GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Finite element method, PG_00059390		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Part-time studies	Mode of delivery	blended-learning
Year of study	1	Language of instruction	Polish
Semester of study	2	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	dr inż. Leszek Dąbrowski	
	Teachers	dr inż. Leszek Dąbrowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	18.0	0.0	0.0	18.0	0.0	36

E-learning hours included: 18.0

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	36	10.0	54.0	100

Subject objectives

Presentation of the theoretical basis of the Finite Element Method. Understanding the basics of the method will enable students to consciously use the commercial software of the method, without treating it as a black box.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U05] is able to plan and conduct the experimental research determining the parameters of a device or system, assesses the usability and correctly selects methods and tools, is able to interpret the results and estimate the measurement errors and is able to apply computer systems to simulate the operation of a machine or technology	The student is able to plan and implement a numerical experiment with the use of FEM	[SU3] Assessment of ability to use knowledge gained from the subject [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 knows the basics of numerical modeling of structures in accordance with FEM procedures	[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 knows the basics of numerical methods used in FEM.	[SW1] Assessment of factual knowledge

Subject contents	Lecture: Fundamentals of FEM, methods of discretization, the concept of a finite element. Shape function, ways of creating shape functions. Approximation of deformation and stress fields in FEM. Derivation of the characteristic matrices of a finite element. Examples of the structure of matrices characteristic for one-, two- and three-dimensional elements. Derivation of the equations of motion of a discretized body FEM. Creating global matrices in FEM. Modeling of boundary conditions, mechanical properties of the construction material, loading method. Solving equations of motion in FEM. Accuracy of the method. Linear and nonlinear analysis of statics and dynamics. Commercial software.Project: Development of own FEM program to solve the problems of statics and dynamics of one-dimensional structures, with particular emphasis on the impact of the assumptions (type of theory, element type, boundary conditions model, material model, load model) on the accuracy of the obtained results.
Prerequisites and co-requisites	Linear algebra, differential and integral calculus, strength of materials,

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
test of theoretical knowledge	60.0%	50.0%
Project	100.0%	50.0%

Recommended reading

Basic literature	1. Jaworski A.(1981), Metoda elementów skończonych w wytrzymałości konstrukcji, Wyd. PW, Warszawa, 2. Rakowski G., Kacprzyk Z. (1993), Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wyd. Pol. Warszawskiej, Warszawa 3. Zienkiewicz O.C. (1972), Metoda elementów skończonych. Arkady, Warszawa 4. Król K.(2007), Metoda elementów skończonych w obliczeniach konstrukcji, PR, Radom,
Supplementary literature	1. Szmelter W., Dacko M., Dobrociński S. (1979), Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady, Warszawa, 2. Zagrajek T., Krzesiński G., Marek P. (2005), Metoda elementów skończonych w mechanice konstrukcji. Ćwiczenia z zastosowaniem systemu Ansys, Oficyna Wyd. Pol. Warszawskiej, Warszawa. 3. Liu G.R., QUEK S.S. (2003), The finite element method. A practical course. Butterworth- Heinmann
eResources addresses	Adresy na platformie eNauczanie: Metoda elementów skończonych - Moodle ID: 41815 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=41815

Example issues/ example questions/ tasks being completed	Define the concept of a finite element. The matrix of masses and stiffness of the beam acc. To elementary theory and the theory of Timoshenko. The influence of the finite element type on the accuracy of calculations.
Work placement	Not applicable

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