COURSE SYLLABUS AND COURSE REQUIREMENTS
2024/2025 SEMESTER II.

Course title	*System Theory 2.*
Course Code	IVB352ANMI
Hours/Week: le/pr/lab	2/2/0
Credits	5
Degree Programme	Computer Science Eng. (BSc)
Study Mode	full-time
Requirements	exam
Teaching Period	spring
Prerequisites	System Theory 1.
Department(s)	Dept. of Technical Informatics
Course Director	Jancskárné Dr. Anweiler Ildikó
Teaching Staff	Dr. Sári Zoltán

COURSE DESCRIPTION

A short description of the course (max. 10 sentences).
Neptun: Instruction/Subjects/Subject Details/Basic data/Subject description

The course provides a basic introduction to control theory and control systems in general. The focus is primarily on continuous-time control systems, and the methods of analysis and design. The main content includes the principles of control, feedback control and open loop control, analysis of linear control systems in time-, frequency-, and operator-domain, concept of disturbance rejection and reference-tracking, stability analysis, performance metrics of control systems, synthesis of continuous time control systems, closed control loop, loop gain, type number, the PID controller, parameter tuning for prescribed steady-state accuracy and phase margin, control principles of systems with time-delay, robustness investigation of control systems.

SYLLABUS

Neptun: Instruction/Subjects/Subject Details/Syllabus

1. GOALS AND OBJECTIVES

Goals, student learning outcome.
Neptun: Instruction/Subjects/Subject Details/Syllabus/Goal of Instruction

The course aims for getting the students familiar with the fundamental concepts of control engineering including the operating principles of control systems, their analysis and synthesis. The student successfully completing the course will be able to analyse continuous-time control systems in various engineering applications, and to understand and solve the most common control problems in real-time embedded environment. The course provides sufficient background for later specialized studies.

2. COURSE CONTENT

Neptun: Instruction/Subjects/Subject Details/Syllabus/Subject content

	TOPICS
LECTURE	1. *Fundamentals, terminology, basics of feed-forward and feedback control* 2. *Fundamental dynamic terms and their properties, the transient behavior, the effect of negative feedback* 3. *Control requirements, stability of feedback systems, steady-state accuracy of reference tracking and disturbance rejection* 4. *Stability of the closed control loop, investigation of stability in the frequency domain, the simplified Nyquist-criterion, gain-margin and phase-margin* 5. *On-off control and its dynamic features, comparison of continuous and on-off control* 6. *The PID controller, structure, constructions and role of the components, PID control and the performance metrics, the steady state error* 7. *The saturation of the final control element, controlling second order and third order systems with a P-controller, comparing the P- and I-controllers.*

8. *The PI controller and its behavior in time- and frequency-domain, comparison of P-, I-, and PI-controllers, the pole cancellation, the PD-controller*
9. *The PID controller in time and frequency domain, the effect of saturation and high frequency noise on the PID controller, the behavior of the filtered derivative term*
10. *Systems with time-delay and their control*
11. *Parameter-tuning of PID controller in time and frequency domain*

PRACTICE

1. *Fundamentals, terminology, basics of feed-forward and feedback control*
2. *Fundamental dynamic terms and their properties, the transient behavior, the effect of negative feedback*
3. *Control requirements, stability of feedback systems, steady-state accuracy of reference tracking and disturbance rejection*
4. *Stability of the closed control loop, investigation of stability in the frequency domain, the simplified Nyquist-criterion, gain-margin and phase-margin*
5. *On-off control and its dynamic features, comparison of continuous and on-off control*
6. *The PID controller, structure, constructions and role of the components, PID control and the performance metrics, the steady state error*
7. *The saturation of the final control element, controlling second order and third order systems with a P-controller, type number of control systems, application of the I-controller.*
8. *The PI controller and its behavior in time- and frequency-domain, comparison of P-, I-, and PI-controllers, the pole cancellation, the PD-controller*
9. *The PID controller in time and frequency domain, the effect of saturation and high frequency noise on the PID controller, the behavior of the filtered derivative term*
10. *Systems with time-delay and their control*
11. *Parameter-tuning of PID controller in time and frequency domain*

DETAILED SYLLABUS AND COURSE SCHEDULE

ACADEMIC HOLIDAYS INCLUDED

LECTURE

week	**Topic**	**Compulsory reading; page number (from … to …)**	**Required tasks (assignments, tests, etc.)**	**Completion date, due date**
1.	Fundamentals, terminology, basics of feed-forward and feedback control	[1]: 11-18	see. Moodle	see. Moodle
2.	Fundamental dynamic terms and their properties, the transient behavior, the effect of negative feedback	[1]: 18-29		
3.	Fundamental dynamic terms and their properties, the transient behavior, the effect of negative feedback	[1]: 18-29	see. Moodle	see. Moodle
4.	Control requirements, stability of feedback systems, steady-state accuracy of reference tracking and disturbance rejection	[1]: 30-34	see. Moodle	see. Moodle
5.	Stability of the closed control loop, investigation of stability in the frequency domain, the simplified Nyquist-criterion, gain-margin and phase-margin	[1]: 34-38	see. Moodle	see. Moodle
6.	On-off control and its dynamic features, comparison of continuous and on-off control	[1]: 39-42	see. Moodle	see. Moodle
7.	The PID controller, structure, constructions and role of the components, PID control and the performance metrics, the steady state error and the P- controller, The saturation of the actuator, controlling second order and third order systems with a P-controller, type number of control systems, application of the I-controller	[1]: 43-73	see. Moodle	see. Moodle

8.			*Midterm test 1.*	
9.	The PI controller and its behavior in time- and frequency-domain, comparison of P-, I-, and PI- controllers, the pole cancellation, the PD-controller	[1]: 74-86	see. Moodle	
10.	The PID controller in time and frequency domain, the effect of saturation and high frequency noise on the PID controller, the behavior of the filtered derivative term	[1]: 87-91	see. Moodle	see. Moodle
11.	Systems with time-delay and their control, parameter-tuning of PID controller in time and frequency domain	[1]: 92-113	see. Moodle	see. Moodle
12.	**Spring brake**			
13.			*Midterm test 2.*	see. Moodle
14.			**Retakes**	
15.				

