



## Subject card

Subject name and code	Fundamentals of Automatics, PG_00042102						
Field of study	Power Engineering, Power Engineering, Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2022/2023		
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			English N/A		
Semester of study	5	ECTS credits			6.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Control and Power Engineering -> Faculty of Ocean Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Mohammad Ghaemi					
	Teachers	dr inż. Mohammad Ghaemi mgr inż. Damian Jakowski					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	30.0	0.0	0.0	75
	E-learning hours included: 0.0						
Additional information:							
<ul style="list-style-type: none"><li>In the first semester of the academic year 2020/2021, the lecture on Fundamentals of Automation, as a part of the study program for students of Power Engineering, cohort Energy Technologies, will be delivered online.</li><li>The lecture will be conducted on the e-Learning platform of GUT.</li><li>All information and materials for this lecture are available on this platform.</li><li>The lectures will be delivered in accordance with your study plan available on <i>moja.pg</i>, i.e. on Monday from 9 till 11.</li><li>Classes are conducted in the form of a webinar, and the recordings of the webinars will be made available successively. All webinars are set up as "meeting", which means that any participant can join the discussion and ask questions at any time.</li><li>Two forums are available. The discussion forum can be used for discussions between the participants, while the Q&amp;A forum is used for asynchronous consultation with me.</li><li>Due to the current pandemic situation, it is impossible to inform you in advance about the type of exam, I will inform you about it later. The preferred scheme, however, is organizing the exam at the university, not online.</li><li>Questions can also be sent by e-mail to me: ghaemi@pg.edu.pl.</li><li>In-person consultation at the university is possible each Monday from 13:15 till 15:00 in Room 173 located at the Faculty of Ocean Engineering and Ship Technology, first floor.</li></ul>							
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	75	10.0	65.0	150		
Subject objectives	Gaining the knowledge about fundamental concepts of control systems and robotics including system modeling and representation, analysis and synthesis, as well as technical solutions. Ability of implementation and application of control systems in industrial and engineering processes and systems.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_W03	Knows the basics of control systems and automatic regulation, including the necessary rules for the selection of related devices and components.			[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge		
	K6_W06	He knows the basic concepts and principles of analysis, synthesis, operation and evaluation of simple technical automation systems, important for power engineering systems.			[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge		

Subject contents	1. Introduction and principal definitions 2. Classification of control systems 3. Modelling of dynamic systems and description of elements of control systems 4. Mathematical model presentation: differential equation, transfer function, block diagram, state and observation equations; model transformation 5. Transient function and time characteristics 6. Feedback control 7. Analysis of control systems in time and frequency domains 8. Stability 9. Controllers and principles of their selection and design 10. Quality of control systems 11. Discrete control systems														
Prerequisites and co-requisites	Preceding subjects: 1. Mathematics 2. Physics 3. Technical mechanics														
Assessment methods and criteria	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:33%;">Subject passing criteria</th> <th style="width:33%;">Passing threshold</th> <th style="width:33%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Lab.</td> <td>51.0%</td> <td>30.0%</td> </tr> <tr> <td>class tests</td> <td>51.0%</td> <td>20.0%</td> </tr> <tr> <td>Written colloquiums, oral egzamination</td> <td>56.0%</td> <td>50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Lab.	51.0%	30.0%	class tests	51.0%	20.0%	Written colloquiums, oral egzamination	56.0%	50.0%
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Recommended reading	Basic literature	1. Domachowski Z., Automatyka i robotyka – podstawy, Wydawnictwo PG, Gdańsk, 2003. 2. Nise N. S., Control system engineering, John Whiley & Sons Inc., 2000. 3. Próchnicki W., Dzida M., Zbiór zadań z podstaw automatyki, skrypt dla studentów Wydziału Oceanotechniki i Okrętownictwa PG, Gdańsk, 1993.													
	Supplementary literature	1. Friedland B., Control System Design, McGraw Hill Co., 1986. 2. Bubnicki Z., Teoria i algorytmy sterowania, Wydawnictwo Naukowe PWN, Warszawa, 2002. 3. Kaczorek T., Teoria sterowania i systemów, Wydawnictwo Naukowe PWN, Warszawa, 1999. 4. Ogata K., Modern Control Engineering, 4th edition, Prentice Hall, 2002. 5. Perycz S., Podstawy automatyki, skrypt dla Instytutu Okrętowego PG, Gdańsk, 1983. 6. Raven, F. H., Automatic control engineering, McGraw Hill Co., 1986.													
	eResources addresses	Adresy na platformie eNauczanie:													

Example issues/  
example questions/  
tasks being completed

1. Feedback control, the role, function and elements, natural and artificial examples
2. Comparison of open and closed loop control systems, examples.
3. The aim and goal of automatic control system
4. Possibilities of control systems
5. Dynamic system, examples
6. Steady state and dynamic characteristics of control systems, general block diagram of a control system, signals.
7. elements of a control system, their roles.
8. Disturbances and their influence.
9. Definition, block diagram and examples of the following control systems:
  - constant value, programmed, tracking/tracking point
  - SISO, MIMO
  - linear and nonlinear,
  - time-variant, time-invariant
  - lumped, distributed
  - continuous, discrete
  - optimal
  - adaptive,
  - extreme.
10. Building mathematical models of dynamic systems
11. The types of linear mathematical models
12. Equivalency of dynamic systems
13. Relations between differential equations, transfer functions, block diagram, state space model and frequency response
14. Step and impulse responses
15. linearization
16. Transient response

17. Representation of the most important dynamic systems in the form of transfer function
18. Response trajectory
19. Solving the state and observation equations
20. Transition matrix
21. natural frequency and resonance in control systems
22. Definition:
  - rise time
  - settling time
  - overshoot
  - oscillation degree.
23. Frequency domain characteristics
24. Relation between time and frequency domain characteristics
25. Nyquist and Bode characteristics
26. Bandwidth and filters
27. Resonance compensation
28. Damping coefficient and its influence
29. Structure of controllers, their block diagrams
30. The elements of controllers
31. General principles for selecting a controller
32. Ideal linear controllers, types, transfer functions
33. Design of structure of controllers
34. Controller characteristics and its influence of the behaviour of control system
35. Design of characteristics of controllers using parallel connection of elements
36. Hydraulic amplifier
37. Stability of control systems, definition based on Lyapunov, examples.

	<p>38. Stability of control systems</p> <p>39. How stability is affected by the conditions</p> <p>40. Characteristic equation of a control system</p> <p>41. Stability checking based on the roots of characteristic equation</p> <p>42. The reason for which we use stability criteria</p> <p>43. Routh-Hurwitz stability criterion</p> <p>44. Nyquist stability criterion</p> <p>45. Stability margins</p> <p>46. Steady-state error, way of calculation</p> <p>47. Relation between the controller parameters and steady state error</p> <p>48. Optimization of control system</p> <p>49. Quality of control system</p> <p>50. General information about discrete control systems</p>
Work placement	Not applicable