# COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 44287 |
| **Name** | Industrial control systems |
| **Cycle** | Master's degree |
| **ECTS Credits** | 2.0 |
| **Academic year** | 2020 - 2021 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 2199 - M.D. in Electronic Engineering | School of Engineering | 1 | Second term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 2199 - M.D. in Electronic Engineering | 3 - Industrial electronic | Obligatory |

**Coordination**

| Name | Department |
|---|---|
| CASTELLO MORENO, JAIME | 242 - Electronic Engineering |

# SUMMARY

This is an obligatory subject taught in the first semester of the Master Electronic Engineering. It weights 2 ECTS (European credits). The student dedication is estimated in 20 hours distributed in different theoretical and practical activities.

The subject "Control of Industrial Systems" aims to provide students with the necessary knowledge of the approach and resolution of multivariable control systems (MIMO). Throughout the course different practical problems will be presented that students must solve individually, gradually increasing their complexity. The designs obtained theoretically should be later verified by computer aided simulation. Specifically, the following contents will be the main basis of the course:

- Design of state space controllers
- Design of state space observers

The study and analysis of the theoretical concepts studied and their subsequent verification and implementation is a great interest subject, offering students the ability to solve complex control problems that can arise in companies and in any area of industry.

# PREVIOUS KNOWLEDGE

## Relationship to other subjects of the same degree

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

## Other requirements

Per al normal desenvolupament docent de l'assignatura és aconsellable que l'alumne tingui coneixements previs en matemàtiques i en sistemes de control clàssic.

# OUTCOMES

## 2199 - M.D. in Electronic Engineering

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Take into account the economic and social context in engineering solutions, be aware of diversity and multiculturalism and ensure sustainability and respect for human rights and equality between men and women.
- Diseñar un sistema, componente o proceso que cumpla unas especificaciones desde diferentes puntos de vista: electrónico, económico, social, ético y medioambiental.
- Demostrar una comprensión sistemática de un campo de estudio y el dominio de las habilidades.
- Realizar un análisis crítico, evaluación y síntesis de ideas nuevas y complejas.
- Ser capaz de fomentar, en contextos académicos y profesionales, el avance tecnológico, social o cultural dentro de una sociedad basada en el conocimiento.
- Capacidad para proyectar, calcular y diseñar productos, procesos e instalaciones en todos los ámbitos de la Ingeniería Electrónica y en particular los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.
- Capacidad para el modelado matemático, cálculo y simulación en todos los ámbitos relacionados con la Ingeniería Electrónica y campos multidisciplinares afines. En especial los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.
- Identificar, formular y resolver problemas de los sistemas electrónicos industriales.

- Ability to specify, implement, document and set-up electronics, instrumentation and control equipment and systems, considering both technical aspects and the relevant regulatory requirements.

## LEARNING OUTCOMES

After having passed the subject, the student should have earned a bundle of skills, among which are:

- Representation continuous linear systems by state equations.
- Discretization continuous systems in the state space.
- Design of digital controllers in state feedback.
- Design of digital observers in state feedback.

## DESCRIPTION OF CONTENTS

### 1. Description of linear systems with state equations

1.1 Definition of state space equation
1.1.1 Continuous state space equation
1.1.2 Discrete state space equation
1.2 Solution of the state space equation
1.3 Stability of MIMO systems
1.4 Transfer Matrices
1.5 Discretization of continuous systems in the state space
1.6 Problems

### 2. Design of state space controllers

2.1 Introduction
2.1.1 State space feedback
2.1.2 Homogeneous feedback
2.2 Allocation of state feedback poles
2.2.1 Method of identifying coefficients
2.2.2 General method for pole assignment
2.3 Proportional control
2.3.1 Analog implementation
2.3.2 Digital implementation
2.4 Integral Control
2.4.1 Analog implementation
2.4.2 Digital implementation

### 3. Design of observers systems

3.1 Introduction
3.2 Complete observers
3.2.1 Analog implementation
3.2.2 Digital implementation
3.2.3 Analysis of the inner loop with complete observer
3.2.4 Principle of separation with complete observer

