



## Subject card

Subject name and code	Theory of mechatronic systems, PG_00057023						
Field of study	Mechatronics						
Date of commencement of studies	February 2024	Academic year of realisation of subject			2023/2024		
Education level	second-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	1	Language of instruction			Polish		
Semester of study	1	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Mechanics and Mechatronics -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Rafał Hein					
	Teachers	dr hab. inż. Rafał Hein					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	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	30	4.0		16.0	50	
Subject objectives	To acquaint students with the fundamentals theory of mechatronic systems analysis and design. Explanation of the basic concepts used in the theory of mechatronic systems including among others synergy, emergence, holism. Presentation, characterization and comparison of reductionist and holistic paradigms in modeling, designing, analyzing and creating a real mechatronic system.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W10] knows development trends and most important new achievements in technical sciences and science disciplines: Mechanical Engineering, Automation, Electronics and Electrical Engineering and related: Informatics and Materials Engineering	Student knows the directions of development of technical sciences, in particular in the fields of mechanics, automation and robotics, control, electronics and computer science.	[SW1] Assessment of factual knowledge
	[K7_U08] is able identify and formulate tasks specification in terms of design of non-stationary mechatronic systems and processes, including non-standard problems and taking into consideration its non-technical aspects	Student can plan subsequent stages of the modeling, design and construction process of a real mechatronic system, including non-stationary one.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
	[K7_W02] has organised, general, supported by the theory knowledge in terms of systems theory and techniques, mechatronic design, mechatronic systems and exploitation of mechatronic devices	Student knows the basic concepts used in the theory of mechatronic systems. He applies a holistic and reductionist approach to the design, analysis, modeling and investigation of mechatronic systems.	[SW1] Assessment of factual knowledge
	[K7_W07] has basic knowledge on lifecycle of devices, objects and technical systems	Is aware of the periodic durability of mechatronic devices and systems.	[SW1] Assessment of factual knowledge
[K7_U04] is able to utilise known methods and mathematical models, as well as computer simulations for analysis and evaluation of non-stationary continuous and discrete mechatronic systems and processes	Student can apply signal processing methods for the analysis and investigation of stationary and non-stationary mechatronic systems. He designs passive and active analog filters to eliminate interference, aliasing, various kinds of parasitic effects and to reduce back-interaction between cooperating elements of the mechatronic system. Student models, analyzes and investigates mechatronic systems consisting of subsystems of various physical nature.	[SU1] Assessment of task fulfilment	
Subject contents	<p><b>Lecture.</b> System. System structure and classification. System engineering. System operation analysis and modeling problems. Mechatronic system. Mathematical model of a mechatronic system. Modeling of systems of various physical nature. Identification methods in the frequency domain - Fourier transform of signals. Analog filtration. Passive filters. Active filters. Digital filtration. Backward interactions. Expert systems. Fuzzy systems, fuzzy signals, rules of inference, areas of application. Fuzzy control.</p> <p><b>Laboratory.</b> Spectral analysis of signals. Modeling and investigation of analog and digital filters. Modeling of complex mechatronic systems of varied physical nature.</p>		
Prerequisites and co-requisites	Fundamentals of control systems, Control theory, Mathematics, including: linear algebra, differential and integral calculus.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture	50.0%	50.0%
	Laboratory	50.0%	50.0%

Recommended reading	Basic literature	<p>1 Morrison F.: Sztuka Modelowania Układów Dynamicznych, Wydawnictwo Naukowo Techniczne, Warszawa, 1996,</p> <p>2. Zieliński T. P.: Cyfrowe przetwarzanie sygnałów, Wydawnictwa Komunikacji i Łączności (WKŁ), Warszawa 2009</p> <p>3. Izydorczyk J., Płonka G., Tyma G.: Teoria sygnałów, Helion, 2006</p> <p>4. Lyons R. G.: Wprowadzenie do cyfrowego przetwarzanie sygnałów, Wydawnictwa Komunikacji i Łączności (WKŁ), Warszawa 2000</p> <p>5. Izydorczyk J., Konopacki J.: Filtry analogowe i cyfrowe, Wydawnictwo Pracowni Komputerowej Jacka Skalmierskiego, 2003</p> <p>6. Piegat A.: Modelowanie i Sterowanie Rozmyte, Wyd. EXIT, Warszawa 1999.</p>
	Supplementary literature	<p>1. Gutenbaum J.: Modele Matematyczne Systemów, Wyd. Omnitech, Warszawa, 1992,</p> <p>2. Hall A. D.: Podstawy Techniki Systemów, PWN Warszawa, 1968,</p>
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	