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## Subject card

Subject name and code	Mathematical and numerical modelling, PG_00057370							
Field of study	Mechanical Engineering							
Date of commencement of studies	February 2023		Academic year of realisation of subject			2022/2023		
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			assessment		
Conducting unit	Institute of Mechanics	of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technolog				chnology		
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Krzysztof Kaliński					
	Teachers		dr hab. inż. Szymon Grymek					
			prof. dr hab. inż. Krzysztof Kaliński					
Lesson types and methods	Lesson type	Lecture	Tutorial	Laboratory	Projec	t	Seminar	SUM
of instruction	Number of study hours	30.0	0.0	0.0	15.0		0.0	45
	E-learning hours included: 0.0							
Learning activity and number of study hours	Learning activity	Participation in classes includ plan	ed in study Participation in consultation hours		in nours	Self-study		SUM
	Number of study hours	45		8.0				100
Subject objectives	Mastering the knowledge and skills related to creating and solving computational models of selected mechanical systems.						lected	
Learning outcomes	Course outcome		Subject outcome			Method of verification		
	[K7_W02] possesses a wide and profound knowledge on continuum mechanics and materials strength within the range of modelling and simulating multi-function mechanical systems		The student develops elements of mechanics of deformable bodies for modeling and simulation of componentsand the entirety of mechanical systems, as well as technological processes.			[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects		
	[K7_W01] possesses a profound mathematical knowledge useful in the analysis and description of the operation of complex mechanical systems, technological processes and operating properties of machines and devices; is familiar with the main development trends		The student develops a mathematical and numerical description of the phenomena related to the functioning of components and the entirety of mechanical systems, as well as technological processes.			[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects		
	[K7_U08] is able to design a procedural equipment or device compliant with the specifications using a design aid system in the form of a design documentation, selecting the appropriate model, performing critical analysis with the proper selection of tools and technologies		The student recognizes the methods of modeling and simulating the structure of mechanical systems and the implemented technological processes			[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools		

Subject contents	LECTURE. Basics of modeling mechatronic systems: Models of elements of mechatronic systems; Modeling of vibrating systems: Free and forced vibrations of systems with 1 degree of freedom. Modeling of multi- mass systems. Vibrations of systems with a finite number of degrees of freedom; Discrete modeling of stationary and non-stationary systems: Fundamentals of the finite element method. Linear stationary systems. Variable configuration systems. Nonlinear systems. Description in state coordinates; Selected numerical methods: Integration of matrix dynamics equations in the time domain and in the frequency domain. Static optimization; Selected issues of modeling dynamics. Modeling of self-excited vibrations of the chatter type. Application examples.						
Prerequisites and co-requisites	Mathematics, Applied mechanics, Strength of materials, Information technology, at the level of bachelor's course						
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade				
and criteria	Project exercises	50.0%	33.33%				
	Lecture - 2 written colloquia	50.0%	66.67%				
Recommended reading	Basic literature Supplementary literature	<ol> <li>Cannon R. H.: Dynamics of Physical Systems. Warsaw: WNT 1973.</li> <li>Kaliński K. J.: Supervising dynamic processes in mechanical systems. Gdańsk: Gdańsk University of Technology Publishing House 2012.</li> <li>Kruszewski J., Wittbrodt E.: Vibrations of mechanical systems in a computer approach. Volume I. Linear problems. Warsaw: WNT 1995.</li> <li>Morel J.: Machine vibrations and diagnostics of their technical condition. Publisher: Polish Society of Technical Diagnostics 1994.</li> <li>Kaliński K.: Vibration supervision of discretely modeled mechanical systems. Series of Monographs No. 22. Gdańsk: Wydaw. Polit. Gdańska 2001.</li> <li>Marchelek K.: Dynamics of machine tools. Ed. 2. Warsaw: WNT 1991.</li> <li>Jemielniak K.: Machining. Warsaw: Publishing House of the Warsaw University of Technology 1998.</li> <li>Gawrysiak M.: Mechatronics and mechatronic design. Białystok: Wyd. Polit. Białostocka 1997. (available on the Internet)</li> <li>Borkowski W., Konopka S., Prochowski L.: Dynamics of working machines. Warsaw: WNT 1996. ISBN 83-204-2051-2.</li> <li>Wrotny L.T.: Kinematics and dynamics of technological machines and industrial robots. Warsaw: PW Publishing House 1998.</li> <li>Grzegożek W., Adamiec-Wójcik I., Wojciech S.: Computer modeling of the dynamics of motor vehicles. Krakow: Cracow University of Technology T. Kościuszko 2003.</li> <li>Heimann B., Gerth W., Popp K.: Mechatronics. Components of the method examples. Warsaw: Wyd. Science. PWN 2001.</li> <li>Mechatronics. Analysis, design and testing of selected elements and systems. (Edited by K. Kluszczyński). Warsaw: PAK Publishing House 2013.</li> </ol>					
	eResources addresses	Adresy na platformie eNauczanie: Modelowanie matematyczne i numeryczne, P, MiBM II, sem. 01, letni 22/23 (PG_00057370) - Moodle ID: 29363 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29363 Modelowanie matematyczne i numeryczne, P, MiBM II, sem. 01, letni 22/23 (PG_00057370) - Moodle ID: 29363 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29363					
Example issues/ example questions/ tasks being completed	<ol> <li>Mathematical description of the elements of mechatronic systems that store potential energy</li> <li>Free vibrations of a system with two degrees of freedom. Coordinate coupling</li> <li>Modeling of stationary systems. The principle of virtual work</li> <li>Dynamics of the main drive of the machine tool. Bending, torsional and bending-torsional vibrations.</li> <li>Self-excited chatter vibrations. Face milling example</li> </ol>						
Work placement	Not applicable						