ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

ISEL ADEM
Área Departamental de Engenharia Mecânica

Sheet course ()

Course	MSc IN MECHANICAL ENGINEERING		
Unit	Automatic Control Systems	Mandatory	☒
		Optional	☐
Unit scientific area	Control Systems	Category	B

Unit category: B - Basic; C - Core Engineering; E - Specialization; P - Complementary.

Year: 1st	Semester: 2nd		ECTS: 6,5			
Contact time	Total:	T:	TP: 67,5	PL:	S:	OT:

T - Lectures; TP - Theory and practice; PL - Lab Work; S - Seminar; OT - Tutorial Guidance.

Unit Director	Title	Position
José Manuel Prista do Valle Cardoso Igreja	Ph.D.	Associate Professor

Learning Objectives (knowledge, skills and competences to be developed by students)

(max. 1000 characters)

The aim of this course is to provide students a basic training on the concepts underlying the theory of classical and intelligent control. Thus, it shall discuss techniques for modeling physical systems, presenting methods and techniques for analyzing/designing control systems. At the course conclusion the students should possess the following competencies: To identify control systems in open and closed loop; study of control systems in time and frequency domain; Select methods for design of industrial controllers like PID; Linking several theoretical concepts in order to form a global concept of the discipline; Explore, using processes that simulate industry practice, the theoretical concepts presented; Manipulating and adjust industrial PID and predictive controllers, verify the results obtained in experimentation and to validate them with the theoretically expected results.

Syllabus

(max. 1000 characters)

1.Basic notions of control systems.

Open and close loop systems. Automatic control system examples. Dynamic systems modelling. Transfer functions. Block diagrams. State-Space. Stability concept.

2.Time domain response.

1st and 2nd order systems. Routh-Hurwitz stability criterion. Root Locus.

3. Frequency domain response.

Frequency response. Bode and Nyquist Diagrams. Nyquist stability criterion. Gain and phase margin.

4. Industrial Controllers

PID controllers. Tune of PID controllers. Ziegler-Nichols rules. Lead and lag controllers. PID design in time and frequency domain.

5. Advanced control topics.

Predictive control, properties and characteristics. Tuning predictive controllers. Optimum control. Cost functions and performance indices.

Demonstration of consistency of the syllabus with the objectives of the course

(max. 1000 characters)

The syllabus of this course provides students with an evolutionary learning on the objectives and competencies to be acquired. Thus, the early chapters provide all the basic knowledge of the area of modeling systems and typical tools for the analysis/design of systems and controllers, in time and frequency domain. The last chapters study the design and analysis/adjustment of the PID controllers, and intelligent controllers as well. The student can acquire skills about concepts underlying the theory of classical and intelligent control.

Teaching methodology (evaluation included)

(max. 1000 characters)

This course is taught with theoretical class room lessons where powerpoint slides and Matlab simulations are used as pedagogical method to transmit the fundamental concepts of Automatic Control Systems. The course teaching is complemented with laboratorial works.

The evaluation is 1 final exam classified from 0 to 20. To get positive evaluation the student must have a grade equal or greater than 10.

Demonstration of consistency of teaching methods with the learning objectives of the course

(max. 3000 characters)

Taking into account the objectives of this course, the teaching methodology used here allows the student to

have contact in the classroom and laboratory, with educational resources enabling them to obtain the theoretical and practical skills about the basic concepts of Automatic Control Systems. With this in mind, oral and written teaching in classroom, the simulations in MATLAB and contact with real systems and industrial controllers is fundamental.

Main Bibliography

(max. 1000 characters)

Ogata, K, Engenharia de Controlo Moderno. Prentice-Hall, 4ª Ed. 2003.

Nise, N., Control Systems Engineering. Wiley. 2003.

Maciejowsky, Jan M., Predictive Control with Constraints. Addison Wesley Longman, 2002.