Universitat de Lleida

DEGREE CURRICULUM

DISCRETE PROCESSES

Coordination: PALLEJA CABRE, TOMAS

Academic year 2022-23

DISCRETE PROCESSES 2022-23

Subject's general information

Subject name	DISCRETE PROCESSES
Code	102125
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	Degree: Bachelor's Degree in Automation and Industrial Electronic Engineering; Course: 3; Character: COMPULSORY; Modality: Attendance-based
Course number of credits (ECTS)	6
Type of activity, credits, and groups	Activity type: PRAULA – Number of credits: 3, Number of groups: 1; TEORIA – Number of credits: 3, Number of groups: 1
Coordination	PALLEJA CABRE, TOMAS
Department	COMPUTER SCIENCE AND INDUSTRIAL 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	English 10 % Spanish 10% Catalan 80%

Typology:

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

Type of activity, credits, and groups:

Activity type	PRAULA	TEORIA
Number of credits	3	3
Number of groups	1	1

DISCRETE PROCESSES 2022-23

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

Subject's extra information

For a proper development of the teaching, it 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. **It is highly recommended to have passed the Basic Theory of Control subject.**

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 Automatic Digital 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 s and z complex-domie.

Learning objectives

- Understand the digitalization concept.
- Learn the different kind of holders and their characteristics.
- Master the Z transform and the different digitalization methods.
- Relate the system transfer function poles whit the system stability.
- Learn the conditions and characteristics of FIR (Finite Impulse Response) controller.
- Analyze the system transient and stationary response.
- Analyze and design digital control systems.
- Digitalize analogical controllers.

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

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1 Introduction to Discrete Time Control Systems

1.1 Introduction

1-2 Digital control systems

1-3 Quantification errors

1-4 Data acquisition and conversion systems

2 Mathematical processing of the sampled signal

2-1 Introduction

2-2 Periodic sampling

2-3 Fourier transform of a sampled function

2-4 Shannon's Theorem

2-5 Aliasing Problem

3 Ideal Sampling

3-1 Introduction

3-2 Laplace transform of the sampled function

3-3 Primary and secondary strips

4 Reconstruction of the original continuous function

4-1 Introduction

4-2 Ideal filter

4-3 Zero Order Holder

4-4 First Order Holder

4-5 Polynomial Holder

5 Z-Transform

5-1 Calculation of the Z-Transform.

5-2 Z transform of elementary functions

5-3 Important properties and theorems of the Z-Transform

5-4 The Z Inverse Transformation

5-5 Use of the Z-Transform for the solution of differential equations.

6 Block Diagrams in Zed

6-1 Introduction

6-2 Phillips-Nagle simplification method

6-3 Systems with continuous and discrete blocks

7 Correspondence between the S-plane and the Z-plane

7.1 Primary band and unit circle

7.2 Variation of the poles as a function of the period.

7.3 Calculation of the number of samples per oscillation cycle.

7.4 Transformation techniques between the S-plane and the Z-plane.

8 Stability analysis

8.1 Introduction

8.2 General criteria

8.3 Jury's criteria

8.4 Bilinear Transformation and Routh-Hurwitz's criteria

9 Transient response and permanent regime

9.1 Transient response at impulse input

9.2 Transient Response Specifications

9.3 Steady state error

10 Design by the Root-Locus Method

10.1 Root-Locus plots

10.2 Lead Compensators

10.3 Lag Compensators

11 Minimum time systems

11.1 Introduction

11.2 Basic design

11.2 Advanced design

12 Polynomial compensators

12.1 Diophantine equations

12.2 Basic design

13 Anti Wind-Up

13.1 Introduction

13.2 Implementation

Methodology

Master class

Problem-based learning

Practices using MatLab

Development plan

Week	Description	Classroom Activity	Classroom/independent work
1	Lecture and problems	Tema 1-2	4h/4h
2	Lecture and problems	Tema 3-4	4h/4h
3	Lecture and problems	Tema 5	4h/6h
4	Lecture and problems	Tema 6	4h/6h
5-6	Lecture and problems	Tema 7	8h/12h
7	Lecture and problems	Tema 8	4h/6h
8	Lecture and problems	Tema 1-8	6h/10h
9	**Written tests**	Tema 1-8	
10	Lecture and problems	Tema 9	4h/6h
12-13	Lecture and problems	Tema 10	8h/12h
14	Lecture and problems	Tema 11	4h/6h
15	Lecture and problems	Tema 12-13	4h/6h
16	Pràctiques amb ordinador	Tema 1-13	6h/12h
17	**Written tests**	Tema 1-13	
20	**Written tests (Recovery)**	Tema 1-13	

Evaluation

Due to the class incremental learning, the second partial exam will have a greater deal than the first one. To avoid students relaxing at the end of the course, a mark higher than 3.5 will be expected at the second partial in order to average it with the practices, that is to say, the final mark will be like so:

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First Partial Mark:	***PP***	First Assignment:	***P1***
Second Partial Mark:	***SP***	Second Assignment	***P2***
Recovery Exam	***RE***	Continuous evaluation	***AC***

Case	Tests marks	Fiinal mark calculation
A	Si (***PP*** ≥ 5 i ***SP*** < 3.5)	***PP*** *0.2* + ***SP*** *0.4*
B	Si (***PP*** ≥ 5 i ***SP*** ≥ 3.5)	***PP*** 0.2 + ***SP*** 0.4 + ***AC*** 0.1 + ***P1*** 0.1 + ***P2*** 0.2
C	Si (***PP*** < 5 i ***SP*** ≥ 3.5)	***SP*** 0.6 + ***AC*** 0.1 + ***P1*** 0.1 + ***P2*** 0.2
D	Si (***PP*** < 5 i ***SP*** < 3.5)	***SP*** 0.6
E	Si (***RE*** ≥ 3.5)	***RE*** 0.6 + ***AC*** 0.1 + ***P1*** 0.1 + ***P2*** 0.2
F	Si (***RE*** < 3.5)	***RE*** 0.6
Case B, final marck = max{B,C} *Case F: final grade = minimum{F, 6.9}*		

Midterm and final exams will have a **practice validation question** weighted between 0 and 10. <u>If this question is not passed with more than 3.5 points, the practice will not be taken into account for the final grade.</u>

Bibliography

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