GDAŃSK UNIVERSITY OF TECHNOLOGY

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 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	dr hab. inż. Szymon Grymek 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 of 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 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 of machine tools and machining processes: Dynamics of the carrying system. Main driving dynamics. Modeling of self-excited vibrations of the chatter type. Application examples. PROJECT. Numerical implementation of two tasks related to the topics presented in the lecture.
Prerequisites and co-requisites	Mathematics, Applied mechanics, Strength of materials, Information technology, at the level of bachelor's course

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Project exercises	50.0%	33.33%
Lecture - 2 written colloquia	50.0%	66.67%

Recommended reading

Basic literature

1. Cannon R. H .: Dynamics of Physical Systems. Warsaw: WNT 1973.
2. Kaliński K. J .: Supervising dynamic processes in mechanical systems. Gdańsk: Gdańsk University of Technology Publishing House 2012.
3. Kruszewski J., Wittbrodt E .: Vibrations of mechanical systems in a computer approach. Volume I. Linear problems. Warsaw: WNT 1995.
4. Morel J .: Machine vibrations and diagnostics of their technical condition. Publisher: Polish Society of Technical Diagnostics 1994.
5. Kaliński K.: Vibration supervision of discretely modeled mechanical systems. Series of Monographs No. 22. Gdańsk: Wydaw. Polit. Gdańska 2001.
6. Marchelek K .: Dynamics of machine tools. Ed. 2. Warsaw: WNT 1991.
7. Jemielniak K.: Machining. Warsaw: Publishing House of the Warsaw University of Technology 1998.

Supplementary literature

1. Gawrysiak M .: Mechatronics and mechatronic design. Białystok: Wyd. Polit. Białostocka 1997. (available on the Internet)
2. Borkowski W., Konopka S., Prochowski L .: Dynamics of working machines. Warsaw: WNT 1996. ISBN 83-204-2051-2.
3. Wrotny L.T .: Kinematics and dynamics of technological machines and industrial robots. Warsaw: PW Publishing House 1998.
4. Grzegożek W., Adamiec-Wójcik I., Wojciech S .: Computer modeling of the dynamics of motor vehicles. Krakow: Cracow University of Technology T. Kościuszko 2003.
5. Heimann B., Gerth W., Popp K .: Mechatronics. Components of the method examples. Warsaw: Wyd. Science. PWN 2001.
6. Mechatronics. Analysis, design and testing of selected elements and systems. (Edited by K. Kluszczyński). Warsaw: PAK Publishing House 2013.

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

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Example issues/ example questions/ tasks being completed	1. Mathematical description of the elements of mechatronic systems that store potential energy 2. Free vibrations of a system with two degrees of freedom. Coordinate coupling 3. Modeling of stationary systems. The principle of virtual work 4. Dynamics of the main drive of the machine tool. Bending, torsional and bending-torsional vibrations. 5. Self-excited chatter vibrations. Face milling example
Work placement	Not applicable