



Subject card

Subject name and code	Mathematical and numerical modelling, PG_00057379						
Field of study	Mechanical Engineering, Space and Satellite Technologies						
Date of commencement of studies	February 2024		Academic year of realisation of subject		2023/2024		
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		English		
Semester of study	1		ECTS credits		4.0		
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		prof. dr hab. inż. Krzysztof Kaliński				
	Teachers		prof. dr hab. inż. Krzysztof Kaliński mgr inż. Grzegorz Banaszek				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	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 didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	45		8.0		47.0	100
Subject objectives	Mastering the knowledge and skills related to creating and solving computational models selected mechanical systems.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[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 the components and the entire 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		
	[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 the elements of mechanics of deformable bodies for modeling and simulation components and all mechanical systems, as well as technological processes.		[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects		

Subject contents	<p>LECTURE. Modelling of controlled mechanical systems by the mixed method of rigid and flexible finite elements: The finite element volume problems. Dynamics of multibody systems. Modelling of stationary closed loop systems. Modelling of systems whose configuration changes with time. Modelling of nonlinear controlled systems. Optimal control at energy performance index: Control of continuous nonstationary systems in domain of generalised and state coordinates. Control of discrete nonstationary systems. Control of nonlinear discrete systems. Motion control of 2-wheeled autonomous mobile platform. Vibration surveillance on a basis of the acceleration closed loop control. Modal analysis: Modal control as a method of vibration suppression. A frequency domain surveillance of the robots structural vibration with the use of modal control at energy performance index. Optimal control in domain of hybrid coordinates. Modal energy participation. Mechatronic solutions for a surveillance of high speed milling processes: Vibration suppression during HSM with the use of variable spindle speed. Building the map of optimal spindle speeds during HSM of flexible details. Vibration suppression during milling flexible details with the use of the active optimal control. A concept of mechatronic design for a surveillance of dynamic systems: Tool-workpiece vibration surveillance in production processes supported by the mechatronic design. Mechatronic design of three wheeled mobile platform controlled by surveillance system at energy performance index. Virtual prototyping technique for predicting fatigue endurance of the vehicles.</p> <p>PROJECT. Numerical implementation of two tasks related to the topics presented in the lecture</p>											
Prerequisites and co-requisites	Mathematics, Applied mechanics, Strength of materials, Information technology, Fundamentals of automation, at the level of bachelor's course											
Assessment methods and criteria	<table><tr><td>Subject passing criteria</td><td>Passing threshold</td><td>Percentage of the final grade</td></tr><tr><td>Project</td><td>50.0%</td><td>33.33%</td></tr><tr><td>Lecture</td><td>50.0%</td><td>66.67%</td></tr></table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Project	50.0%	33.33%	Lecture	50.0%	66.67%
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Recommended reading	<table><tr><td>Basic literature</td><td colspan="2">Relevant core bibliographies will be provided immediately upon completion of the current lecture or series.</td></tr><tr><td>Supplementary literature</td><td colspan="2">Relevant follow-up references will be provided immediately upon completion of the current lecture or series.</td></tr><tr><td>eResources addresses</td><td colspan="2">Adresy na platformie eNauczanie: Mathematical and numerical modelling, P, IDE+EMSS, sem. 01, letni 23/24, stacjonarne, II stopień, (PG_00057379) - Moodle ID: 38390 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=38390</td></tr></table>			Basic literature	Relevant core bibliographies will be provided immediately upon completion of the current lecture or series.		Supplementary literature	Relevant follow-up references will be provided immediately upon completion of the current lecture or series.		eResources addresses	Adresy na platformie eNauczanie: Mathematical and numerical modelling, P, IDE+EMSS, sem. 01, letni 23/24, stacjonarne, II stopień, (PG_00057379) - Moodle ID: 38390 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=38390	
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Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none">1. Modelling of stationary closed loop systems.2. Control of discrete nonstationary systems.3. Modal energy participation.4. Building the map of optimal spindle speeds during HSM of flexible details.5. Virtual prototyping technique for predicting fatigue endurance of the vehicles.											
Work placement	Not applicable											