PRACTICE, LABORATORY PRACTICE

week	**Topic**	**Compulsory reading; page number (from … to …)**	**Required tasks (assignments, tests, etc.)**	**Completion date, due date**
1.	Fundamentals, terminology, basics of feed-forward and feedback control	[1]: 11-18	see. Moodle	see. Moodle
2.	Fundamental dynamic terms and their properties, the transient behavior, the effect of negative feedback	[1]: 18-29		
3.	Fundamental dynamic terms and their properties, the transient behavior, the effect of negative feedback	[1]: 18-29	see. Moodle	see. Moodle
4.	Control requirements, stability of feedback systems, steady-state accuracy of reference tracking and disturbance rejection	[1]: 30-34	see. Moodle	see. Moodle
5.	Stability of the closed control loop, investigation of stability in the frequency domain, the simplified Nyquist-criterion, gain-margin and phase-margin	[1]: 34-38	see. Moodle	see. Moodle
6.	On-off control and its dynamic features, comparison of continuous and on-off control	[1]: 39-42	see. Moodle	see. Moodle
7.	The PID controller, structure, constructions and role of the components, PID control and the performance metrics, the steady state error and the P- controller, The saturation of the actuator, controlling second order and third order systems with a P-controller, type number of control systems, application of the I-controller	[1]: 43-73	see. Moodle	see. Moodle
8.			*Midterm test 1.*	
9.	The PI controller and its behavior in time- and frequency-domain, comparison of P-, I-, and PI- controllers, the pole cancellation, the PD-controller	[1]: 74-86	see. Moodle	
10.	The PID controller in time and frequency domain, the effect of saturation and high frequency noise on the PID controller, the behavior of the filtered derivative term	[1]: 87-91	see. Moodle	see. Moodle
11.	Systems with time-delay and their control, parameter-tuning of PID controller in time and frequency domain	[1]: 92-113	see. Moodle	see. Moodle
12.	**Spring brake**			

13.			*Midterm test 2.*	see. Moodle
14.			**Retakes**	
15.				

3. ASSESSMENT AND EVALUATION

(Neptun: Instruction/Subjects/Subject Details/Syllabus/Examination and Evaluation System)

ATTENDANCE

In accordance with the Code of Studies and Examinations of the University of Pécs, Article 45 (2) and Annex 9. (Article 3) a student may be refused a grade or qualification in the given full-time course if the number of class absences exceeds 30% of the contact hours stipulated in the course description.

Method for monitoring attendance *(e.g.: attendance sheet / online test/ register, etc.)*

Attendance sheet on practice sessions. Maximum allowed absence: 30% of practice classes.

ASSESSMENT

Cells of the appropriate type of requirement is to be filled out (course-units resulting in mid-term grade or examination). Cells of the other type can be deleted.

Course-unit with final examination

Mid-term assessments, performance evaluation and their weighting as a pre-requisite for taking the final exam

(The samples in the table to be deleted.)

Type	Assessment	*Weighting as a proportion of the pre-requisite for taking the exam*
1. ***Midterm Test 1***	*max. 100%*	*50 %*
2. ***Midterm Test 2***	*max. 100%*	*50 %*

Requirements for the end-of-semester signature

(Eg.: mid-term assessment of 40%)

Result of each midterm test : min. 40%.

Re-takes for the end-of-semester signature (PTE TVSz 50§(2))

The specific regulations for grade betterment and re-take must be read and applied according to the general Code of Studies and Examinations. E.g.: all the tests and the records to be submitted can be repeated/improved each at least once every semester, and the tests and home assignments can be repeated/improved at least once in the first two weeks of the examination period.

Each midterm test can be retaken one time during the semester.

Type of examination *(written, oral): oral*

The exam is successful if the result is minimum ***40*** ***%.*** *(The minimum cannot exceed 40%.)*

Calculation of the grade *(TVSz 47§ (3))*

The mid-term performance accounts for ***25*** %, the performance at the exam accounts for ***75*** % in the calculation of the final grade.

Calculation of the final grade based on aggregate performance in percentage.

Course grade	Performance in %
excellent (5)	85 % …
good (4)	70 % ... 85 %
satisfactory (3)	55 % ... 70 %
pass (2)	40 % ... 55 %
fail (1)	below 40 %

The lower limit given at each grade belongs to that grade.

4. SPECIFIED LITERATURE

In order of relevance. (In Neptun ES: Instruction/Subject/Subject details/Syllabus/Literature)

COMPULSORY READING AND AVAILABILITY

[1.] Jancskárné Anweiler Ildikó: Control Engineering, Pécs, PTE Műszaki Kar, 2016. 148 p.

RECOMMENDED LITERATURE AND AVAILABILITY

[2.] Norman S. Nise,: Control Systems Engineering, Wiley, 2019