GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical and numerical modelling, PG_00057379		
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	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	mgr inż. Grzegorz Banaszek prof. dr hab. inż. Krzysztof Kaliński	

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_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.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[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	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[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.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>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.

PROJECT. Numerical implementation of two tasks related to the topics presented in the lecture</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Mathematics, Applied mechanics, Strength of materials, Information technology, Fundamentals of automation, at the level of bachelor's course</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lecture</td><td>50.0%</td><td>66.67%</td></tr>
<tr><td>Project</td><td>50.0%</td><td>33.33%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Relevant core bibliographies will be provided immediately upon completion of the current lecture or series.</td></tr>
<tr><td>Supplementary literature</td><td>Relevant follow-up references will be provided immediately upon completion of the current lecture or series.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Mathematical and numerical modelling, P, IDE-sem.01, AT-sem. 03, CS-sem. 03, summer 22/23, (PG_00057379) - Moodle ID: 30077 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30077
Mathematical and numerical modelling, P, IDE-sem.01, AT-sem. 03, CS-sem. 03, summer 22/23, (PG_00057379) - Moodle ID: 30077 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30077</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>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.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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