GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modelling of mechatronic systems, PG_00038863		
Field of study	Mechatronics, Mechatronics		
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
Semester of study	5	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Zakład Mechatroniki -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Krzysztof Kaliński	
	Teachers	dr inż. Natalia Stawicka-Morawska prof. dr hab. inż. Krzysztof Kaliński	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	15.0	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

Introduction to modeling of mechatronic systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U06	The student identifies the phenomena related to the functioning of mechatronic systems. The student defines team tasks of modeling mechatronic systems.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
K6_W03	The student develops physical models of mechatronic systems. The student recognizes the methods of modeling the structure of mechatronic systems and the observed signals.	[SW1] Assessment of factual knowledge
K6_U07	The student designs models of open and closed mechatronic systems in interdisciplinary teams.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
K6_W10	The student presents the mastery of the methods of modeling stationary mechatronic systems. The student designs models of open and closed mechatronic systems in interdisciplinary teams.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
K6_W01	The student presents the mastery of the methods of modeling stationary mechatronic systems.	[SW1] Assessment of factual knowledge

Subject contents	LECTURES. Basic terms. Creation of calculation models: Models of mechatronic systems components. Modelling of multi-body systems. Structural models. Modal models. Mathematical description: Analogies between physical environments. Dynamic equations in generalised coordinates. Control of mechatronic systems: Multidimensional control systems. Linear optimal control. Modal control. Closed-loop systems. Control systems design. Examples of modelling of mechatronic systems: Industrial robot. Chosen problems of vehicle dynamics. LABORATORY Introduction. Physical models of mechanical, electric, hydraulic and thermal systems. Modelling of multi-body systems. Structural modelling of mechatronic systems. Creation of dynamic equations of mechatronic systems in generalised and state coordinates. Modal analysis. Synthesis of multidimensional control system. Multidimensional linear optimal control system. Chosen example of modelling of mechatronic systems. PROJECT The students perform 2 projects in their own interdisciplinary teams, at simultaneous distribution of competences between several members. The tasks depend on creation of calculation models of the mechatronic systems with diversified physical nature, and on multidimensional control systems design. The first project concerns modelling of open-loop systems, while the second one considers additionally existence of feedbacks, due to accompanying working processes. During the projects performance one ought to focus a special attention on modelling in mechatronic systems as well the structure, as the signals.
Prerequisites and co-requisites	Knowledge on Mechanics and Strength of materials. Knowledge and experience on Fundamentals of automatic control. Knowledge and experience in Informatics (sem. II, IV). Knowledge on Mechatronic systems components.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Reports from laboratory exercises	100.0%	25.0%
Project	100.0%	25.0%
Written exam	50.0%	50.0%

Recommended reading

Basic literature	1. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty metody przykłady. Warszawa: Wyd. Nauk. PWN 2001. 2. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Białystok: Wyd. Polit. Białostockiej 1997. (jest dostępna w internecie) 3. Cannon R. H.: Dynamika układów fizycznych. Warszawa: WNT 1973. 4. Kaliński K. J.: Nadzorowanie procesów dynamicznych w układach mechanicznych. Gdańsk: Wydawnictwo Politechniki Gdańskiej 2012. 5. Metoda elementów skończonych w dynamice konstrukcji. Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski J., Wittbrodt E. Warszawa: Arkady 1984. 6. Kaczorek T.: Teoria sterowania i systemów. Warszawa: Wyd. Nauk. PWN 1993.
Supplementary literature	1. Mechatronika. Analiza, projektowanie i badania wybranych elementów i systemów. (Red. K. Kluszczyński). Warszawa: Wydawnictwo PAK 2013. 2. Skoczyński W.: Sensory w obrabiarkach CNC. Warszawa: Wydawnictwo Naukowe PWN S.A. 2018. 3. Grzegożek W., Adamiec-Wójcik I., Wojciech S.: Komputerowe modelowanie dynamiki pojazdów samochodowych. Kraków: Politechnika Krakowska im. T. Kościuszki 2003.
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Elements of mechatronic systems that store kinetic energy
2. Multidimensional control systems. Dynamics equations. Operator transmittance matrix
3. Modal control at the energy quality indicator. Optimum control signal
4. Closed loop systems. Modeling responses with an observer
5. Modeling of the robot's support system. Control modeling

Work placement	Not applicable