GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechatronic design techniques, PG_00057020		
Field of study	Mechatronics		
Date of commencement of studies	February 2022	Academic year of realisation of subject	2021/2022
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 none
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	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	0.0	30.0	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	10.0	45.0	100

Subject objectives	Deepening some elements of discrete mathematics, optimization and numerical methods; theoretically founded general knowledge of mechatronic systems; theoretically founded detailed knowledge of mechatronic design; knowledge about development trends and achievements in the field of mechatronics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U03] makes use of English language at the level allowing comprehensive reading of scientific reports concerning mechatronic systems and mechatronic design	The student recognizes the examples of the application of mechatronic design techniques published in the English literature and uses these examples in their own solutions.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
[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	The student organizes the theoretically founded general knowledge in the field of selected areas of mechatronic design	[SW3] Assessment of knowledge contained in written work and projects
[K7_U08] is able identifiy and forumlate 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	The student identifies modern technologies and tests selected mechatronic design techniques.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
[K7_W08] has a knowledge essential for understanding social, economic, law and non-technical aspects of enginnering and include it in engineering practice	The student recognizes dedicated mechatronic design techniques and uses them in their own engineering solutions, while taking into account non-technical aspects.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[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	The student recognizes the mechatronic design tasks aimed at various innovative solutions.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools

Subject contents

LECTURE. Basic definitions and terms of mechatronic design in non-stationary systems. Tasks of mechatronic design. Selected techniques of mechatronic design. Virtual prototyping. Real-time simulation. Rapid prototyping on the target object. An example of mechatronic design of a 3-wheel mobile platform. Mechatronic design tasks aimed at supervising dynamic processes. Supervision of vibrations during milling susceptible objects with kinematic excitation.
Optimization of the tool rotation speed when milling large-size items. The technique of virtual prototyping supported by an experiment. Modal procedure. Operating procedure.
Optimizing the clamping fixture of a flexible workpiece during milling. Supervision procedure. Minimization of cutting forces in the direction of the layer width.
Mechatronic design tasks focused on diagnostics of industrial installations. Analysis static, taking into account the influence of the temperature of medium-pressure steam pipelines.
Mechatronic design tasks aimed at testing the fatigue strength of means of transport. Bench tests of car bodies with kinematic input.
Mechatronic design tasks focused on innovative solutions in enterprises. The process of stand-alone acoustic tests and flows in ventilation systems.

DESIGN. During the course, students carry out 2 mechatronic projects in created interdisciplinary teams, with the simultaneous division of competences into individual team members. Both projects concern non-stationary systems. The first project is to transform a functional electromechanical system into a mechatronic system, by replacing conventional actuators with microprocessor systems. The second project concerns an original mechatronic system based on a defined operating principle. It is dominated by automation and control elements. Virtual prototyping technique is required. Appropriate software (eg AMESim, Matlab, Visual C, etc.) is recommended by the teacher.

Prerequisites and co-requisites

Knowledge of the Theory of Controls course (1st degree).
Knowledge and skills from the subject of Computer Science (1st degree).
Knowledge and skills from the subject Modeling of mechatronic systems (1st degree)
Knowledge and skills from the subject of Mechatronic design (1st degree).

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	50.0%	70.0%
2 team projects	100.0%	30.0%

Recommended reading

Basic literature

1. Petko M .: Selected methods of mechatronic design. Radom: Scientific Publisher of the Institute of Sustainable Technologies - PIB 2008.
2. Heimann B., Gerth W., Popp K .: Mechatronics. Components - methods - examples. Warsaw: Polish Scientific Publishers PWN 2001.
3. Gawrysiak M .: Mechatronics and mechatronic design. Białystok: Wyd. Polit. Białostocka 1997 (available on the Internet).
4. Kaliński K .: Supervising dynamic processes in mechanical systems. Gdańsk: Gdańsk University of Technology Publishing House 2012.
5. Galewski M., Kaliński K .: Vibration supervision in high speed milling with slender tools with variable rotational speed. Gdańsk: Gdańsk University of Technology Publishing House 2009.

	Supplementary literature	1. Mechatronic design. Selected issues. (Edited by T. Uhl, M. Mańka). Krakow: Kated. Robotics and Mechatronics AGH 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2017, 2018. 2. Design and dynamics of mechatronic devices. Ed. M. Mańka and K. Mendrok. Krakow: Department of Robotics and Mechatronics AGH 2019. 3. Mechatronics. Analysis, design and testing of selected components and systems. Series Advances in electric drive and power electronics. (Edited by K. Kluszczyński). Warsaw: PAK Publishing House 2013. 4. Skoczyński W .: Sensors in CNC machine tools. Warsaw: Polish Scientific Publishers PWN SA 2018. 5. Powałka B .: Micromilling. Selected issues of modeling and experimental research. Radom: Scientific Publisher of the Institute of Sustainable Technologies - PIB 2019 (new position). 6. Articles from scientific and technical journals (recommended on a regular basis)
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Implementation of algorithms. Industrial computers. 2. Vibration monitoring during the milling of flexible objects with the use of a kinematic vibration exciter. HILS. 3. Optimization of the spindle speed when milling large-size workpieces. Operating procedure. 4. Static analysis of pipelines taking into account the influence of temperature. Stages of a mechatronic project. 5. Test of fatigue strength of means of transport. Identification of the kinematic input - virtual prototyping. 6. Bench acoustic and noise tests in ventilation systems. The essence of an innovative solution.	
Work placement	Not applicable	