

## 。 GDAŃSK UNIVERSITY OF TECHNOLOGY

## Subject card

Subject name and code	Control of Continuous Processes, PG_00038108							
Field of study	Automation, Robotics and Control Systems							
Date of commencement of studies	October 2022		Academic year of realisation of subject		2024/2025			
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		Assessmer	ssment form		assessment		
Conducting unit	Department Of Intelligent And Decision Support Systems -> Faculty Of Electrical And Control Engineering -> Wydziały Politechniki Gdańskiej							
Name and surname of lecturer (lecturers)	Subject supervisor dr inż. Rafał Łangowski							
	Teachers		mgr inż. Mateusz Czyżniewski					
			dr inż. Rafał Łangowski					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Projec	t	Seminar	SUM
	Number of study hours	30.0	15.0	15.0	0.0		0.0	60
	E-learning hours included: 0.0							
Learning activity and number of study hours	Learning activity	Participation in classes includ plan	n didactic led in study	Participation in consultation hours		Self-study		SUM
	Number of study hours	60		4.0		36.0		100
Subject objectives	The aim of this course is to present an advanced classical and basic modern approach to modelling, analysis and synthesis of control systems, together with the development of skills in the selection of control technology, in control tasks primarily of continuous systems based on their linear (linearised), stationary, deterministic, lumped models and the use of modern computer tools for the purpose of the above.							

Learning outcomes	Course outcome	Subject outcome	Method of verification			
	[K6_U07] can build and analyze models of systems and systems in the field related to control systems and automation	The student derives models of dynamic plants both in the form of input-output models and state- space models using the basic knowledge of physics of these plants. He/she analyses basic properties of dynamic plants: stability, controllability, observability. The student explains structures and properties of PID family controllers and determines their parameters as well as structures with state feedback, also in the situation of unmeasured state variables and occurrence of constant and slow variable disturbances. He/she designs basic control systems satisfying quality requirements in the time domain and state observers using the pole allocation and LQ methods.	[SU3] Assessment of ability to use knowledge gained from the subject			
	[K6_W10] has basic knowledge related to mechatronics and robotics systems	The student models mechanical dynamic plants of the inverted pendulum type, electrical objects of the R, L, C type, DC electric motors, thermal and hydraulic plants, using basic knowledge of the physics of these plants, and then analyses their properties.	[SW1] Assessment of factual knowledge			
Subject contents	LECTURES: State - space modelling the system dynamics. Controllability, observability, transition matrix and stability of linear time invariant and continuous time dynamic systems. Control design for linear time invariant SISO deterministic dynamic systems: state feedback, state feedback observer controllers. Control design controller, state observers, separation principle and the state feedback observer controllers. Control design under uncertainty: state-feedback integral controllers. Integral control of MIMO systems under slowly varying disturbance inputs. Methods for discretising continuous time controllers. Introduction to nonlinear system dynamics. TUTORIALS: State space modelling the SISO R, L, C electrical circuits: deriving the equations and analysis of system dynamics properties. A heat exchanger state space modelling as the MIMO system with two control inputs and two control outputs: deriving nonlinear model equations, model linearisation, deriving transfer matrix of the linearised dynamics and analysis of the cross term gains, deriving the transition matrix and analysis of the cross term gains in time domain based on the impulse responses, simplification of the MIMO dynamics to two independent SISO systems. Stabilising control of inverted pendulum at an upper equilibrium point: linearising the model dynamics, synthesising the state feedback control law by pole placement and preparation for implementation in Simulink environment, links between the derived controller and the P, PI. ID controllers. Stabilising control of inverted pendulum at an upper equilibrium point under limited access to the state teadback controller stabilising with the low quality speed sensor having not negligible dynamics the inverted pendulum at an upper equilibrium point. Design of integral state feedback controllers for selected speed reference trajectories. Position control of DC motor in NI Elvis 2 environment by digital PI controller under the active actuator constraints and speed sensor measurement noi					
and co-requisites	Algebra.					
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade			
and criteria	Laboratory exercise	50.0%	20.0%			
	Midterm colloquium	50.0%	60.0%			
	Tutorials	50.0%	20.0%			

Recommended reading	Basic literature	<ol> <li>Kaczorek T. Teoria układów regulacji automatycznej, Wydawnictwa Naukowo-Techniczne, Warszawa, 1974.</li> <li>Nise N.S. Control System Engineering. 3th edition. John Wiley &amp; Sons, 2000.</li> <li>Ogata K. Modern Control Engineering. 4th edition. Prentice Hall, 2002.</li> <li>Mitkowski W.: Zarys teorii sterowania, Wydawnictwa AGH, Kraków, 2019.</li> <li>Astrom K.J., Murray R.M.: Feedback Systems - An Introduction for Scientists and Engineers, Princeton University Press, 2008.</li> <li>Ljung L., Glad T.: Modelling of Dynamic Systems, Prentice Hall, 1994.</li> <li>Slotine J-J. E., Li. W.: Applied nonlinear control, Prentice Hall, Englewood Cliffs, New Jersey, US 1991.</li> </ol>			
	Supplementary literature	<ol> <li>Franklin G. F., Powell J.D., Abbas Emami-Naeini: Feedback Control Dynamic Systems. Sixth Edition, Pearson, Upper Saddle River, 2010.</li> <li>Dorf R.C., Bishop R.H. Modern Control Systems. Addison Wesley &amp; Sons Inc., 1998.</li> <li>Ostertag E.: Mono- and Multivariable Control and Estimation, Springer Verlag, 2011.</li> </ol>			
eResources	eResources addresses	Adresy na platformie eNauczanie: STEROWANIE PROCESAMI CIĄGŁYMI [ARiSS][2024/25] - Moodle ID: 39784 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=39784			
Example issues/ example questions/ tasks being completed	<ul> <li>DC motor position control</li> <li>chemical process control including disturbance impact</li> </ul>				
Work placement	Not applicable				

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