### 4. Laboratory practices

Session 1: Introduction
Session 2: Homogeneous control
Session 3: Proportional control
Session 4: Integral control
Session 5: Homogeneous control with observer
Session 6: Proportional control with observer
Session 7: Integral control with observer

## WORKLOAD

| ACTIVITY | Hours | % To be attended |
|---|---|---|
| Theory classes | 10,00 | 100 |
| Laboratory practices | 10,00 | 100 |
| Study and independent work | 5,00 | 0 |
| Readings supplementary material | 5,00 | 0 |
| Preparation of evaluation activities | 5,00 | 0 |
| Preparing lectures | 5,00 | 0 |
| Preparation of practical classes and problem | 5,00 | 0 |
| Resolution of online questionnaires | 5,00 | 0 |
| **TOTAL** | **50,00** | |

## TEACHING METHODOLOGY

- THEORY CLASSES: Theory classes will be taught in masterfully way. Different questions will be proposed by the teacher to determinate the level of knowledge acquired by the students in the preparation work of each of the issues. Theory classes and problems will be in a classroom with computers. The student will have access to educational materials related to course content (slides, articles, web addresses, additional references, etc..), through the Virtual Classroom, an application developed by the University of Valencia which permits an easy access to different types of teaching resources and/or administrative.

- LABORATORY CLASSES: Laboratory classes will be taught in the laboratories of the Centre. The teacher will evaluate students on knowledge and understanding of the practice. This evaluation is carried out by PC.

## EVALUATION

The students will be assessed by written final exam mode. They must solve a similar case to those that have been performed in laboratory sessions. The students may use any material that they deem necessary as well as a computer.

## REFERENCES

### Basic

- Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado. Control System Design
- Sigurd Skogestad, Ian Postlethwaite. Multivariable Feedback Control: Analysis and Design

## ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

## English version is not available

**1. Contenidos**

Se mantienen los contenidos inicialmente recogidos en la guía docente.

**2. Volumen de trabajo y planificación temporal de la docencia**

Respecto al volumen de trabajo:

Se mantienen las distintas actividades descritas en la Guía Docente con la dedicación prevista.

Respecto a la planificación temporal de la docencia

El material para el seguimiento de las clases de teoría/problemas permite continuar con la planificación temporal docente tanto en días como en horario, tanto si la docencia es presencial en el aula como si no lo es.

**3. Metodología docente**

En las clases de teoría y de problemas se tenderá a la máxima presencialidad posible, siempre respetando las restricciones sanitarias que limitan el aforo de las aulas al 50 % de su ocupación habitual. Para completar las sesiones de teoría los estudiantes dispondrán de material en el aula virtual, para su trabajo autónomo.

Con respecto a las prácticas de laboratorio, la asistencia a las sesiones programadas en el horario será totalmente presencial.

Si se produce un cierre de las instalaciones por razones sanitarias que afecte total o parcialmente a las clases de la asignatura, éstas serán sustituidas por sesiones no presenciales siguiendo los horarios establecidos.

**4. Evaluación**

Se mantiene el sistema de evaluación descrito en la Guía Docente de la asignatura en la que se han especificado las distintas actividades evaluables así como su contribución a la calificación final de la asignatura.

Si se produce un cierre de las instalaciones por razones sanitarias que afecte al desarrollo de alguna actividad evaluable presencial de la asignatura ésta será sustituida por una prueba de naturaleza similar que se realizará en modalidad virtual utilizando las herramientas informáticas licenciadas por la Universitat de València o bien mediante un trabajo individual si no fuera posible la utilización de las mismas. La contribución de cada actividad evaluable a la calificación final de la asignatura permanecerá invariable, según lo establecido en esta guía.

**5. Bibliografía**

Se mantiene la bibliografía recomendada en la Guía Docente y se complementa con apuntes, diapositivas y problemas subidos a Aula Virtual como material de la asignatura.