GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modelling of mechatronic systems, PG_00055449		
Field of study	Mechatronics		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
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_U07] is able to design elements of mechatronic systems taking into consideration given application and economic criteria, using appropriate methods, techniques and tools	Student presents a command of the methods of the stationary mechatronic systems; modelling. Student recognises the methods of modelling of as well; the mechatronic systems; structure, as; observed signals. Student elaborates physical models of mechatronic systems. Student defines group tasks of the mechatronic systems; modelling. Student designs open- and closed-loop models of mechatronic systems in interdisciplinary teams.	[SU4] Assessment of ability to use methods and tools
[K6_W03] has organized and theoretically supported knowledge in terms of automation and control theory of stationary , continuous and discrete mechatronic systems, mechatronic design, developments and exploitation of mechatronic systems	Student identifies phenomena accompanied functioning of mechatronic systems. Student presents a command of the methods of the stationary mechatronic systems; modelling. Student recognises the methods of modelling of as well; the mechatronic systems; structure, as; observed signals. Student elaborates physical models of mechatronic systems. Student defines group tasks of the mechatronic systems; modelling. Student designs open- and closed-loop models of mechatronic systems in interdisciplinary teams.	[SW1] Assessment of factual knowledge
[K6_W09] knows and understands methods of mechatronic modelling and design of systems / stationary processes as well as utilized methods and techniques including structural modelling, modal analysis, optimal control, digital control and knows modelling languages as well as computer tools for design and simulation of systems / mechatronic processes	Student identifies phenomena accompanied functioning of mechatronic systems. Student presents a command of the methods of the stationary mechatronic systems; modelling. Student recognises the methods of modelling of as well; the mechatronic systems; structure, as; observed signals. Student elaborates physical models of mechatronic systems. Student defines group tasks of the mechatronic systems; modelling. Student designs open- and closed-loop models of mechatronic systems in interdisciplinary teams.	[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
Written exam	50.0%	50.0%
Project	100.0%	25.0%
Reports from laboratory exercises	100.0%	25.0%

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	Adresy na platformie eNauczanie: Modelowanie układów mechatronicznych, W, MTR, Ist, sem. 05, zima, 2023/24, (PG_00055449) - Moodle ID: 33302 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33302
Example issues/ example questions/ tasks being completed	1. Energy dissipating elements of mechatronic systems. 2. Basics of the finite element method in spatial problems. 3. Multidimensional control systems. Equations of state. 4. Modal control with energy quality indicator. Optimal control signal. 5. Design of control systems. Selection of poles in a multidimensional system.	
Work placement	Not applicable	