Co-funded by the
Erasmus+ Programme
of the European Union

EUROPEAN UNIVERSITY FOR CUSTOMISED EDUCATION

STUDY GUIDE

INTRODUCTION TO CONTROL SYSTEMS

Organised by

Poznań University of Technology (PUT)

Co-funded by the Erasmus+ Programme of the European Union

1. IDENTIFYING DATA.	
· Course Name.	Introduction to Control Systems
· Coordinating University.	Poznań University of Technology (PUT)
· Partner Universities Involved.	none
· Course Field(s).	Technical sciences
· Related Study Programme.	Part of the bachelor programme in technical sciences at the Faculty of Control, Robotics and Electrical Engineering
· ISCED Code.	ISCED 0714
· SDG.	9
· Study Level.	B

· Number of ECTS credits allocated.	4 ECTS
· Mode of Delivery.	Online live, Online self-study
· Language of Instruction.	English
· Course Dates.	From 4th of March 2024 until 16th of June 2024
· Precise Schedule of the Lectures.	The precise schedule of the lectures is to be confirmed. Students enrolled into this course will receive it by email before the first lecture.
· Key Words.	Control, controller, frequency response, time response, model, digital control
· Catchy Phrase.	Do you want to get the gist of control systems? Thanks to the Introduction to control systems course, students from various fields of studies can discover a variety of control techniques, and means to improve control actions, on the side of their own studies.

· Prerequisites and co-requisites.	Good command of English (B2+). Basic knowledge of maths, covering integrals, derivatives, possibly Fourier or Laplace transform basics.
· Number of EUNICE students that can attend the Course.	Up to 2 students per EUNICE university
· Course inscription procedure(s).	Through the EUNICE website

2. CONTACT DETAILS.	
· Department.	Faculty of Control, Robotics and Electrical Engineering

· Name of Lecturer.	Dariusz HORLA
· E-mail.	Dariusz.Horla@put.poznan.pl
· Other Lecturers.	-

3. COURSE CONTENT.

The learning activity “Basics of continuous-time control systems” consists of:
1) Introduction to control engineering. Model of dynamics.
2) Transfer function. Block diagram algebra.
3) Time domain analysis of linear systems. Frequency response.
4) Analytical stability criteria. Transport delay.
5) Nyquist and Nichols plots. Nyquist stability criterion. Stability margins.
6-7) Linear controllers.
8) Impact of controller gains and its type on control performance. Output- and velocity-feedback control.

The learning activity “Basics of digital control systems” consists of:
1) Fuzzy logic control. Anti-windup compensators.
2) Introduction to discrete-time systems. Sampler and hold units.
3) Reconstruction of original signals from samples.
4) Discretization methods. Discrete-time model of a PID controller.
5) Synthesis of discrete-time control system models based on conventional methods.
6) Transient- and steady-state response analysis.
7) Frequency response of discrete-time models. Analytical stability criteria of discrete-time models.

These modules aim to bring interest to the students, allowing them identify ideas related to control or modelling in everyday situations, and to develop efficient control loops.

4. LEARNING OUTCOMES.

In terms of knowledge
Knowledge related to tools and techniques necessary to describe and analyse control systems. Also, related to stability analysis of linear continuous- and discrete-time control systems. Knowledge concerning the interplay between control performance and gains of basic controllers, as well as a relation between time and frequency responses of linear systems.

In terms of skills
Is capable of using appropriate methods to analyse stability of control systems, and can use the block diagram algebra to reduce complex control systems to an auxiliary transfer function, to

perform further analysis of the system. Can select an appropriate controller with its gains for a particular control task.

In terms of social competences
Recognizes the value of basic analysis and synthesis methods of control systems in engineering practice.

5. OBJECTIVES.

To present the students with synthesis and analysis methods related to control systems, basics of linear continuous-time and discrete-time closed-loop system models, digital control, as well as with the possible effects of nonlinearities on control performance.

6. COURSE ORGANISATION.

UNITS

1.	Basics of continuous-time control systems (16 hours of theory)
2.	Basics of digital control systems (14 hours of theory)
3.	Laboratory exercises related to problems to be worked-out (15 hours of exercises)

LEARNING RESOURCES AND TOOLS.

PDF files with course handouts, collaboration tools

PLANNED LEARNING ACTIVITIES AND TEACHING METHODS.

Lectures, individual work, group work

7. ASSESSMENT METHODS, CRITERIA AND PERIOD.

The final evaluation will consist of a test exam connected to both the units.

OBSERVATIONS.

8. BIBLIOGRAPHY AND TEACHING MATERIALS.

Franklin F.G., Powell J.D., Emami-Naeini A., *Feedback Control of Dynamic Systems*, 8th ed, Pearson 2019.
Ogata K., *Discrete-time Control Systems*, 2nd ed, Prentice Hall International 1995.
Ogata K., *Modern Control Engineering*, 5th ed, Pearson 2009.

Shinners S.M., *Modern Control System Theory and Design*, 3rd ed, New York, John Wiley & Sons, 1992.