COURSE DATA

Data Subject	
Code	34816
Name	Dynamics and Control Engineering
Cycle	Grade
ECTS Credits	6.0
Academic year	2018 - 2019

Study (s)

Degree	Center	Acad. year	Period
1402 - Degree in Telecommunications Electronic Engineering	School of Engineering	3	First term

Subject-matter

Degree	Subject-matter	Character
1402 - Degree in Telecommunications Electronic Engineering	17 - Dynamics and control	Obligatory

Coordination

Name	Department
ESPI HUERTA, JOSE MIGUEL	242 - Electronic Engineering

SUMMARY

This is an obligatory subject taught in the first semester of the third curse of the Telecommunication Electronics Engineering degree. It weights 6 ECTS (European credits). The student dedication is estimated in 150 hours, from which 60 are classroom hours and 90 are non-classroom hours.

This subject configures by itself the whole matter “Dinámica y Control”. It is a multidisciplinary subject that intends to give a global and practical overview of feedback systems.

The subject provides the student the theoretical and practical concepts needed to solve problems in the field of control systems, i.e. to analyze and implement feedback control systems, which are typically present in electronic equipment or in industrial production processes.

The subject aims to give the means to the students to analyze and design control systems. The process modelling and its feedback control are undertaken. There are presented the graphical methods (block and flux diagrams) used to represent feedback systems, and the methods utilized to analyze their stability. Finally the standard methods to design analog PID compensators are described.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

The recommended previous knowledge to follow this subject is:
- Basic contents related with complex variable and Laplace transform, which are taught in the 1st curse subjects Matemáticas I and II.
- Circuit network theory, frequency response and transfer function concepts.
- Analog electronic basics.
- The Newton physics equations for translational and rotational dynamics, covered in the 1st curse subject Física I.

OUTCOMES

1402 - Degree in Telecommunications Electronic Engineering

- G3 - Acquisition of the knowledge of the basic and technological subjects that allows students to learn new methods and theories and endows them with the versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.
- G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.
- G9 - Ability to work in a multidisciplinary environment and in a multilingual group and to communicate, in writing and orally, knowledge, procedures, results and ideas related to telecommunications and electronics.
- G6 - Ability in the handling of specifications, regulations and norms of compulsory compliance.
- TE6 - Ability to understand and use feedback theory and electronic control systems.

LEARNING OUTCOMES

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

- Be able to obtain mathematical models of most typical industrial processes (G3).
- Know and manage with the block and flux diagrams that represent feedback systems (G3).
- Analyze whether a feedback system is stable or not, and determine its stability margins (TE6).
- Know the different types of analog compensators that can be used, as well as their implementation with operational amplifiers (TE6)
- Design and implement the analog feedback compensation attending to a given static and dynamic specifications (G4, G6, TE6).

DESCRIPTION OF CONTENTS

1. Introduction to Feedback Control

Examples, definitions and terminology.

2. Systems Dynamics

1. Introduction
2. Linear and non-linear systems
3. Systems modelling. Examples
4. Linearization techniques
5. Dynamics of 1st order systems
6. Dynamics of 2nd order systems
7. Equivalent order-reduced system

3. Feedback Systems Representation

1. Definitions
2. Properties of a feedback control
3. Block diagrams
4. Flux diagrams. Masons rule

4. Static Analysis of Feedback Systems

1. Steady-state error
2. Unitary errors: position, speed and acceleration errors
3. Error and type of a control system
4. Output error

5. Stability of Feedback Systems

1. Absolute stability analysis. Routh-Hurwitz criterion
2. Relative stability analysis. Nyquist criterion.
3. Phase and gain margins.
4. Relationships between frequency and transient features

6. Design of Feedback Control Systems

1. Introduction
2. Types of analog compensators
3. Design specifications
4. Design based on asymptotic loop frequency response
5. Design based on analytical frequency-based methods.
6. Tune of PID compensators using experimental methods

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of individual work	5,00	0
Study and independent work	40,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	25,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

THEORY CLASSES:

The theory classes are taught as “master classes”. After introduction of each new concept, its application is illustrated through an example (G3, G4, G5, G6, TE6). After that, the teacher could propose a related problem as non-classroom task (G4, TE6), which will be solved on the next problems class.

PROBLEMS CLASSES:

The students can present the solution to the non-classroom problem posed in the previous theory class, by sending an e-mail to the teacher with the solution before the beginning of the problems class. The teacher could select one among all correct solutions, which should be defended in class by the corresponding student (G4, G9), assessed by the teacher, and complementing the theory-problems mark.

LABORATORY CLASSES:

They are taught in the ETSE's laboratories, which are equipped with specific electronic equipment as well as computers. The students are gathered in groups of 2 or 3. There is a descriptive guide of each laboratory practice. Beside this guide, the teacher formulates questions to each group, which answers are graded to give the mark of the laboratory seasons. At the end of the semester, the teacher could pose a practical problem, which is also assessed to complement the laboratory mark (G3, G4, G5, G6, G9, TE6).

EVALUATION

For the first period of exams, the student can choose between two assessment methods: continuous assessment or final examination. Both are explained below.

a) CONTINUOUS ASSESSMENT method:

-Assessment of the theory-problems part:

The student will take 3 exams along the semester (G3, G4, G5, G6, TE6). If grades are all above 4 (over 10), the mean grade will give the "nota_parciales" quantity. The student can retake the failed matters in the final examination.

The resolution of problems and its presentation to the class (G3, G4, G5, G6, G9, TE6) will also be graded up to 2,5 points, giving the "nota_prob" mark.

The theory-problems mark is obtained as:

nota_teorpro = 0.75*nota_parciales + nota_prob

-Assessment of the laboratory part:

The laboratory sessions will be assessed (G4, G6, TE6). If marks are all above 4 (over 10), the mean mark will give the quantity "nota_prac". Otherwise the student has to retake all the lab matter in the final examination.

Additional contributions of the student to requested lab tasks will be graded up to 3 points, giving the "nota_exp" score.

The laboratory mark will be computed as:

nota_lab = 0.7*nota_prac + nota_exp

b) FINAL EXAMINATION method:

Both “nota_teorpro” and “nota_lab” scores are directly obtained from a theory and lab exams respectively (G3, G4, G5, G6, TE6).

Regardless of the assessment method chosen, If both marks are equal or greater than 5, the final mark of the subject is calculated as:

Nota= (2*nota_teorpro + nota_lab)/3

The second period of exams can only be assessed through the final examination method.

In any case, the assessment method will be regulated by the Assessment Regulation of the University of Valencia, which can be found in:
https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639

REFERENCES

Basic

- Sistemas de Control Moderno. Richard C. Dorf. Ed. Pearson. ISBN: 9788420544014.
- Ingenieria de Control Moderna. Katsuhiko Ogata. Ed. Pearson. ISBN: 9788483226605. ISBN (e-book): 9788483229552.