GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Methods of identification in mechatronics, PG_00057028						
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		
Semester of study	1		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Michał Mazur				
	Teachers		dr inż. Michał Mazur				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	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	Overview of stages and selected methods of identification, model correlation, modal updating.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U06] is able to evaluate feasibility and possibility of application of new achievements (technical and technological) in terms of mechatronics	Assess the suitability and ability to use modern methods of identification for mechatronics.	[SU4] Assessment of ability to use methods and tools
[K7_U09] is able to evaluate feasibility of advanced methods and tools (including programmistic and for computer aided design and manuacturing) for solving complex, practical engineering task, characteristic for mechatronics, and to choose and apply proper method and tools	Assess the suitability and ability to use modern methods of identification for mechatronics.	[SU4] Assessment of ability to use methods and tools
[K7_W01] has extended knowledge in terms of selected areas of mathematics, including discrete and applied mathematics, optimisation methods, mathematical and numerical methods essential for: 1) modelling and analysis of nonstationary mechatronics, continuous and discrete time systems as well as physical phenomena; 2) description and analysis of mechatronic systems that include programmable devices 3) description and analysis of signal processing algorithms 4) synthesis of non-stationary mechatronic systems	Has expanded and deepened knowledge of certain branches of mathematics, including elements of discrete mathematics and applied and optimization methods, including mathematical and numerical methods necessary for identification	[SW3] Assessment of knowledge contained in written work and projects
[K7_W05] has detailed, supported by the theory knowledge in terms of control theory, identification methods, concurrent and real time programing, signal and image processing and Artificial Intelligence	Has a theoretical detailed knowledge of the methods of identification and signal processing.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

LECTURES. Basic definitions and terms of modal analysis. Signal processing. Modal testing. Indirect methods of identification in the time domain. Direct methods of identification in the time domain. Methods of identification of one-degree-of-freedom systems in the frequency domain. Indirect methods of identification in the frequency domain. Direct methods of identification in the frequency domain. Coupling techniques in identification of mechatronic systems. Structural models modification. Operational modal analysis. Deep learning and optimization. FEM model validation. Hybrid models.

PROJECT The students implement a mechatronic project in their own interdisciplinary teams, with the division of competences into individual team members. The main goal of the project is to identify the modal parameters (poles and scaled shapes of vibrations) of the real object. An additional goal is to create an FEM model of the real object. Then, the correlation of the FEM model and the model obtained through the experiment is assessed. Additional tasks are the synthesis of responses in the time and frequency domain.

Prerequisites and co-requisites

Knowledge on Control Theory (I-st level).
Knowledge on Theory and technique of systems (II-nd level).
Knowledge and experience in Informatics (I-st level).
Knowledge and experience in Modelling of mechatronic systems (I-st level). Knowledge and experience in Mechatronic design (I-st and II-nd level).

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	50.0%	60.0%
Project	50.0%	40.0%

Recommended reading

Basic literature	1. Uhl T.: Komputerowo wspomagana identyfikacja modeli konstrukcji mechanicznych. Warszawa: WNT 1997. 2. Maia N. M. M., Silva J. M. M.: Theoretical and Experimental Modal Analysis. Taunton, Somerset (England): Research Studies Press 1997. 3. Heylen W., Lammens S., Sas P.: Modal Analysis Theory and Testing. Leuven: KU Leuven 2007.
Supplementary literature	1. Wybrane zagadnienia analizy modalnej konstrukcji mechanicznych. (Red. T. Uhl). Kraków: Kated. Robotyki i Mechatroniki AGH 2005, 2006, 2008. 2. Lisowski W.: Wybrane problemy automatyzacji eksperymentalnej analizy modalnej. Kraków: AGH Uczelniane Wydawnictwa NaukowoDydaktyczne 2006. Rozprawy Monografie 158.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. The ERA method 2. pLSCFd method 3. Residues 4. LSFD method 5. Time windows 6. H1 and H2 estimator 7. Spectrum leak 8. OMA 9. FBS 10. CMS 11. MAC 12. CMIF 13. Assumptions of Modal Analysis 14. Dynamic stiffness, effective mass 15. Modes scaling 16. Frequency aliasing 17. Correctness of measurements 18. Correctness of identification 19. Stages of identification 20. SVD decomposition 21. Poles Determination from the characteristic polynomial equation 22. Multiple poles 23. Inverse problem - load identification 24. TPA 25. FRF synthesis 26. Complex shapes 27. Peak-Picking - damping determination 28. Self-excited vibrations 26. Zespolone kształty postaci drgań własnych 27. Peak-Picking - wyznaczanie tłumienia 28. Drgania samowzbudne
Work placement	Not applicable