COURSE DESCRIPTION CARD - SYLLABUS

Course name

AN APPLICATION OF THE BOUNDARY ELEMENT METHOD TO STATIC, DYNAMIC AND INITIAL STABILITY ANALYSIS OF ENGINEERING STRUCTURES

Course

Proposed by Discipline
Civil engineering, geodesy and transport

Year/Semester
II/3, III/5

Type of studies
Doctoral School

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture
4

Tutorials

Projects/seminars

Number of credit points

1

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Knowledge: student knows the basics of linear algebra and matrix analysis of structures.

Skills: student is able to write the above algorithm in the matrix form and apply it using commercial numerical tools.

Social competencies: student is able to critically verify the obtained results.

Course objective

To acquaint students with the Boundary Element Method (BEM), which is a very useful numerical tool, competing with the well-known Finite Element Method (FEM).

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:
1) General application of numerical methods in mechanics, especially the Finite Element Method (FEM) and the Boundary Element Method (BEM), [P8S_WG/SzD_W01]
2) knows how to refer to the available literature in his own research, how to embed his own research in it. [P8S_WK/SzD_W07]

Skills

A PhD student who graduated from doctoral school can:
1) develop numerical procedures for classical problems of structural mechanics using the FEM and the BEM approaches, especially, [P8S_UW/SzD_U01]
2) consciously use scientific and commercial numerical computing packages (e.g.: Maple, Matlab, ABAQUS, etc.). [P8S_UW/SzD_U02]

Social competences

A PhD student who graduated from doctoral school is ready to:
1) develop numerical procedures for classical problems of structural mechanics using the FEM and the BEM approaches, especially [P8S_KK/SzD_U01]
2) critical evaluation of the results of own scientific research, [P8S_KK/SzD_K02]
3) formulating and solving scientific problems in the field of mechanics of materials and structures. [P8S_KK/SzD_K03]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W01, W07	a short test or an independent lecture	40% - 50% sufficient, 50%- 65% average, 65%-80% good, 80%-95% very good, 95%-100% excellent
U01, U02	a short test or an independent lecture	40% - 50% sufficient, 50%- 65% average, 65%-80% good, 80%-95% very good, 95%-100% excellent
K01, K03	a short test or an independent lecture	40% - 50% sufficient, 50%- 65% average, 65%-80% good, 80%-95% very good, 95%-100%

		excellent

Programme content

1. Introduction: Dirac's delta, Fundamental solution (or set of fundamental solituions), Singular Kernel Functions, Integral representation of the differential equation, Betti's Theorem, Types of Boundary Elemets.
2. Static analysis of shiels and membrane structures, The Boundary Integral Equations, singular and non-singular formulation of the Boundary Integral Equations.
3. Static analysis of thin (Kirchhoff-Love) plate using classic and simplified formulation of the Boundary Integral Equations. Assembling of set of algebraic equation.
4. Dynamic analysis of thin (Kirchhoff-Love) plate using simplified formulation of the Boundary Integral Equations. Assembling of set of algebraic equation and the standard eigenvalue problem. Plate-water interaction (additionally).
5. Initial stability analysis of thin (Kirchhoff-Love) plate using simplified formulation of the Boundary Integral Equations. Assembling of set of algebraic equation and the standard eigenvalue problem.

Teaching methods

Lecture: clasic bench, chalk and blackboard approach and multimedia presentation including illustrations and examples.

Bibliography

Basic

1. T. Burczyński, Metoda elementów brzegowych w mechanice, Wydawnictwo Naukowo-Techniczne, 1995 (The Boundary Element Method in mechanics, Scientific and Technical Publishing House, 1995).

2. J.T. Katsikadelis, Boundary Elements: Theory and Applications, Elsevier, 2002.

3. M. Guminiak, Metoda elementów brzegowych w analizie płyt, Wydawnictwo Politechniki Poznańskiej, 2016 (The Boundary Element Method in the analysis of plates, Poznań University of Technology Publishing House, 2016).

4. J. T. Katsikadelis, The Boundary Element Method for Plate Analysis, Elsevier, 2014.

Additional

1. K. Myślecki, Metoda elementów brzegowych w statyce dźwigarów powierzchniowych, Oficyna Wydawnicza Politechniki Wrocławskiej, 2004 (The Boundary Element Method in the static of surface girders, Wrocław University of Technology Publishing House, 2004).

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,0
Classes requiring direct contact with the teacher	4	0,2
Student's own work (literature studies, preparation for tutorials, project preparation, consultations with the teacher) [1]	21	0,8

[1] delete or add other activities as appropriate