



Subject card

Subject name and code	Finite element method, PG_00057399						
Field of study	Mechanical Engineering						
Date of commencement of studies	February 2023	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group			Optional subject group 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	2	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Zakład Mechaniki Stosowanej i Biomechaniki -> 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. Marek Krawczuk				
	Teachers		prof. dr hab. inż. Marek Krawczuk				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	30.0	0.0	60
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	60		8.0		32.0	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		84 / 5 000 Wyniki tłumaczenia The student is able to plan and implement a numerical experiment with the use of FEM		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject		
	[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 MES.		[SW1] Assessment of factual knowledge		
	[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 construction in accordance with MES procedures		[SW3] Assessment of knowledge contained in written work and projects		

Subject contents	<p>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.</p>											
Prerequisites and co-requisites	The student has theoretical and practical skills in technical mechanics, strength of materials and the basics of programming.											
Assessment methods and criteria	<table border="1" data-bbox="448 593 1497 696"> <thead> <tr> <th data-bbox="448 593 798 629">Subject passing criteria</th> <th data-bbox="801 593 1139 629">Passing threshold</th> <th data-bbox="1142 593 1497 629">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 633 798 663">Project</td> <td data-bbox="801 633 1139 663">100.0%</td> <td data-bbox="1142 633 1497 663">50.0%</td> </tr> <tr> <td data-bbox="448 667 798 696">Test of theoretical knowledge</td> <td data-bbox="801 667 1139 696">60.0%</td> <td data-bbox="1142 667 1497 696">50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Project	100.0%	50.0%	Test of theoretical knowledge	60.0%	50.0%
Subject passing criteria	Passing threshold	Percentage of the final grade										
Project	100.0%	50.0%										
Test of theoretical knowledge	60.0%	50.0%										
Recommended reading	Basic literature	<ol style="list-style-type: none"> 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	<p>1. Szmelter W., Dacko M., Dobrociński S. (1979), Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady, Warszawa,</p> <p>2. Zagrajek T., Krześciński G., Marek P. (2005), Metoda elementów skończonych w mechanice konstrukcji. Ćwiczenia z zastosowaniem systemu Ansys, Oficyna Wyd. Pol. Warszawskiej, Warszawa.</p> <p>3. Liu G.R., QUEK S.S. (2003), The finite element method. A practical course. Butterworth- Heinmann</p> <p>4. Rusiński E., Czmochoowski J., Smolnicki T., (2000) Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wyd. Pol. Wrocławskiej., Wrocław</p> <p>5. Moaveni S. (1999), Finite element analysis. Theory and application with Ansys. Prentice Hall</p>
	eResources addresses	<p>Adresy na platformie eNauczenie: Metoda Elementów Skończonych - Projekt (PG_00057399), MwBM iP sem1, zima 23/24 - Moodle ID: 31605 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=31605 Metoda Elementów Skończonych - Projekt (PG_00057399), MwBM iP sem1, zima 23/24 - Moodle ID: 31605 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=31605</p>
Example issues/ example questions/ tasks being completed	Zdefiniować pojęcie elementu skończonego. Macierz mas i sztywności belki wg. teorii elementarnej oraz teorii Timoshenko. Wpływ typu elementu skończonego na dokładność obliczeń.	
Work placement	Not applicable	