

。 GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Control Structures and Algorithms, PG_00038324								
Automation, Robotics and Control Systems								
		Academic year of realisation of subject			2026/2027			
second-cycle studies		Subject group			Specialty subject group Subject group related to scientific research in the field of study			
Part-time studies		Mode of delivery			at the university			
2		Language of instruction			Polish			
3		ECTS credits			4.0			
general academic profile		Assessment form			assessment			
Faculty Of Electrical A	And Control En	gineering -> W	ydziały Politecl	hniki Gd	ańskiej	i		
Subject supervisor	dr inż. Tomasz Rutkowski							
Teachers								
Lesson type	Lecture	Tutorial	Laboratory	Project	t	Seminar	SUM	
Number of study hours	10.0	10.0	0.0	0.0		0.0	20	
E-learning hours included: 0.0								
Adresy na platformie eNauczanie:								
Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study		SUM	
Number of study hours	20		6.0		74.0		100	
Acquiring a knowledge related to advanced control methods and algorithms enabling the construction of such control structures that will allow for effective control of linear/nonlinear objects, both single and multidimensional.								
Course outcome		Subject outcome			Method of verification			
Course outcome [K7_W06] has an extended knowledge of the design of automation components and devices, control and decision support systems control and decision support systems and complex mechatronic systems		The student uses known (learned during the classes) methods and advanced control algorithms in the projects of control systems.			[SW1] Assessment of factual knowledge			
known mathematical tools and methods and computer techniques to analyse and evaluate automation and robotics components, devices, systems and systems [K7_K04] is able to react in abnormal and emergency situations, health and life- threatening when use of		synthesis of the known advanced control algorithms for a given object specification. The student designs and implements control structures using the known advanced control methods and			[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task			
	Automation, Robotics October 2025 second-cycle studies Part-time studies 2 3 general academic pro Faculty Of Electrical A Subject supervisor Teachers Lesson type Number of study hours E-learning hours inclu Adresy na platformie Learning activity Number of study hours Acquiring a knowledg such control structure multidimensional. Course out [K7_W06] has an ext knowledge of the des automation compone devices, control and support systems con decision support syst complex mechatronic [K7_U10] is able to a known mathematical methods and comput to analyse and evaluate and robotics compon devices, systems and [K7_K04] is able to re abnormal and emerg situations, health and threatening when us automation and robo	Automation, Robotics and Control S October 2025 second-cycle studies Part-time studies 2 3 general academic profile Faculty Of Electrical And Control En Subject supervisor Teachers Lesson type Lecture Number of study 10.0 hours 10.0 E-learning hours included: 0.0 Adresy na platformie eNauczanie: Learning activity Participation in classes includ plan Number of study 20 Number of study 20 Acquiring a knowledge related to ad such control structures that will allow multidimensional. Course outcome [K7_W06] has an extended knowledge of the design of automation components and devices, control and decision support systems control and decision support systems and computer techniques to analyse and evaluate automation and robotics components, and complex mechatronic systems [K7_L10] is able to apply the known mathematical tools and methods and computer techniques to analyse and evaluate automation and robotics components, devices, systems and systems [K7_K04] is able to react in abnormal and emergency situations, health and life-	Automation, Robotics and Control Systems October 2025 Academic y realisation second-cycle studies Subject grown ealisation second-cycle studies Mode of detection Part-time studies Mode of detection 2 Language of the design of the design of study plan Subject supervisor dr inż. Tomas Faculty Of Electrical And Control Engineering -> W Subject supervisor dr inż. Tomas Teachers Intorial Lesson type Lecture Lesson type Lecture Lesson type Lecture Number of study hours 10.0 Number of study hours 20 Acquiring a knowledge related to advanced control such control structures that will allow for effective comultidimensional. Course outcome Subj [K7_W06] has an extended knowledge of the design of automation components and decision support systems control and decision support systems and complex mechatronic systems The student u during the cla advanced cor projects of complex mechatronic systems [K7_U10] is able to apply the known mathematical tools and methods and computer techniques