Universidad Zaragoza

Year : 2019/20

60820 - Control engineering

Syllabus Information

Academic Year: 2019/20
Subject: 60820 - Control engineering
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 532 - Master's in Industrial Engineering
ECTS: 6.0
Year: 1
Semester: First semester
Subject Type: Optional
Module: ---

1.General information

1.1.Aims of the course

The objectives of subject and its expected results are the following:

Objectives of theoretical type: The student seeks to know and manage with ease theoretical contents that support the control of systems using the computer. At the end of the subject the student will be able to:

- Understand the role of the computer as an element of control.
- Represent the behavior of systems and continuous signals in discrete domain, as well as the transformation between both domains.
- Analyze and simulate the behavior of discretized systems in the discrete domain.
- Identify continuous systems.
- Understand the importance of the automation systems and control of discretized systems.

Objectives of practical type: It is pursued that the student performs well in a real control environment, applying and analyzing the practical aspects of the theoretical contents learned. At the end of the subject the student will be able to:

- Simulate discretized systems.
- Program controllers in a computer.
- Use tools for the identification of systems.
- Modeling and experimenting with discrete event systems and their control.

1.2.Context and importance of this course in the degree

Control Engineering is a homogenization subject for the students to have similar background when pursuing the Master of Industrial Engineering. In this context, the advanced concepts of the control of continuous systems are presented, addressing theoretical aspects, their implementation and practical application.

The student has studied previously Automatic Systems. The student learns in this subject to analyze and design digital control of continuous systems with techniques based on external representation. At the end of the subject the student is able to understand the advantages of the control of systems using computers, its importance in industrial processes from the technical, economic and environmental point of view, as well as to carry out its analysis and design. In this subject they are introduced to the modeling of discrete event systems, in the supervision and control systems (SCADA) and in the manufacturing control systems.

1.3.Recommendations to take this course

This course presents concepts and techniques of computer-based control for continuous systems. The modeling and control of discrete event systems and the simulation of hybrid systems are also presented. Upon completion, the student is able to model systems, analyze their behavior, design control schemes, and implement them using programming languages and commercial industrial controllers. The student will be able to understand and program control strategies for discretized systems and is capable of simulating hybrid systems, in which continuous and discretized systems are combined.

This is a homogenization subject so that all students who attend the Master of Industrial Engineering can have similar background of systems' control and can take courses offered on related topics with control of systems. The students are expected to have completed a Degree in which they have acquired "Knowledge on the basics of automatisms and control

methods", normally through the subject of Automatic Systems. The previous study of this subject provides the student with the basic tools necessary to develop, analyze, simulate, control a real system and achieve its automatic functioning.

The study and autonomous work are fundamental to take advantage of the subject. It is important to solve any doubts that may arise as soon as possible, for which the student has the assistance of the teacher, both during the classes and in the tutoring hours assigned to it.

2.Learning goals

2.1.Competences

Upon passing the subject, the student will be more competent to ...

Generic competences:

CG1 - Have adequate knowledge of the scientific and technological aspects of: mathematical, analytical and numerical methods in engineering, electrical engineering, energy engineering, chemical engineering, mechanical engineering, industrial electronics, automation, manufacturing, materials, quantitative methods for management, industrial computing, urban planning, infrastructure, etc.

Specific competences:

Ability to design control systems and industrial automation. Knowledge of the principles of automatic regulation and its application to industrial automation (CE24).

2.2.Learning goals

The student, to pass this subject, must demonstrate the following results ...

Design and implement the computer control of a system, selecting the most appropriate technique according to the control requirements and the context in which it is proposed.

Applies systems identification techniques in order to extract mathematical models suitable for use in control.

Simulates the behavior of dynamic systems using computer tools suitable for this purpose.

Designs a hierarchy of distributed control, solving both the communication needs between the different elements of the control architecture and the computerized supervision of the system.

2.3.Importance of learning goals

The knowledge that the student acquires in Control Engineering involves advanced aspects of the control and automation of systems and processes. Currently, the industrial processes have reached a high degree of automation. The control of operations is carried out by industrial regulators, industrial computers, programmable controllers, specific, robots, etc. The advanced understanding of the processes and the techniques to control them automatically can bring great improvements in working conditions, in the environment, in the quality of the product and in the competitiveness of the sector. With this subject the student will be able to analyze and design control systems using a computer.

The learning outcomes of this subject give students the ability to analyze real situations of control of industrial processes and enable them to propose control schemes and design appropriate control parameters that allow meeting certain operating requirements. These results, and the capacities and abilities derived from them, have a great importance in the industrial environment, where the control of processes and systems is fundamental for the development of the product, allowing reducing costs, both economic and environmental, and increasing the final quality of the product.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that he has achieved the expected learning outcomes through the following assessment activities

In accordance with the regulations of the University of Zaragoza, the evaluation of this subject is established as "Global evaluation".

Given the relevance of the acquisition of practical skills in the subject, through the use of computer environments and in the laboratory, development of practical work will also be evaluated throughout the course.
The evaluation will comprise two parts:

- Individual written test (80%). Rated between 0 and 10 points (CT). It will be done during the exam period. The student will be evaluated from the theoretical point of view and problem solving.
- Evaluation of practical work (20%). Qualified between 0 and 10 points (CP). It can be evaluated throughout the course. In any case, a specific individual test will be carried out during the evaluation period for students who have not passed it during the course. In it the student will be evaluated from the point of view of practical work.

In order to pass the subject, it is required to obtain CP and CT scores greater than or equal to 4 points out of 10. Only in this case will the overall mark of the subject will be (0.20 * CP + 0.80 * CT). The subject is passed with an overall score of 5 points out of 10.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as

- Lectures, where the main theoretical concepts of the course will be presented and illustrated with practical examples.
- Practice sessions with problem-solving tasks and student participation.
- Laboratory sessions, where practical work is carried out individually or in pairs and students put into practice the concepts of interest, and implement the designed control schemes in simulation and real systems.

4.2.Learning tasks

The course includes the following learning tasks:

- **T1 Lectures** (30 hours). The teacher presents the theoretical and practical content of the course. The concepts and fundamentals of computer control are illustrated with examples. Student participation through questions and brief discussions is encouraged.
- **T2 Practice sessions** (15 hours). Problems and case studies with student participation, coordinated with the theoretical contents. Students are encouraged to work on the problems previously.
- **T3 Laboratory sessions** (15 hours). The student carries out the simulation, implementation of real control and analysis of automation systems. Task instructions will be available, which consists of a previous study and the different activities of the task. The preliminary study should be done prior to the session.
- **T7 Individual assignment** (86 hours). It consists of an individual study of theoretical concepts and implementation problems. The ongoing work of the student is encouraged by the homogeneous distribution throughout the semester of the various learning activities.
- **T8 Assessment tests** (4 hours). In addition to their grading function, the tests are also a learning tool with which the student checks the degree of understanding and assimilation acquired.

4.3.Syllabus

The course will address the following topics:

Lectures

- Topic 1. Introduction.
- Topic 2. Sampling and reconstruction of signals.
- Topic 3. Z-Transform.
- Topic 4. Analysis of discrete-time systems
- Topic 5. Design of digital controllers. Industrial PID.
- Topic 6. System identification.
- Topic 7. Modeling discrete event systems.
- Topic 8. Implementation of industrial automation controllers.

Laboratory sessions

- Analysis of discrete systems and design of a digital controller.
- System identification.
- Modeling and analysis of a discrete event system.
- Design and implementation of control and supervision.
- Simulation of hybrid systems.

4.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website or http://add.unizar.es

4.5.Bibliography and recommended resources