

ECE804 - Industrial Control

MSc in Intelligent Critical Infrastructure Systems Spring Semester 2020-2021

Instructor: Professor Thomas Parisini, t.parisini@imperial.ac.uk

Teaching Assistant: Anastasis Charalambous, charalambous.anastasis@ucy.ac.cy

Lectures: Tuesday: 18:00-19:30, Thursday: 18:00-19:30 (Week 1-7)

Tutorials: Friday: 16:00-18:00

Main References

This is a course on basics of control engineering and many good books can be found that serve the purpose.

Some classical and extremely good suggested references are:

- Control System Design by G.C. Goodwin, S.F. Graebe, and M.E. Salgado (2001)
- Linear Control System Analysis and Design by J.J. D’Azzo and C.H. Houpis, 4th edition, 1995
- Feedback Control of Dynamic Systems by G.F. Franklin, J.D. Powell, and A. Emami-Naeini, 8th edition, 2015

Course Objective

The aim of the course is to provide the basic elements of the theory of dynamic systems in the continuous-time contexts and construct their digital implementation and of the basic techniques to design automatic control systems of interest in industrial engineering contexts

Learning Outcomes

D1 - Knowledge and understanding

The student, at the end of the course, should know the basic principles governing the behaviour of a closed-loop control system including the modes of behaviour of the basic elements of such a control system

D2 - Applying knowledge and understanding

The student should be able to carry out the static and dynamic analysis of basic linear closed-loop control systems and should also be able to design controllers such that the overall control system behaves according to pre-specified requirements

D3 - Making judgements

The student should be able to evaluate, among several options, how to configure and design the architecture and the controller of an automatic control system starting from requirements and considering technological constraints

D4 - Communication skills

The student should be able to describe in a clear and plain way the functionalities of a control system with the correct use of technical terminology

D5 - Learning skills

The student should be able to read and understand reference textbooks on systems and control

Course Content

1. Introduction to control problems relevant to industry

Objectives of automatic control in industry. Examples in the engineering context of automatic control problems. Transient and steady-state performances of control systems. Types and elements of an automatic control system (open-loop, closed-loop, compensation, regulators, sensors, actuators). Definition of discrete-time signal and motivations for the use of discrete-time digital control systems.

2. Dynamic models

Continuous-time linear systems: time-domain and transfer function models, stability. Step-response (with emphasis on first and second-order systems), block schemes. Mathematical description of significant engineering systems in continuous time.

3. Frequency response

Definition and basic properties of frequency response and relations with transfer function models. Polar and Bode diagrams. Relations between frequency response and time response. Interpretation of linear systems as filters.

4. Analysis and design of automatic control systems

Control systems requirements: stability, precision (steady-state error, response speed, overshoot), disturbance compensation, robustness. Stability analysis: Nyquist and Bode criteria. Performance analysis and relation with loop-transfer function characteristics. Design of continuous time regulators using the Bode loop-shaping method. A glimpse on Fixed structure parametrized controller (lead, lag, lead-lag, PID).

Pre-requisites

Calculus basics with specific reference to differential equations, complex variable functions and linear algebra

Evaluation Methods – Grade Distribution

- Coursework (60%): three coursework (20% each) assigned and carried out during the course and before the Final Exam
- Final Exam (40%), Monday March 12th, 2021 (tentative)

Academic Honesty: it is acceptable to work together in small groups for study and discussing the coursework assignments. However, work that you turn in under your name must be your own. Cheating will not be tolerated; neither during coursework nor during exams. Note that all rules set by the University of Cyprus and the Department of Electrical and Computer Engineering apply.