DEGREE CURRICULUM

BASICS OF THE CONTROL THEORY

Coordination: PALLEJA CABRE, TOMAS

Academic year 2023-24

Subject's general information

Subject name	BASICS OF THE CONTROL THEORY
Code	102124
Semester	1st Q(SEMESTER) CONTINUED EVALUATION

Typology	Degree	Course	Character	Modality
	Bachelor's Degree in Automation and Industrial Electronic Engineering	3	COMPULSORY	Attendance-based

Course number of credits (ECTS)	6

Type of activity, credits, and groups	Activity type	PRALAB	PRAULA	TEORIA
	Number of credits	0.8	2.2	3
	Number of groups	2	1	1

Coordination	PALLEJA CABRE, TOMAS
Department	INDUSTRIAL AND BUILDING ENGINEERING
Teaching load distribution between lectures and independent student work	(40%) 60 h classroom (60%) 90 h autonomous work
Important information on data processing	Consult this link for more information.
Language	Idioma Percentatge d'ús Anglès 10.0 Castellà 10.0 Català 80.0

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
PALLEJA CABRE, TOMAS	tomas.palleja@udl.cat	6,8	

Subject's extra information

For a proper development of the teaching, is needed that the student has already reach the basic knowledge of general topics like differential equations, Laplace's Transforms and previous knowledge in Dynamics, Circuit's Theories and Electronics In order to reach the evaluations in a satisfactory level is recommended to be present at the lecture sessions and to have an active participation in them. Apart, is recommended that the student solves by its own the proposed exercises and the regular crosscheck of the bibliography.

The subject is defined to form specialists in Automation; it develops the theoretical basic knowledge in terms of Automation Controls that will be used as a basis for the learning of other graduation subjects and the future professional exercise. The study of the subject implies that the student is getting the basic needed knowledge to understand, analyze, design and evaluate Automation Control Systems. For that, is necessary to introduce to the student the Linear Control systems by the classic analysis techniques and system designs in the time-domain and frequency-domain performances.

Learning objectives

- Modelling electrical and mechanical systems using differential equations
- Linearization of nonlinear mathematical models
- Transform lineal differential equation to: block diagrams, transfer functions and state space models
- Transient and Steady-State Response Analyses.
- Analyze and design control systems using: root-locus and frequency method
- Analyze control systems using state space models
- Analyze and design PID controls.

Competences

Cross-disciplinary competences

- **EPS1.** Capacity to solve problems and prepare and defense arguments inside the area of studies.
- **EPS2**. Capacity to gather and interpret relevant data, within the area of study, to judge and think about relevant subjects of social, scientific and ethical nature.

Specific competences

- **GEEIA25.** Knowledge and capacity for modelling and simulation of systems.
- **GEEIA26.** Knowledge of automation and technical regulation of control and his application to the industrial automation.
- **GEEIA27.** Knowledge of principles and applications of robotic systems.
- **GEEIA29.** Capacity to design systems of industrial automation control.

Subject contents

1. Introduction to Control Systems

1-1. Introduction

1-2. Examples of Control Systems

1-3. Closed-Loop Control Versus Open-Loop Control

1-4. Design and Compensation of Control Systems

2. Mathematical Modeling of Control Systems

2-1. Introduction

2-2. Transfer Function and Impulse-Response Function

2-3. Automatic Control Systems

2-4. Modeling in State Space

2-5. State-Space Representation of Scalar Differential Equation Systems

2-6. Transformation of Mathematical Models with MATLAB

2-7. Linearization of Nonlinear Mathematical Models

3. Mathematical Modeling of Mechanical Systems and Electrical Systems

3-1 Mathematical Modeling of Mechanical Systems

3-2 Mathematical Modeling of Electrical Systems

4. Mathematical Modeling of Fluid Systems and Thermal Systems

4-1 Introduction

5. Transient and Steady-State Response Analyses

5-1 First-Order Systems

5-2 Second-Order Systems

BASICS OF THE CONTROL THEORY 2023-24

Methodology

Master class

Problem-based learning

Practices using MatLab

Development plan

Week	Description	Classroom Activity	Classroom/independent work
1	Lecture and problems	Lesson 1	4h/3h
2-3	Lecture and problems	Lesson 2	8h/8h
4-5	Lecture and problems	Lesson 3	8h/8h
5-6	Lecture and problems	Lesson 4	8h/10h
7	Práctiquas con ordenador	Lesson 1-4	4h/12h
8	**Written tests**	Lesson 1-4	
9-11	Lecture and problems	Lesson 5	12h/12h
12-14	Lecture and problems	Lesson 6	12h/12h
15	Práctiquas con ordenador	Lesson 5-6	4/25h
17	**Written tests**	Lesson 1-6	
20	**Written tests (Recovery)**	Lesson 1-6	

Evaluation

Grup A (Exams)		Grup B (Practices)		Grup C (Continued Evaluation)	
First Exam: Validation P1:	**PP** (20%) **V1** (0/1)	Practice 1	**P1** (10%)	Exercises	**EX** (10%)
Second Exam: P2 Validation:	**SP** (45%) **V2** (0/1)	Practice 2	**P2** (15%)	Positives - Negatives	0,05·**PN**
Recovery Exam:	**RE** (65%)				

Grup	Grade calculation
A	MAX{**PP** 0.2 + **SP** 0.45 , **SP** 0.65 , **RE** 0.65}
B	**P1** V1 0.1 + **P2** V2 0.15
C	**EX** 0.1 + **PN** 0,05
TOTAL	IF(A ≥ 2.275) A + B + C IF(A < 2.275) A + B
Avaluació Alternativa	MAX{**SP** , **RE**} (S'ha d'informar al inici de curs)

- The two exams (PP and SP) will have a question related to the practices, this question, evaluated from 0 to 10, will have a weighted weight within the exam and must be passed with more than 4 points to validate the practices.
- Positives will be awarded to those students who excel in P1, P2, EX and attitude.
- The Negatives will be applied when the student does not follow the delivery instructions of P1, P2, EX or does not bring the coat to the laboratory.
- To add the continuous assessment (Group C) to the final grade, the value of **A ≥ 2.275**

Bibliography

Recommended bibliography

Control Systems, Katsuhiko Ogata.

Automatic Control Systems, Benjamin Kuo.

Sistemas de Control, Hostetter