GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fundamentals of Atomation, PG_00042061		
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	Polish N/A
Semester of study	5	ECTS credits	6.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	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:

- 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.
- The lecture will be conducted on the e-Learning platform of GUT.
- All information and materials for this lecture are available on this platform.
- The lectures will be delivered in accordance with your study plan available on *moja.pg*, i.e. on Monday from 9 till 11.
- 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.
- Two forums are available. The discussion forum can be used for discussions between the participants, while the Q&A forum is used for asynchronous consultation with me.
- 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.
- Questions can also be sent by e-mail to me: ghaemi@pg.edu.pl.
- 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.

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. Analisis 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

Subject passing criteria	Passing threshold	Percentage of the final grade
class tests	51.0%	20.0%
Written colloquiums, oral egzamination	56.0%	50.0%
Lab.	51.0%	30.0%

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: Podstawy automatyki, W/ĆW, Energetyka, sem.05, zimowy 22/23 (PG_00042061) - Moodle ID: 26197 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26197

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 resonanse 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.

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