Course guide
3200331 - MASD1 - Modelling and Analysis of Dinamic Systems I

Last modified: 28/06/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: Josep Cugueró Escofet

Others: ALEJANDRO BACHILLER MATARRANZ
JOSEP CUGUERÓ ESCOFET

PRIOR SKILLS

Industrial Control and Automation and associated previous capacities.
Mathematical Methods III and associated previous capacities.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. ELO: skills for The modelling and simulation of systems.

TEACHING METHODOLOGY

- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

LEARNING OBJECTIVES OF THE SUBJECT

This subject will provide students with the necessary theoretical and practical knowledge and skills to build mathematical and simulation models corresponding to real systems and use them to study and analyse the dynamic behaviour of the systems. In particular, students will study the control of the dynamic behaviour of systems.

STUDY LOAD

Type	Hours	Percentage
Self study	67,5	60.00
Hours large group	30,0	26.67
Hours small group	15,0	13.33

Total learning time: 112.5 h

CONTENTS

TOPIC 1: Introduction

Description:
1.1. Objectives and stages in dynamical system modelling.
1.2. Internal and external representation of continuous-time and discrete-time systems.
1.3. Tools for simulating mathematical models.

Specific objectives:
The ability to distinguish between the various system model types.
The ability to distinguish between the various modelling stages.
The ability to represent systems mathematically using transfer functions and block flow diagrams.
The ability to use tools to simulate systems on the basis of their models.

Related activities:
Lectures, laboratory practicals and examinations.

Full-or-part-time: 14h
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h

TOPIC 2: Cases of dynamical system modelling

Description:
2.1. Models of electrical systems.
2.2. Models of mechanical translational systems.
2.3. Models of mechanical rotational systems.
2.4. Models of thermal systems.
2.5. Models of hydraulic systems.
2.6. Models of economic and social systems.
2.7. Analogies between systems.

Specific objectives:
The ability to create unified mathematical models for various types of systems.
The ability to draw analogies between different types of systems.

Related activities:
Lectures, laboratory practicals and examinations.

Full-or-part-time: 14h
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h

TOPIC 3: Temporal analysis of continuous dynamical systems

Description:
3.1. Time response of systems.
3.2. Equilibrium points.
3.2. Stability.
3.3. Speed.

Specific objectives:
The ability to calculate the time evolution of a system due to external signals and out-of-equilibrium initial conditions.
The ability to assess the stability and speed of system on the basis of its time response.

Related activities:
Lectures, laboratory practicals and examinations.

Full-or-part-time: 20h
Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

TOPIC 4: Frequency analysis of continuous dynamical systems

Description:
4.1. System frequency response.
4.2. Bode representation.
4.3. Bandwidth.
4.4. Ressonance.

Specific objectives:
The ability to represent system frequency response.
The ability to define and calculate the various frequency-response characteristics of a feedback system.
The ability to assess speed and ressonances of a system on the basis of its frequency response.

Related activities:
Lectures, laboratory practicals and examinations.

Full-or-part-time: 27h
Theory classes: 6h
Laboratory classes: 5h
Self study : 16h

TOPIC 5: Interface between continuous and discrete systems

Description:
5.1. Sampling and reconstruction.
5.2. Quantification.
5.3. Discrete model of a mixed system.

Specific objectives:
The ability to mathematically represent mixed (continuous and discrete) dynamical systems.
The ability to choose the sampling period and quantification accuracy on the basis of the desired application.
The ability to construct simulation models of mixed systems.

Related activities:
Lectures, laboratory practicals and examinations.

Full-or-part-time: 17h
Theory classes: 5h
Laboratory classes: 2h
Self study : 10h

TOPIC 6: Discrete systems analysis

Description:
6.1. Difference equations.
6.2. Transfer function.
6.3. Time response.
6.4. Time-response characteristics.
6.5. Stability.
6.6. Speed.

Specific objectives:
The ability to represent a discrete system mathematically using a difference equation.
The ability to represent a discrete system mathematically using a transfer function.
The ability to calculate the time response of a discrete system using its mathematical model.
The ability to assess the stability and speed of a discrete system on the basis of its mathematical representations.

Related activities:
Lectures, laboratory practicals and examinations.

Full-or-part-time: 20h 30m
Theory classes: 5h
Laboratory classes: 2h
Self study : 13h 30m

ACTIVITIES

EXAMS

Full-or-part-time: 7h
Theory classes: 4h
Laboratory classes: 3h

LECTURES

Full-or-part-time: 26h
Theory classes: 26h

LABORATORY SESSIONS

Full-or-part-time: 12h
Laboratory classes: 12h

SELF STUDY

Full-or-part-time: 67h 30m
Self study: 67h 30m

GRADING SYSTEM

Each student's final mark is obtained by weighting his/her marks on the following:
- Examinations: 70%: two possibilities exist:
1) if the mark of the second exam is less than the mark of the first one: 35% first exam, 35% second exam
2) if the mark of the second exam is greater or equal than the mark of the first one: 70% second exam
- Continuous assessment in laboratory sessions: 30%.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

EXAMINATION RULES.

Attendance and participation in laboratory sessions is compulsory.

BIBLIOGRAPHY

Basic:
- Ogata, Katsuhiko. Ingeniería de control moderna . 2ª ed. México D.F. [etc.] : Prentice-Hall Hispanoamericana, 1993. ISBN 968-880-234-4.
- Dorf, Richard C; Bishop, Robert H; Dormido Canto, Sebastián. Sistemas de control moderno . 10a ed. Madrid [etc.] : Pearson Prentice Hall, cop. 2005. ISBN 84-205-4401-9.
- Ljung, Lennart; Glad, Torkel. Modeling of dynamic systems. Englewood Cliffs: Prentice Hall, 1994. ISBN 0135970970.
- Phillips, Charles L.; Nagle, H. Troy. Sistemas de control digital: análisis y diseño. 2ª ed. Barcelona: Gustavo Gili, 1993. ISBN 8425213355.
- Ogata, Katsuhiko. Sistemas de control en tiempo discreto. 2ª ed. México: Prentice Hall, 1996. ISBN 9688805394.

Complementary:
- Ogata, Katsuhiko. System dynamics. Second edition. New Jersey: Prentice-Hall International Editions, 1992. ISBN 0-13-880428-1.
- Åström, Karl J.; Wittenmark, Björn. Sistemas controlados por computador. Madrid: Paraninfo, 1988. ISBN 8428315930.