GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Computational methods in machine dynamics, PG_00064788		
Field of study	Mechatronics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Applied Mechanics and Biomechanics -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Krzysztof Lipiński	
	Teachers	dr hab. inż. Krzysztof Lipiński	

Lesson types	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
Student becomes familiar with the literature on dynamics of machines and mechanisms, the most important branches of the Theory of machines and mechanisms, the most important aspects of vibrations of discrete systems with many degrees of freedom and damping, and with the most important aspects of vibrations in continuous systems, He becomes familiar with methods of discretization of continuous systems using the idea of rigid finite elements. Student uses matrix description of geometry of mechanisms, known methods of kinematic analysis of mechanisms based on Denavit-Hartenberg notation.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 theoretically based detailed knowledge in the field of analytical mechanics, theory of mechanisms, general issues of the operation of mechanisms and issues of machine dynamics, with particular emphasis on the operation of mechanisms within the devices designed in accordance with the principles of mechatronics.	[SW1] Assessment of factual knowledge
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	Student is able to assess the usefulness of advanced methods and tools (including programming methods and computer-aided design and manufacturing) for solving a complex practical engineering task, typical of mechatronics, and to select and apply the appropriate method and tools	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
[K7_U02] formulates and tests hypotheses concerning problems od stationary and non-stationary mechatronic systems/processes, as well as simple research problems	Student is able to formulate and test selected hypotheses related to the problems of the operation of mechanisms and issues of machine dynamics, with particular emphasis on the operation of mechanisms within the device. designed in accordance with the principles of mechatronics. At this stage, the student learns the methodology and has the opportunity to practice solving simple research problems	[SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment

Subject contents

Course content – lecture

Lectures: To familiarize students with the main problems of unbalance of mechanisms and of their dynamic reactions, the coefficient of irregularity of work, the selection of a flywheel and counterweights. To familiarize students with problems of vibrations of discrete systems with many degrees of freedom including damping, with vibrations of continuous systems and the method of discretization of continuous systems using the idea of rigid finite elements. To familiarize student with methods of vector and matrix description of kinematics of mechanisms, including the coordinates of constituting elements, coordinate systems, as well as the matrix notation. The analytical methods in kinematics of planar mechanisms, as well as the Denavit-Hartenberg notation for spatial mechanisms and manipulators are presented. The student become familiar with the methods of numerical determination of velocities and accelerations of selected points of planar and spatial mechanisms. Presentation of numerical methods for solving simple and inverse. The student become familiar with the numerical methods used in the dynamics of manipulators, especially the direct and inverse problems of dynamics. Discussion of the energy balance of the machine to familiarize students with the calculation of mechanical efficiency of machines and self-locking conditions. Problems of system balancing are discussed for mechanisms composed of rigid bodies.

Computer projects: Matlab-based students propositions of computer programs used to solve and presents problems of vibrations of single degree of freedom systems; solve and presents problems of vibrations of multi degree of freedom systems; solve and presents problems of vibrations of continuous systems after their discretizations, solve and presents problems of kinematics (position and velocity) of selected manipulators with use od the Denavit-Hartenberg notation.

Prerequisites and co-requisites

Mechanism theory and dynamics of machines I, including aspects of structural analysis, kinematics and dynamics of planar mechanisms, vibrations of systems with one degree of freedom and with many degrees of freedom without damping.

Mechanics including statics, kinematics, dynamics of mechanical systems.

Mathematics including algebra, matrix calculus, differential and integral calculus, linear differential equations.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
colloquia with solving practical problems	56.0%	50.0%
final test of the theory	56.0%	50.0%

Recommended reading	Basic literature	1. Morecki A., Knapczyk J., Kędzior K.: Teoria mechanizmów i manipulatorów WNT 2002 2. Olędzki A.: Podstawy teorii maszyn i mechanizmów. WNT 1978 3. Morecki A., Knapczyk J., Kędzior K.: Teoria mechanizmów i manipulatorów. Podstawy i przykłady zastosowań w praktyce. WNT, Warszawa 2001 4. Wawrzecki J.: Teoria maszyn i mechanizmów. Wyd Polit. Łódzkiej, Łódź 1994
	Supplementary literature	1. Miller S.; Teoria maszyn i mechanizmów analiza układów kinematycznych; Oficyna Wydawnicza Politechniki Wrocławskiej; Wrocław 1996 2. Młynarski T., Listwan A., Pazderski E.; Zbiór zadań z teorii mechanizmów i maszyn do analizy kinematycznej mechanizmów; skrypt Politechniki Krakowskiej; Kraków 1992
	eResources addresses	
Example issues/ example questions/ tasks being completed	The concept of a barycentric vector and its role in the analysis of dynamic reactions of mechanisms Fourier's method for solving of partial-differential equations of the second and fourth order Structural classification of mechanisms: groups, classes, orders, forms. Homogeneous transformations: the idea and properties DenavitaHartenberga coordinates: orientation of axes	
Practical activites within the subject	Not applicable	

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