to advanced cor algorithms. The student control addecision synthesis of the design and in structures usi advanced cor algorithms. [K7_K04] is	Automation, Robotics and Control Systems October 2025 Academic year of realisation of subject second-cycle studies Subject group Part-time studies Mode of delivery 2 Language of instruction 3 ECTS credits general academic profile Assessment form Faculty Of Electrical And Control Engineering -> Wydziały Politect Subject supervisor dr inž. Tomasz Rutkowski Teachers Eeson type Lesson type Lecture Tutorial Lesson type Lecture Tutorial Number of study 10.0 10.0 Number of study 20 6.0 Kr_W06] has an extended Knowledge of the design of automation components and devices, control and decision support systems and complex mechatronic systems The student can conduct the synthesis of the known advanced control algorithms for a giver object specification. The student can conduct the synthesis of the known advanced control methods and complex mechatronic systems [K7_K04] is able to react i	Automation, Robotics and Control Systems October 2025 Academic year of realisation of subject second-cycle studies Subject group Part-time studies Mode of delivery 2 Language of instruction 3 ECTS credits general academic profile Assessment form Faculty Of Electrical And Control Engineering -> Wydziały Politechniki Gd Subject supervisor dr in2. Tomasz Rutkowski Teachers	Automation, Robotics and Control Systems 2026/ October 2025 Academic year of realisation of subject 2026/ second-cycle studies Subject group Speci Subject group at the 2 Part-time studies Mode of delivery at the 2 Language of instruction Polish 3 ECTS credits 4.0 general academic profile Assessment form asses: Faculty Of Electrical And Control Engineering -> Wydziały Politechniki Gdańskiej Subject supervisor dr inż. Tomasz Rutkowski Teachers	Automation, Robotics and Control Systems October 2025 Academic year of realisation of subject 2026/2027 Second-cycle studies Subject group Specialty subject group feature research in the field research in the results of the research in the field research in the field research in the research in the field research in the field research in the field research in the result research in theresearch in the result research in there result re	

Outlinet erstants							
Subject contents	Lectures						
	Control structures, methods and algorithms for control and state estimation: Kalman filters (assumptions, disturbances and measurement noise, a recursive form of the estimator); predictive control algorithms DMC, QDMC, GPC (problem formulation, a model for prediction, stability, implementation aspects); linearization by feedback (input-state linearization, input-output): differential-integral calculus of fractional orders (definitions of fractional-order operators, approximations of fractional-order operators, fractional-order PID controllers); variable structure control, sliding mode control (stability of sliding motion and conditions of its existence, control law, consideration of various aspects of uncertainty, a continuous approximation of the control law); intelligent adaptive neural and object fuzzy control with nonlinear dynamics with unavailable state and uncertainty in object model dynamics.						
	Laboratory exercises cover the practical implementation of the following topics:						
	 Estimation of the linear state of an object with distortions and measurement noise with a temporal structure using the Kalman Filter method, Synthesis of follow-up manipulator control (robot arm) realizing the reference movement trajectory by linearization method by feedback with nonlinearity leakage compensation in conditions of viscous friction and additive disturbances, Synthesis, implementation and verification of fractional-orders PID controllers for selected linear objects, Implementation and verification of DMC and QDMC predictive control algorithms for selected single and multidimensional linear objects, Implementation and verification of the sliding mode control algorithm enabling the stabilization of a nonlinear object with disturbances in internal dynamics. 						
Prerequisites and co-requisites		æs in internar dynamics.					
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade				
and criteria	Class tests	50.0%	50.0%				
	Laboratory exercises	50.0%	50.0%				
Recommended reading	Basic literature	 Franklin G. F., Powell J.D., Abbas Emami-Naeini: Feedback Control Dynamic Systems. Sixth Edition, Pearson, Upper Saddle River, 2010. Slotine Jean Jacques E., W. Li: Applied Nonlinear Control. Prentice Hall, Englewood Cliffs, New Jersey 07632, 1991. Brdys Mietek A., Tatjewski P.: Iterative Algorithms for Multilayer Optimizing Control, Imperial College Press, World Scientific Publishing Co. Pte. Ltd., 2005. Rawlings J.B., Mayne D.Q.: Model Predictive Control: Theory and Design. Nob-Hill Publishing, 1st edition, 2009. 					
