GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechatronics design techniques, PG_00064781		
Field of study	Mechatronics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
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	4.0
Learning profile	general academic profile	Assessment form	exam
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	dr inż. Natalia Stawicka-Morawska prof. dr hab. inż. Krzysztof Kaliński	

Lesson types	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	12.0	43.0	100

Subject objectives	Mastering theoretically based, detailed knowledge and practical skills in use in mechatronic design techniques. Recognition and assessment of development trends and achievements in the field of mechatronic design techniques.

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 uses the reinforced theoretically general knowledge in selected areas of mechatronic design, for solving detailed design tasks.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U04] creatively designs or modifies, either entirely or at least in part, a mechatronic system or process according to a given specification, considering both technical and non-technical aspects, estimating costs and utilizing design techniques appropriate for tasks within the scope of mechatronics	The student maps the functionality of a given mechatronic system (structure + working process) by using the virtual prototyping technique and the experiment-aided virtual prototyping technique.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K7_W11] interprets social, economic, legal (including industrial and intellectual property laws), and other non-technical aspects of engineering activities, and includes them into engineering practice	The student recognizes dedicated mechatronic design techniques and uses them in own engineering solutions, at the same time taking into account non-technical aspects.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_U03] identifies and formulates task specifications in the scope of stationary and non-stationary mechatronic systems/processes design, including non-standard problems ans taking into consideration their 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

Subject contents

Course content – 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.

Course content – project

During the course, students carry out 2 mechatronics projects, individually or in teams, with competences divided among individual team members. The first project involves mapping the functionality of a given mechatronic system (structure + working process) by using the virtual prototyping technique. The second project concerns mapping the functionality of a given mechatronic system (structure + workingprocess) by using the technique of experiment-aided virtual prototyping. Appropriate software (e.g. Matlab, dedicated modeling and simulation programs) and the required results of material experiments are providedby the teacher.

Prerequisites and co-requisites

Knowledge of the subject Control theory (1st degree).
Knowledge and skills in the subject of 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).

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. J.: Supervising dynamic processes in mechanical systems (2-nd Edition verified). Gdańsk: Gdańsk University of Technology Publishing House 2026. 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 andpower 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. 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.	
Practical activites within the subject	Not applicable	

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