



Subject card

Subject name and code	Identification methods in mechatronics, PG_00064796						
Field of study	Mechatronics						
Date of commencement of studies	February 2025	Academic year of realisation of subject			2025/2026		
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	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						
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_U13] evaluates the feasibility and potential for utilizing new technical and technological achievements in accomplishing tasks characteristic for the field of study	Assesses the usefulness and possibility of using identification methods.			[SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		
	[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Mechatronics, enabling modeling and analysis of stationary and non-stationary mechatronic systems, devices, and processes with continuous and discrete operation	Has expanded and deepened knowledge of certain branches of mechatronics including elements of discrete mathematics and applied and optimization methods, including mathematical and numerical methods necessary for identification			[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation		
	[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	Has a theoretical detailed knowledge of the methods of identification and signal processing.			[SW3] Assessment of knowledge contained in written work and projects		
	[K7_U02] formulates and tests hypotheses concerning problems of stationary and non-stationary mechatronic systems/processes, as well as simple research problems	Is able to verify the stationarity of the identified system.			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<p>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.</p>											
Prerequisites and co-requisites	<p>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).</p>											
Assessment methods and criteria	<table border="1" data-bbox="448 837 1497 943"> <thead> <tr> <th data-bbox="448 837 794 875">Subject passing criteria</th> <th data-bbox="794 837 1141 875">Passing threshold</th> <th data-bbox="1141 837 1497 875">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 875 794 904">Projekt</td> <td data-bbox="794 875 1141 904">50.0%</td> <td data-bbox="1141 875 1497 904">40.0%</td> </tr> <tr> <td data-bbox="448 904 794 943">Colloquium</td> <td data-bbox="794 904 1141 943">50.0%</td> <td data-bbox="1141 904 1497 943">60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Projekt	50.0%	40.0%	Colloquium	50.0%	60.0%
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Projekt	50.0%	40.0%										
Colloquium	50.0%	60.0%										
Recommended reading	Basic literature	<p>1. Uhl T.: Komputerowo wspomaganą identyfikacja modeli konstrukcyjnych 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.</p>										
	Supplementary literature	<p>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 Naukowo-Dydaktyczne 2006. Rozprawy Monografie 158.</p>										
	eResources addresses	Adresy na platformie eNauca:										
Example issues/ example questions/ tasks being completed	<p>1. The ERA method 2. pLSCF method 3. Residues 4. LSCF 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</p>											
Work placement	Not applicable											

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