	Supplementary literature	 Khail Hassan K.: Nonlinear Systems. Prentice Hall, Englewood Cliffs, New Jersey 07632, 2002. Maciejowski J.M.: Multivariable Feedback Design. Addison Wesley, 1989 Byrski W.: Obserwacja i Sterowanie w Systemach Dynamicznych. Uczelniane Wydawnictwa Naukowo Dydaktyczne Akademii Górniczo Hutniczej w Krakowie, 2007 (<i>Control and Estimation in Dynamical Systems</i>) Tatjewski P.: Sterowanie Zaawansowane Obiektów Przemysłowych struktury i algorytmy. Warszawa, Akad. Oficyna Wyd. EXIT, 2002. (<i>Advanced Control of Industrial Processes</i> <i>Structures and Algorithms</i>) Duda J. T.: Modele Matematyczne, Struktury i Algorytmy Nadrzędnego Sterowania Komputerowego. Uczelniane Wydawnictwa Naukowo Dydaktyczne Akademii Górniczo-Hutniczej w Krakowie, Kraków, 2003. (<i>Mathematical Models, Structures and Algorithms for Supervisory Computer Control</i>) 					
		 Wesley, 1989 Byrski W.: Obserwacja i Sterow Uczelniane Wydawnictwa Nauk Górniczo Hutniczej w Krakowie Dynamical Systems) Tatjewski P.: Sterowanie Zaaw Przemysłowych struktury i algo Wyd. EXIT, 2002. (Advanced C Structures and Algorithms) Duda J. T.: Modele Matematyc: Nadrzędnego Sterowania Kom Wydawnictwa Naukowo Dydak w Krakowie, Kraków, 2003. (Matematica) 	Feedback Design. Addison anie w Systemach Dynamicznych. owo Dydaktyczne Akademii , 2007 (<i>Control and Estimation in</i> ansowane Obiektów rytmy. Warszawa, Akad. Oficyna <i>ontrol of Industrial Processes</i> zne, Struktury i Algorytmy outerowego. Uczelniane yczne Akademii Górniczo-Hutniczej athematical Models, Structures and				
	eResources addresses	 Wesley, 1989 Byrski W.: Obserwacja i Sterow Uczelniane Wydawnictwa Nauk Górniczo Hutniczej w Krakowie Dynamical Systems) Tatjewski P.: Sterowanie Zaaw Przemysłowych struktury i algo Wyd. EXIT, 2002. (Advanced C Structures and Algorithms) Duda J. T.: Modele Matematyc: Nadrzędnego Sterowania Kom Wydawnictwa Naukowo Dydak w Krakowie, Kraków, 2003. (Matematica) 	Feedback Design. Addison anie w Systemach Dynamicznych. owo Dydaktyczne Akademii , 2007 (<i>Control and Estimation in</i> ansowane Obiektów rytmy. Warszawa, Akad. Oficyna <i>ontrol of Industrial Processes</i> zne, Struktury i Algorytmy outerowego. Uczelniane yczne Akademii Górniczo-Hutniczej athematical Models, Structures and				
Example issues/ example questions/ tasks being completed	 Present the structure of the Kall Describe the concept of lineariz Introduce the concepts of the pi Identify the similarities and diffe Identify the similarities and diffe Describe the concept of sliding 	 Wesley, 1989 Byrski W.: Obserwacja i Sterow Uczelniane Wydawnictwa Nauk Górniczo Hutniczej w Krakowie Dynamical Systems) Tatjewski P.: Sterowanie Zaaw Przemysłowych struktury i algo Wyd. EXIT, 2002. (Advanced C Structures and Algorithms) Duda J. T.: Modele Matematyc: Nadrzędnego Sterowania Kom Wydawnictwa Naukowo Dydaki w Krakowie, Kraków, 2003. (Ma Algorithms for Supervisory Con man Filter and describe its properties ration by feedback methodology. men control algorithm. rences between the DMC and QDMC pre- 	Feedback Design. Addison anie w Systemach Dynamicznych. owo Dydaktyczne Akademii , 2007 (<i>Control and Estimation in</i> ansowane Obiektów rytmy. Warszawa, Akad. Oficyna ontrol of Industrial Processes zne, Struktury i Algorytmy outerowego. Uczelniane yczne Akademii Górniczo-Hutniczej ithematical Models, Structures and nputer Control)				

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