2. INDUSTRIAL AUTOMATION

Description:
2.1. Elements of an automated system: sensors, actions, control system.
2.2. Discrete event system models with Grafcet.
2.3. Basic characteristics of a programmable logic controller.
2.4. Security in automated facilities.
4.5. Supervision and control systems for industrial communication networks.

Specific objectives:
- Understand and master the basic concepts of industrial automation.
- Properly use modeling and simulation tools for discrete event systems.
- Solve a basic automation problem with different tools available.

Related activities:
Activity 1: Automation practices.
Activity 3: Written tests.
Activity 4: Self-learning exercises.

Full-or-part-time: 51h
Theory classes: 14h
Laboratory classes: 10h
Self study : 27h

3. MODELING AND ANALYSIS OF DYNAMIC SYSTEMS

Description:
3.1 Introduction: models and Laplace transforms.
3.2 Modeling of continuous dynamic systems.
3.3 Definition of transfer function. Block diagrams.
3.4 Temporal response of linear systems.

Specific objectives:
- Understand and master the basic concepts of continuous control.
- Properly use modeling and simulation tools.
- Characterize the model of a linear continuous system from its temporal response.

Related activities:
Activity 2: Continuous systems laboratory practices.
Activity 3: Written tests.
Activity 4: Self-learning exercises.

Full-or-part-time: 44h
Theory classes: 14h
Laboratory classes: 2h
Self study : 28h

4. AUTOMATIC CONTROL

Description:
4.1 Concepts related to feedback. Robustness, stability, precision, follow-up of instructions.
4.2 PID regulators.
4.3 Design of PID regulators.
4.4 Control structures.

Specific objectives:
- Understand and master the basic concepts of continuous control.
- Explain the stability of a feedback system as a function of the feedback gain and study stability criteria.
- Determine the values of the PID parameters to achieve certain operating specifications.

Related activities:
Activity 2: Continuous systems laboratory practices.
Activity 3: Written tests.
Activity 4: Self-learning exercises.

Full-or-part-time: 44h
Theory classes: 14h
Laboratory classes: 2h
Self study : 28h

ACTIVITIES

1. AUTOMATION PRACTICES

Description:
The practices are carried out in the laboratory in sessions of 3 to 4 hours during the first month, in groups of two people.
The students will have the statement of the activity to be resolved that will previously be published in Atenea.
Each group will have a work station, equipped with a process or model, a programmable automaton and a computer.
The computer will be equipped with the necessary software to program the programmable controllers.
After the activity, each group will give the teacher the information required in the practice script.

Material:
Practice script accessible from ATENEA
Bibliography
Catalogs

Delivery:
Before carrying out the practice, the individual preliminary study corresponding to the practice to be carried out will be delivered.
During the performance, the objectives achieved will be assessed.
Individual evaluation questionnaires may be carried out.
Oral communication student / teacher.
The qualification obtained in these activities configures the variable LAB1

Full-or-part-time: 30h
Laboratory classes: 10h
Self study: 20h

2. CONTINUOUS SYSTEMS PRACTICES

Description:
The practices are carried out in the laboratory in sessions of 2 hours during the last month, in groups of two people.
The students will have the statement of the activity to be resolved that will previously be published in Atenea.
Each group will have a work station, equipped with a process or model, a control system and a computer.
The computer will be equipped with the necessary software for process control and signal analysis.
After the activity, each group will give the teacher the information required in the practice script.

Specific objectives:
- Understand and master the basic concepts of continuous control.
- Properly use modeling and simulation tools available in the laboratory.
- Characterize the model of a linear continuous system from its temporal response.
- Observe the stability of a feedback system as a function of the feedback gain.
- Determine the values of the PID parameters to achieve certain operating specifications.

Material:
Practice script accessible from ATENEA
Bibliography

Delivery:
Before carrying out the practice, the individual preliminary study corresponding to the practice to be carried out is delivered.
During the performance, the objectives achieved will be assessed.
Individual evaluation questionnaires may be carried out.
Oral communication student / teacher.
The qualification obtained in these activities configures the variable LAB2.

Full-or-part-time: 12h
Laboratory classes: 4h
Self study: 8h

3. WRITTEN TESTS

Description:
During the course there will be an individual control test. At the end of the course, a final globalizing test of the acquired knowledge will be carried out

Specific objectives:
At the end of the activity, the student must be able to know, understand and use the basic principles of all the contents of the subject.

Material:
Statement of the test delivered at the time of the test

Delivery:
The resolved test will be delivered to the teacher.
The control test score sets the variable CON.
The final test grade sets the FIN variable.

Full-or-part-time: 17h
Theory classes: 4h
Self study: 13h

4. LEARNING EXERCISES

Description:
Students are provided with a list of self-study problems.

Specific objectives:
Carry out a continuous monitoring of the learning process.

Material:
Problem statements
Bibliography

Delivery:
The exercises are evaluated in the written tests.

Full-or-part-time: 20h
Self study: 20h

GRADING SYSTEM

The final grade for the course will be obtained as follows:

Final score: 0.2 * LAB1 + 0.1 * LAB2 + 0.3 * CON + 0.4 * END

Note 1. The qualification in a part or in the whole of the test will be replaced, if it is higher and there is a coincidence in the evaluated aspects, the results obtained in other evaluation acts carried out throughout the course.

Note 2. When the results of the evaluation acts corresponding to the individual activities are substantially lower than those obtained in group activities, the execution of individual activities similar to those carried out in the group may be required.
The rating of the latter will replace the original

EXAMINATION RULES.

If any of the laboratory or continuous evaluation activities is not carried out, it will be considered as not scored.

BIBLIOGRAPHY

Basic:
- Apunts realitzats per els professors de l'assignatura.
- Nise, Norman S. Control systems engineering. 6th ed. Hoboken: John Wiley & Sons, 2011. ISBN 9780470646120.
- Ogata, K. Ingeniería de control moderna [on line]. 5ª ed. Madrid: Pearson Educación, 2010 [Consultation: 02/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1259. ISBN 9788483226605.
- Piedrafita Moreno, R. Ingeniería de la automatización industrial. 2ª ed. Madrid: Ra-Ma, 2004. ISBN 8478976043.
- Medina García, J. L.; Guadayol, J. M. La automatización en la industria química [on line]. Barcelona: Edicions UPC, 2010 [Consultation: 11/11/2020]. Available on: http://hdl.handle.net/2099.3/36842. ISBN 9788498803983.
- Boix Aragonès, Oriol; Sudrià Andreu, Antoni; Bergas Jané, Joan. Automatització industrial amb GRAFCET [on line]. Barcelona: Edicions UPC, 1998 [Consultation: 06/11/2020]. Available on: http://hdl.handle.net/2099.3/36537. ISBN 8483014998.

RESOURCES

Other resources:
Matlab and Simulink program manuals
Manuals for programmable controllers