GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Methods of dynamic processes monitoring , PG_00064795		
Field of study	Mechatronics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Specialty subject group 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	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Mechatronics -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Krzysztof Kaliński	
	Teachers	prof. dr hab. inż. Krzysztof Kaliński dr inż. Natalia Stawicka-Morawska	

Lesson types	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	
	Deepening selected elements of discrete mathematics, optimization, numerical and measurement methods; theoretically based general knowledge of mechatronic design; detailed theoretical knowledge about methods of supervising dynamic processes; knowledge of development trends and achievements in modern mechatronics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W01] explains and describes, based on general knowledge in the field of scientific disciplines forming the theoretical foundations of Mechatronics, the construction and principles of operation of mechatronic systems, processes and their components, as well as methods and means of their integration	The student illustrates the use of general knowledge in the field of mechanics, electronics, control theory and computer science to solve selected problems of supervising dynamic processes in stationary and non-stationary systems with continuous and discrete operation.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K7_U01] utilizes acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of stationary and non-stationary mechatronic systems/processes with continuous and discrete operation	The student plans to use selected elements of discrete mathematics, optimization, numerical and measurement methods to supervise selected dynamic processes in stationary and non-stationary systems with continuous and discrete operation.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[K7_W04] demonstrates knowledge encompassing selected issues in the field of detailed knowledge, particularly in the scope of methods, techniques, tools, and algorithms specific to Mechatronics	The student recognizes detailed knowledge about modern scientific achievements technical, in terms of their use in supervising dynamic processes	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	The student tests in mechatronic design tasks the use of methods for supervising dynamic processes in wheeled mobile robots, robot manipulators, dynamic weighing systems for railway sets and during high-speed milling.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task

Subject contents

Course content – lecture

1. Supervision - Basic Knowledge.
2. Modeling Controlled Mechatronic Systems Using the Mixed Finite Element Method. Stationary Systems. Linear Non-Stationary Systems. Non-Linear Systems.
3. Optimal Control with an Energy Quality Index. Control in a Linear Non-Stationary System with Continuous and Discrete Action. Control in a Non-Linear System.
4. Selected Numerical Methods.
5. Supervising the Motion of a Two-Wheeled Mobile Platform Using Optimal Control with an Energy Quality Index.
6. Supervising the Motion of a Missile Along a Predetermined Trajectory.
7. Supervising Large-Scale Machining Processes Using Optimal Control in a Semi-Active System.
8. Supervising the Dynamic Balancing of Rotating Systems.

Course content – laboratory

During the course, students carry out practical classes on methods for creating and solving computationalmodels of discrete mechatronic systems, optimal control at energy performance index in stationary and nonstationarylinear systems, and in non-linear systems. Modeling and optimal control methods are verified in application for supervising the discrete multibody systems. Requires virtual prototyping technique. Appropriate software (e.g. Matlab, Visual C etc.) is recommended by the teacher.

Prerequisites and co-requisites	Knowledge of the subject Control theory (1st degree).Knowledge and skills in Computer Science (1st degree).Knowledge and skills in the subject: Modeling of mechatronic systems (1st degree)Knowledge and skills in the subject of Mechatronic Design (1st degree).Knowledge and skills in the subject: Manipulators and industrial robots (1st degree).

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory reports	100.0%	40.0%
Final colloquium	50.0%	60.0%

Recommended reading

Basic literature

1. Kaliński K. J.: Supervision of Dynamic Processes in Mechanical Systems. 2nd revised edition. Gdańsk: Gdańsk University of Technology Publishing House 2026. Free e-book.
2. Kalinski K.: Supervision of Vibrations in Discretely Modeled Mechanical Systems. Monograph Series No. 22. Gdańsk: Gdańsk University of Technology Publishing House 2001.
3. Baron B.: Numerical Methods in Turbo Pascal. Gliwice: HELION Publishing House 1995.
4. Curtis H. D.: Orbital Mechanics for Engineering Students. Elsevier Butterworth-Heinemann 2005 (First published - version available online), 2021 (Revised fourth edition).
5. Malec M. F.: Dynamic Balancing of Rigid and Bending-Like Rotors in Theory and Practice. Influence Factor and Modal Methods. 2nd revised edition. Bydgoszcz: MM Publications 2026.

Supplementary literature

1. Mechatronic design. Selected issues. (Edited by T. Uhl). Krakow: The Chair of Robotics and Mechatronics AGH 2006,2007, 2008, 2009, 2010, 2011, 2012, 2017, 2018 and later.
2. Selected issues of modal analysis of mechanical structures. (Edited by T. Uhl). Krakow: The Chair of Robotics andMechatronics AGH 2005, 2006, 2008, 2010 and later.
3. Lisowski W .: Selected problems of automation of experimental modal analysis. AGH University of Science andEducation. Krakow 2006. Dissertations Monographs 158.
4. Giergiel M. J., Hendzel Z., Żylski W .: Modeling and control of mobile wheeled robots. Warsaw: Polish ScientificPublishers PWN 2002.
5. Magazine articles recommended on an ongoing basis

eResources addresses

Example issues/ example questions/ tasks being completed	1. Modeling systems with time-varying configurations. Sliding and turning kinematic pairs. 2. Optimal control at energy performance index in a non-stationary linear discrete-time system. Mathematical description in state coordinates. 3. Supervising the motion of a two-wheeled mobile platform. Platform dynamics. 4. A rocket as a particle. Dynamics of a controlled system. 5. Optimal control at a modified energy performance index.
Practical activites within the subject	Not applicable

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