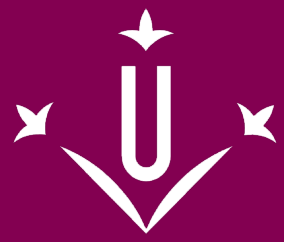

Universitat de Lleida

DEGREE CURRICULUM

# ELECTRONICS AND CONTROL SYSTEMS DESIGN

Coordination: CLARIA SANCHO, FRANCISCO

Academic year 2017-18

## Subject's general information

| | |
|---|---|
| **Subject name** | ELECTRONICS AND CONTROL SYSTEMS DESIGN |
| **Code** | 14525 |
| **Semester** | 1st Q(SEMESTER) CONTINUED EVALUATION |
| **Typology** | <table><tr><th>Degree</th><th>Course</th><th>Typology</th><th>Modality</th></tr><tr><td>Master's Degree in Industrial Engineering</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr></table> |
| **ECTS credits** | 6 |
| **Groups** | 1GG |
| **Theoretical credits** | 6 |
| **Practical credits** | 0 |
| **Coordination** | CLARIA SANCHO, FRANCISCO |
| **Department** | INFORMATICA I ENGINYERIA INDUSTRIAL |
| **Teaching load distribution between lectures and independent student work** | (40%) 60 h classroom<br>(60%) 90 h autonomous work |
| **Important information on data processing** | Consult this link for more information. |
| **Language** | Spanish |
| **Office and hour of attention** | by agreement |

| Professor/a (s/es) | Adreça electrònica professor/a (s/es) | Crèdits | Horari de tutoria/lloc |
|---|---|---|---|
| CLARIA SANCHO, FRANCISCO | claria@diei.udl.cat | 6 | To agree with professor |

## Subject's extra information

Suggestions

The feedback systems can be represented as discrete or continuous models and are usually described by transfer functions, pole-zero diagrams, state equations, differential equations and difference equations. This implies the need for a sufficient basis in electronics, control theory, signal processing, and some ownership in the Laplace transform, z transform Fourier transform, transformed that are common in electronics and control engineering .

The course as part of the academic plan

It is a subject that is given in the second year and first semester of the master in industrial engineering, it is framed in the electronics and control module and belongs to industrial technologies. The content of this subject is oriented to the description of mathematical models of systems whose output signals depend on the input signals and the delayed output signals. In these systems, whose dynamics is unknown, you can only access their input and output. The aim is to identify systems that are fed back by providing a mathematical description. The methodology presented for identification systems, makes possible the design of the elements and control devices.

## Learning objectives

**General objective for the subject**

Provide students knowledge and techniques necessary to identify and design electronic systems characterized by mathematical expressions.

**This general objective is summed in:**

- Estimate and quantify system models.
- Know the techniques for analyzing linear systems.
- Identify and modeling systems.
- Know and understand the concepts of adaptive models.
- Designing adaptive feedback systems.

## Competences

**Basic competences** set in Royal decree 861/2010 and Order CIN/311/2009

- CB2 To be able to apply the knowledge gained and to solve problems in new environments in wider contexts (or multidisciplinary) related with the area of study

**General competences** set in ORDEN CIN/311/2009 and EPS criteri

- CG4 Capacity to conceive, design and implement projects and/or provide new solutions, using the tools that the engineering offers
- CG6 To have suitable knowledge of the scientific and technological issues of: mathematical, analytical and numerical methods in engineering, electrical engineering, energetic engineering, chemical engineering, mechanical engineering, mechanics of continuous means, industrial electronics, automation, manufacture, material, quantitative methods of management, industrial computing, urbanism, infrastructures, etc.
- CG7 To project, calculate and design products, processes, installations and plants.

- CG9 To do research, development and innovation in products, processes and methods

**Specific competences** set in ORDEN CIN/311/2009

- CE7 Capacity to design electronic and industrial instrumentation systems
- CE8 Capacity to design and project automated production and advanced process control systems

**Cross-disciplinary competences** approved by the Plenary Commission of the Degrees of Industrial Engineering, Computer Engineering and Building Engineering, gathered in June 16th, 2008.

