



Subject card

Subject name and code	Control Theory , PG_00055448						
Field of study	Mechatronics						
Date of commencement of studies	October 2024	Academic year of realisation of subject			2026/2027		
Education level	first-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	3	Language of instruction			Polish		
Semester of study	5	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Rafał Hein					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	15.0	0.0	0.0	45
	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	45		6.0		49.0	100
Subject objectives	Presentation of the state variable method in an application to modelling of dynamic systems. Introducing the method of designing feedback control systems. Acquainting with the methods of state variables reconstruction by using a full and reduced order observer. Getting practical skills in designing, synthesis and analysis of multidimensional feedback control systems.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_U02] is able to elaborate on specific mechatronic topics as well as topics from engineering and technology sciences and disciplines such as Mechanical Engineering, Automation, Electronics, Electrical Engineering and Space Technologies	Can design one and multi-dimensional control systems using the state space method.	[SU1] Assessment of task fulfilment
	[K6_W03] has organized and theoretically supported, advanced knowledge in the field of automation and control theory of stationary, continuous and discrete mechatronic systems, mechatronic design, developments and exploitation of mechatronic systems	Student has knowledge about 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
	[K6_W01] has knowledge in the field of mathematics that include vector and matrix calculus, analytical geometry, mathematical analysis (including ordinary and partial differential equations) and elements of discrete and applied mathematics, including mathematical and numerical methods essential to: 1) description and analysis of stationary, continuous and discrete mechatronics systems as well as basic physical phenomena that occur there; 2) description and analysis of programmable mechatronic systems; 3) description and analysis for signal processing; 4) synthesis of mechatronics elements and systems	Student mastered the mathematical methods and tools necessary to design and analysis one as well as multidimensional control systems. He can apply the method of state variables to design control systems with a controller and state observer.	[SW1] Assessment of factual knowledge
	[K6_W10] has knowledge about development trends in the field of engineering and technology sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics, Electrical Engineering and Space Technologies, adequate for Mechatronics course	He knows the trends in the development of theoretical methods as well as practical technologies used in automation and control theory	[SW1] Assessment of factual knowledge
Subject contents	<p>Course content – lecture Modeling of dynamic systems using the state variables method. Converting state-space model to transfer function. Converting transfer function to state-space model. Diagonalization and uncoupling of the state-space equations. Eigenvalues and eigenvectors. Controllability and observability. State variable feedback controller. Observer. Solving state-space equations.</p> <p>Course content – exercises Derivation of state equations for systems of diverse physical nature. Transformation of state equations into transfer functions. Conversion of transfer functions into state-space form. Determination of eigenvalues and eigenvectors. Diagonalization and decoupling of state equations. Assessment of controllability and observability of control systems based on the decoupled state-space representation and algebraic criteria. Calculation of state-feedback controller gains. Synthesis and tuning of full-order and reduced-order observers. Design of control systems with an observer and a state-feedback controller based on estimated state variables. Solution of state equations.</p> <p>Course content – laboratory Synthesis and analysis of digital control systems with memory. Modeling and simulation of control systems in the MATLABSimulink environment. Synthesis of a position servomechanism control system, including: derivation of state equations, calculation of state-feedback controller gains, determination of observer gains, and analysis of system performance with the controller and observer. Analysis of a temperature control system, including: identification of a mathematical model, controller selection and tuning, and implementation of an anti-windup scheme. Two-position (onoff) control system with compensating elements, including the selection of controller hysteresis parameters and tuning of compensator coefficients.</p>		
Prerequisites and co-requisites	Required knowledge of linear algebra including operations on matrices and vectors as well as problems related to solving systems of linear equations and inequalities.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Exercises	56.0%	40.0%
	Laboratory	56.0%	20.0%
	Lecture	56.0%	40.0%

Recommended reading	Basic literature	<p>1. Kaczorek T.: Teoria układów regulacji automatycznej, WNT, Warszawa 1977,</p> <p>2. Kaczorek T.: Teoria sterowania, Tom 1, Układy liniowe, ciągłe i dyskretne, PWN, Warszawa 1977,</p> <p>3. Kaczorek T.: Teoria sterowania, Tom 2, Układy nieliniowe, procesy stochastyczne oraz optymalizacja statyczna i dynamiczna, PWN Warszawa 1981,</p> <p>4. Orlikowski C., Wittbrodt E.: Podstawy automatyki i sterowania. Laboratorium Tom 1, Gdańsk 1999,</p> <p>5. Orlikowski C., Wittbrodt E.: Podstawy automatyki i sterowania. Laboratorium Tom 2, Gdańsk 2008,</p> <p>6. Amborski K., Marusak A.: Teoria sterowania w ćwiczeniach, PWN, Warszawa 1978,</p> <p>7. Nagrath I.J, Gopal M.: Control Systems Engineering, Anshan LTD 2008.</p>
	Supplementary literature	1. Kaczorek T.: Teoria wielowymiarowych układów dynamicznych liniowych. WNT Warszawa 1983.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Practical activities within the subject	Not applicable	

Document generated electronically. Does not require a seal or signature.