VELEUČILIŠTE U KARLOVCU
Karlovac University of Applied Sciences

COURSE SYLLABUS

General information

Course title:	THE FUNDAMENTALS OF CONTROL SYSTEMS
ISVU course code:	82893
Course instructor:	Denis Kotarski
Course assistant:	Marko Pranjić
Study programme and specialization in which the course is taught:	Professional Undergraduate Study - Mechatronics
ECTS credits:	5
Semester of the course execution:	IV
Exam prerequisites:	-
Course objectives:	The course program equips students with knowledge and skills in control systems, covering the analysis of linear systems dynamics with and without feedback (linear control systems). Practical learning is facilitated through laboratory exercises, allowing students to independently explore practical examples using simulations and experimental system testing.

Course structure

Teaching mode	Number of contact hours per semester:	Student's requirements per teaching mode
Lectures:	30	80% attendance
Exercises (auditory, linguistics):	20	80% attendance
Exercises (laboratory, practical):	10	80% attendance
Field work:	-	
Other:	-	
TOTAL:	60	

Monitoring of students' work and knowledge evaluation during the course

OUTCOMES		ET1	ET2	ET3	ET4	ET5	Total	Pass	Time frame for the recognition of the outcome
Outcome 1	Understand the concept of a linear system and utilize dynamic analysis techniques.	15%					15%	7.5%	Until the end of the academic year.
Outcome 2	Determine the transfer function of continuous linear time-invariant systems.	15%					15%	7.5%	Until the end of the academic year.
Outcome 3	Compare the time response of standard elements in automation systems.	20%					20%	10%	Until the end of the academic year.
Outcome 4	Analyze the stability of continuous linear systems.		20%				20%	10%	Until the end of the academic year.
Outcome 5	Propose the configuration of a conventional		20%				20%	10%	Until the end of the academic year.

	controller and calculate its parameters.								
Outcome 6	Implement the programming solution for the cascade controller and carry out testing.			10%			10%	5%	Until the end of the academic year.
Total % grade points		50	40	10			100	50	
Share in ECTS		2,5	2	0,5			5		

Knowledge evaluation on exams

Exam prerequisites					
OUTCOMES		**Written exam**	**Oral exam**	**Total**	**Pass**
Outcome 1	Understand the concept of a linear system and utilize dynamic analysis techniques.	15%		15%	7,5%
Outcome 2	Determine the transfer function of continuous linear time-invariant systems.	15%		15%	7,5%
Outcome 3	Compare the time response of standard elements in automation systems.		20%	20%	10%
Outcome 4	Analyze the stability of continuous linear systems.	20%		20%	10%
Outcome 5	Propose the configuration of a conventional controller and calculate its parameters.	20%		20%	10%
Outcome 6	Implement the programming solution for the cascade controller and carry out testing.		10%	10%	5%
Total % of grade points		70	30	100	50
Share in ECTS		3,5	1,5	5	

Review of units per week with associated learning outcomes

Week	**Lecture course content and learning outcomes:**	**Outcome**	**Exercises course content and learning outcomes:**	**Outcome**
1.	Introductory lecture - basic terms, description of elements and control systems.	I1	Classical solution of the differential equation.	I1
2.	Mathematical approaches and methods of dynamic analysis.	I1	Static and dynamic characteristics.	I1
3.	Application of the Laplace transform.	I1, I2	Laplace transform: typical examples.	I1, I2
4.	Transfer function and response representation using the inverse Laplace transform.	I1, I2	Inverse Laplace transform: typical examples.	I1, I2
5.	Application of block algebra to solve the transfer function of the system.	I2	Determining the transfer function using block algebra: typical examples.	I2
6.	Transfer functions for standard automation elements.	I3	Determination of the transfer function of standard automation elements.	I3
7.	Modeling of the elements of the control system.	I3	An example of modeling automation elements - RLC circuit.	I3

8.	Evaluation of learning outcomes 1, 2.	I1, I2	Evaluation of learning outcome 3.	I3
9.	Analysis in the frequency domain using the Bode diagram.	I4	Transformation of the transfer function and representation in the frequency domain using the Bode diagram - typical examples.	I4
10.	Frequency characteristics of standard automation elements.	I4	Presentation of frequency characteristics of standard elements using Bode diagrams.	I4
11.	Stability of the control system.	I4	Analysis of the stability of the control system - implementation of simulations.	I4, I5
12.	Conventional control algorithms - determining the quality of control of continuous systems.	I5	Determining the control quality of continuous systems by conducting simulations.	I5
13.	Synthesis of standard control systems, proportional-integration-derivative (PID) controller.	I5	Examples of the synthesis of standard control systems - analytical and graphoanalytical procedures using Bode diagrams.	I5
14.	Cascade control.	I6	Implementation of the cascade PID controller for the 2nd order system and adjustment of the controller parameters.	I6
15.	Evaluation of learning outcomes 4, 5.	I4, I5	Evaluation of learning outcome 6.	I6

References (compulsory / additional)

1. P. Crnošija i dr.: Osnove automatike I, ISBN:978-953-197-683-1, Element, 2011.
2. D. Majetić i dr.: Zbirka zadataka iz teorije automatskog upravljanja, ISBN:978-953-7738-37-2, Udžbenici Sveučilišta u Zagrebu - Fakultet Strojarstva i brodogradnje, 2016
3. Z. Vukić i dr.: Automatsko upravljanje – analiza linearnih sustava, ISBN: 953-6045-29-X, Kigen, 2005.