GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical methods, PG_00044016		
Field of study	Civil Engineering		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Katedra Wytrzymałości Materiałów -> Faculty of Civil and Environmental Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Agnieszka Sabik	
	Teachers	dr hab. inż. Agnieszka Sabik dr inż. Łukasz Pachocki dr inż. Karol Daszkiewicz	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	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	5.0	15.0	50

Subject objectives

The aim of this course is solving of structure analysis problems using numerical methods.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] has knowledge of general mechanics, strength of materials and general rules of construction	The student knows the basic methods of solving typical problems of structural mechanics and strength of materials.	
[K6_U02] is able to define basic calculation models used in computer calculations	The student is skilled to define basic computational models for the analysis of problems of structural mechanics. The student has the ability to implement the algorithms of the direct stiffness method in MATLAB environment.	

Subject contents

Elements of matrix analysis of bar structures, direct stiffness method (DSM). Discretisation of bar structure, stiffness matrix and flexibility matrix of frame system. Stiffness matrix of beam element, influence of distributed loads, elastic supports. Condensation, modification and aggregation. Algorithm of DSM. Frame and truss element – local coordinate system transformations. Solution of any bar system by DSM. Introduction to finite element method (FEM). Mathematical modelling. Local and global formulation. Derivation of FEM basic equations, analogies to DSM. Plane stress and plane strain finite element. Principles of meshing. Numerical methods (NM). Elimination and decomposition solution methods of the systems of linear equations. Methods of solution of nonlinear equations. General approximation and interpolation of function. Numerical integration.

Prerequisites and co-requisites

Knowledge of Strength of Materials and Structural Mechanics, in particular the ability to solve statically indeterminate systems. Ability to program in MATALB language.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test (theory and exercises)	60.0%	40.0%
Tests (laboratory)	60.0%	60.0%

<table>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Rucka M., Burzyński S., Sabik A., Macierzowa analiza konstrukcji prętowych w środowisku Matlab, Wydawnictwo PG, 2018.
2. Björck D., Metody numeryczne. PWN, Warszawa 1987.
3. Branicki Cz. , Ciesielski R., Kacprzyk Z., Kawecki J., Kączkowski Z., Rakowski G., Mechanika budowli. Ujęcie komputerowe t. 1, Arkady, Warszawa 1991.
4. Branicki Cz., Wizmur M., Metody macierzowe w mechanice budowli i dynamika budowli. Wydawnictwo PG, Gdańsk 1984.
5. Kłosowski P., Ambroziak A., Metody numeryczne w mechanice z przykładami w programie MATLAB. Wydawnictwo PG, Gdańsk 2011.
6. Rakowski G., Kacprzyk Z., Metoda elementów skończonych w mechanice konstrukcji .Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005.</td></tr>
<tr><td>Supplementary literature</td><td>1. Chapra S.C., Numerical Methods for Engineers. McGraw-Hill Book Company, 1988.
2. Fortuna Z., Macukow B., Wąsowski J., Metody numeryczne. Wydawnictwa Naukowo-Techniczne, Warszawa 1993.
3. Ralston A., Wstęp do analizy numerycznej. PWN, Warszawa 1983.
4. Szmelter J., Metody komputerowe w mechanice, PWN, Warszawa 1980.
5. Zienkiewicz O. C., Metoda elementów skończonych. Arkady, Warszawa 1972.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Determine the stiffness matrix and the flexibility matrix of the frame system with respect to selected displacements.

Determine the internal forces with the use of the direct stiffness method.

Based on experimental stress-strain data perform a linear approximation and then an assessment of the accuracy of approximation.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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