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Course title: APPLICATION OF FINITE ELEMENT METHOD IN CIVIL ENGINEERING

ECTS credit allocation (and other scores): 3

Semester: autumn

Level of study: ISCED-6 - first-cycle programmes (EQF-6)

Branch of science: Engineering and technology

Language: English

Number of hours per semester: 45

Course coordinator/ Department and e-mail: Piotr Srokosz / Institute of Building Engineering, [psrok@uwm.edu.pl](mailto:psrok@uwm.edu.pl)

Type of classes: classes and lectures

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#### Substantive content

**CLASSES:** The idea, purpose and scope of the finite element method (FEM). Basic linear algebra operations in MATLAB. Construction and solution of FEM linear equation systems with given boundary conditions. Discretization of systems: elements and nodes. Discretization of boundary conditions. Flexible supports with given displacements. Computer simulation procedures and calculation functions for FEM linear elements. Statically indeterminate systems with: spring, 1D and 2D bar (truss), beam and frame elements. Numerical determination of unknown displacements, reactions in supports and internal forces in primary and mixed structural systems.

**LECTURES:** Review of computer applications based on the finite element method (FEM), which are widely used in engineering practice. FEM implementation procedures: input data, creation of stiffness matrix for elements, aggregation of global stiffness matrix for the system, creation of a system of linear equations, application of boundary conditions, solving equations, determination of displacement and nodal forces, postprocessing of results: determination of internal forces in elements. Basics of numerical model validation procedures. Stability of solutions obtained from FEM. Achievements of information technologies used in numerical calculations and examples of their application.

**Learning purpose:** Understanding the benefits of using FEM in problems with statically indeterminate rod systems.

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On completion of the study programme the graduate will gain:

**Knowledge:** knows FEM procedures necessary to solve statically indeterminate systems in the design of building structures

**Skills:** can solve statically indeterminate rod systems using FEM numerical calculations

**Social Competencies:** is aware of the consequences of improper use of computer programs commonly used in design work

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**Basic literature:** P.I. Kattan, "Matlab guide to finite elements. An interactive approach", Springer, 2002, p. 479

**Supplementary literature:** I. Smith, D.V. Griffiths, "Programming the Finite Element Method", Wiley, 2004, p. 440; O.C. Zienkiewicz, R.L. Taylor, "Finite Element Method", vol.1. "The Basis", 5th edition, Butterworth & Heinemann, 2000, p. 689.

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The allocated number of ECTS points consists of:

Contact hours with an academic teacher: 47

Student's independent work: 28



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