GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Control System Design, PG_00064794		
Field of study	Mechatronics		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Zakład Mechatroniki -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Rafał Hein	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	0.0	30

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	4.0	16.0	50

Subject objectives

The main aim of the course is to provide students the knowledge necessary to design continuous time control systems. During the course students learn the methods of selecting and designing controllers based on the time, frequency and integral performance indices. They get the skills of designing and application a such compensators as lead, lag and lead-lag to correcting dynamic properties of control systems. Course participants will get also general knowledge about root locus technique and its applications to control system design.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W03] demonstrates structured and theory supported knowledge encompassing key issues in the field of Mechatronics, enabling developement and synthesis of stationary and non-stationary mechatronic systems, devices, and processes with continuous and discrete operation	Student possesses knowledge about the modeling and designing of one dimensional, feedback control systems with single input and single output (SISO) as well as multidimensional feedback control systems with multiple inputs and multiple outputs (MIMO).	[SW1] Assessment of factual knowledge
[K7_U02] formulates and tests hypotheses concerning problems od stationary and non-stationary mechatronic systems/processes, as well as simple research problems	Student can apply the acquired theoretical knowledge to formulate and solve practical problems of controlling real mechatronic systems.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K7_U01] utilizes acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of stationary and non-stationary mechatronic systems/processes with continuous and discrete operation	Student uses learned methods to model control processes of mechatronic systems. Can apply computer programs to analyze, model, and simulate control systems.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment

Subject contents

Designing of continuous controllers based on the time, frequency and integral performance indices. Designing of state feedback optimal controller. Designing of lead, lag and lead-lag compensators. Designing of typical controllers by using the root locus technique.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="2">Mathematics at the academic level, Fundamentals of control engineering</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lecture</td><td>50.0%</td><td>40.0%</td></tr>
<tr><td>Laboratory</td><td>50.0%</td><td>60.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Nagrath I.J, Gopal M.: Control Systems Engineering, Anshan LTD 2008,

2. Dukkipati R.V. : Analysis and design of control systems using Matlab, New Age Science, 2nd edition 200,

3. Kaczorek T.: Teoria układów regulacji automatycznej, WNT, Warszawa 1977,

4. Kaczorek T.: Teoria sterowania, Tom 1, Układy liniowe, ciągłe i dyskretne, PWN, Warszawa 1977,

5. Kaczorek T.: Teoria sterowania, Tom 2, Układy nieliniowe, procesy stochastyczne oraz optymalizacja statyczna i dynamiczna, PWN Warszawa 1981,

6. Orlikowski C., Wittbrodt E.: Podstawy automatyki i sterowania. Laboratorium Tom 1, Gdańsk 1999,

7. Amborski K., Marusak A.: Teoria sterowania w ćwiczeniach, PWN, Warszawa 1978.

8. Mazurek J., Vogt H., Żydanowicz W.: Podstawy automatyki, OWPW, Warszawa 2006,

9. Holejko D., Kościelny W.,J.: Automatyka procesów ciągłych, OWPW, Warszawa2012

10. Próchnicki W., Dzida M.: Podstawy automatyki. Zbiór zadań, WPG, Gdańsk 2004</td></tr>
<tr><td>Supplementary literature</td><td>1. Douglas B.: The fundamentals of control theory</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">1 For a given control system, select the appropriate type of controller and determine its settings based on the given time criteria of regulation (steady state errors, rise time, settling time, overshoot)

2. For a given control system, select the appropriate type of controller and determine its settings based on the given frequency criteria (bandwidth, amplitude margin, phase margin, dimensionless damping coefficient, natural frequency vibrations)

3. For a given control system, select the coefficients of the optimal controller based on the given integral criteria.

4. Select appropriate compensators: phase lag, phase lead and phase lead-lag, so that the systems with compensators have an appropriate stability margin (amplitude or phase) and specified static or dynamic properties of regulation.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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