- CT3 Mastering ICT's

## Subject contents

**SYSTEMS ANALYSIS AND MODELING**

**1. TOOLS FOR MODELING AND ANALYSIS OF SYSTEMS**

1.1. LAPLACE TRANSFORM

*TRANSFER FUNCTION*

1.2. DISCRETE FOURIER TRANSFORM

*SPECTRUM*

*MODULATION*

*SAMPLING*

*DISCRETE FOURIER TRANSFORM AND CONVOLUTION*

1.3. ZETA TRANSFORM

*HOLDERS*

1.4. SIGNAL FILTERING

1.5. FEEDBACK

*STABILITY*

**2. ANALYSIS OF AN ELECTRONIC NONLINEAR SYSTEM**

2.1. PHASE LOKED LOOP DEVICE

*DESCRIPTION*

*OBTAINING THE EQUATION*

*OBTAINING LINEAR MODEL*

*ACQUISITION AND TRACKING SYSTEM*

*STEADY STATE ERROR IN TRACKING SYSTEM.*

**SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL**

**1. IDENTIFICATION SYSTEMS**

1.1. IDENTIFICATION WITH RANDOM SIGNALS

1.2. CONVOLUTIONAL MODELS

1.3. ESTIMATION OF MODELS FOR LOW ORDER

1.4. POLYNOMIAL MODELS

*1.4.1. ARX MODEL*

*1.4.2. ARMAX MODEL*

*1.4.3. BOX-JENKINS MODEL*

*1.4.4. OUTPUT-ERROR MODEL*

**2. EXERCISES WITH THE MATLAB ENVIRONMENT**

2.1. DATA PACKAGING

*2.1.1. IN THE TIME DOMAIN.*

*2.1.2. IN THE FREQUENCY DOMAIN*

*2.1.3. PACKAGING OF THE FREQUENCY RESPONSE*

2.2. DATA GENERATION TO SIMULATING SYSTEMS

2.3. FIRST ORDER ESTIMATION OF A SYSTEM.

2.4. PREDICTION, SIMULATION AND VALIDATION. CONSIDERATIONS

**3. LEAST SQUARES AND ESTIMATION OF PARAMETERS**

3.1. LAYOUT

*3.1.1. MATRIX APPROACH*

*3.1.2. CALCULATION OF THE MATRIX COEFFICIENTS*

*3.1.3. ADAPTIVE APPROACH*

*3.1.4. ADAPTIVE RECURSIVE APPROACH*

**4. ADAPTIVE CONTROL**

4.1. LINEAR ADAPTIVE CODER

*4.1.1. LEAST SQUARES FOR SEVERAL ITERATIONS SAMPLES FORMED BY INPUT SIGNAL AND DESIRED SIGNAL.*

*4.1.2. LEAST SQUARES FOR ITERATIONS OF A SAMPLE OF INPUT SIGNAL AND A SAMPLE OF DESIRED SIGNAL.*

4.2. SEARCH OF THE MINIMUM THROUGH STEEPET DESCENDENT METHOD

*4.2.1. MINIMUM MEAN SQUARE VALUE ALGORITHM (LMS)*

*4.2.2. CONVERGENCE OF THE GRADIENT*

*4.2.3. CONVERGENCE OF THE COEFFICIENTS*

4.3. EXAMPLES OF APPLICATION

4.3.1. IDENTIFIER

4.3.2. PREDICTOR

4.3.3. INTERFERENCE SUPPRESSOR

4.3.4. EQUALIZER

## Methodology

**Master class:** In the master classes the contents of the subject are presented orally by a professor without the active participation of students

**Problem-based learning:** Problem-based learning is used as a method of promoting the learning from selected problems of real life.

**Classroom practices:** Let you apply and configure a practical level, the theory of a field of knowledge in a particular context.

## Development plan

| Week | Metodologi | Agenda | Classroom | Autonomous work |
|---|---|---|---|---|
| 1-3 | Master class Problem-based learning | **TOOLS FOR MODELING AND ANALYSIS OF SYSTEMS** | 12 | 18 |
| 4-5 | Master class Problem-based learning | **ANALYSIS OF AN ELECTRONIC NONLINEAR SYSTEM** | 8 | 12 |
| 6-7 | Master class Problem-based learning | **IDENTIFICATION SYSTEMS** | 8 | 12 |
| 8 | Master class Problem-based learning | **EXERCISES WITH THE MATLAB ENVIRONMENT** | 4 | 6 |
| 9-11 | Master class Problem-based learning | **LEAST SQUARES AND ESTIMATION OF PARAMETERS** | 12 | 18 |
| 12-14 | Master class Problem-based learning | **ADAPTIVE CONTROL** | 12 | 18 |

## Evaluation

**Evaluation Method**

| Objectives | Evaluación Activities | Criteria | % | Dates | O/V (1) | I/G (2) | Observations |
|---|---|---|---|---|---|---|---|
| Systems analysis and modeling. Identification systems. Exercises with the Matlab environment. | Test 1 written exam (*)<br><br>Practice 1 | | 30%<br><br>10% | Week 9 | O<br>V | I<br>I/G | The document of practical work will be delivered on the date proposed. |
| Least squares and estimation of parameters. Adaptive control. | Test 2 written exam (*)<br><br>Practice 2 | | 50%<br><br>10% | Week 15 | O<br>V | I<br>I/G | The document of practical work will be delivered on the date proposed. |
| Recovering the entire agenda | Recovery Written exam | (**) | 80% | Week 17 | O/V | I | |

(1) Mandatory / Voluntary.

(2) Individual / Group.

(*) Written exam consisting of problems with documentation.

(**) See explanatory text of the evaluation

**Explanatory text**

During the semester, there shall be four assessments in the form of two written tests and two papers that account for the study and the work done in the labs. These documents will have a maximum score of 1 point each and not considered any improvement threshold. The two written tests will be held on dates determined by the EPS for this purpose.

In this course, by its nature, has little sense to evaluate parts of avoiding your stuff previous contents. Thus, each written test will be on all the stuff that has been given so far.

The first written test will have a maximum score of 3 points and be considered approved if the score is greater than or equal to 1.5 points. The second written test will have a maximum score of 5 points and will be considered approved if the score is greater than or equal to 2.5 points.

As the material is cumulative in each written test, if the second test is passed, then the first test will be compensated if the latter has not been surpassed, with half its maximum score (1.5 points).

-The total score is the sum of the notes of the 4 reviews. **(This is the first of the two possible pathways of qualifications that are contemplated)**.

-If the second written test you get a lower score to 2.5 points, you must use the recovery activity, to be performed on the date set by the EPS. The written test will have a valuation recovery maximum 8 points and be deemed to have been passed if you get a note added to the laboratory practice notes and document preparation practices study is greater than or equal to 5 points. (**This is the second pathway**)

In addition:

Any person enrolled in this course, that have made the 2nd written test whether or not it has been overcome, be furnished to the recovery activity to increase the final grade. If the 2nd test had been overcome the final grade will never be lower than it would have obtained by the first approach.

## Bibliography

***Specific Bibliography***

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Katsuhiko Ogata

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