COURSE DESCRIPTION CARD - SYLLABUS

Course name
Computer aided design [N1Bud1>KWP]

Course

Field of study
Civil Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
20

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

- basic knowledge in the field of mathematics and physics - basic knowledge in the field of computer science and programming - uses available sources of information - can solve basic engineering problems - can work in a team

Course objective

The main goal is to collect, systematize and order numerical methods for solving differential equations in the context of engineering problems in the field of construction and environmental engineering, methods for creating numerical models of phenomena and objects, with particular emphasis on formulating a problem, choosing a solution method and assessing accuracy. The practical goal is to acquire the ability to solve common problems with generally available IT tools (eg spreadsheets, scilabs) but also with the use of specialized software based on the finite element method or the finite difference method.

Course-related learning outcomes

Knowledge:
-have knowledge in the fields of mathematics, physics, chemistry, biology and other fields of sciencen suitable to formulate and solve problems concerning sustainable building engineering (civil engineering,

environmental engineering and architecture).
-have detailed knowledge in theoretical mechanics, knowledge of materials' strength, and general rules of shaping structures.
-have basic knowledge of operation algorithms of selected software (including the usage of BIM technology), supporting the calculation and design of constructions, construction work organisation, cost estimation, technical fitting of buildings; basic knowledge of operation algorithms of software dedicated for evaluation and design of energy-saving buildings.

Skills:
-are able to obtain information from literature, databases and other properly selected information sources; can integrate the obtained information, interpret and evaluate it, as well as draw conclusions, formulate, discuss and justify opinions.
-are able to use advanced information and communication technologies (ICT) appropriate to perform typical engineering tasks.
-are able to correctly utilise numerical, analytical, simulation, and experimental methods, to identify and solve problems in sustainable building engineering; to obtain and verify the results.
-can utilize selected software supporting design decisions in sustainable building engineering, including programs based on the BIM technology; are able to critically evaluate the obtained results of numerical analysis of building unit.

Social competences:
-are able to adapt to new and changing circumstances, can define priorities for performing tasks defined by themselves and other people, acting in the public interest and with regard to the purposes of sustainable development.
-take responsibility for the accuracy and reliability of working results and their interpretation.
-are able to critically evaluate the results of their own work..

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
-Colloquium in the form of open questions
-Design
-Assessment of participation and activity in classes

Programme content

Approximate solution of differential equations - weighted reside methods. Introduction to the finite element method of the tool for modeling and strength analysis of engineering structures. Assumptions and derivation of equations describing basic flat rod structures. 1D bar element, 2D truss element and 2D beam element. Introduction to the CALFEM calculation system. Optimization of bar structures. Problems of plane stress (PS) and plane strain (PE), triangular finite element CST and LST, quadrangular finite elements for PSN and PSO, isoparametric formulation of elements in 2D, numerical integration. Structure optimization in flat deformation and stress states.

Course topics

The course topics include methods for the approximate solving of differential equations, with particular emphasis on weighted residual methods and the finite element method, introduced as a tool for modeling and analyzing the structural strength of engineering constructions. The course covers the assumptions and derivations of equations describing basic planar frame structures, including 1D bar elements, 2D truss elements, and 2D beam elements. The course also includes topics on the plane stress state and plane strain state, discussing triangular finite elements CST and LST as well as quadrilateral elements for PSN and PSO. During the course, the CALFEM computational system used for calculations is presented. The final part of the course focuses on the optimization of structures in plane strain and stress states.

Teaching methods

Lecture with multimedia presentation.
Laboratory - task solving.

Bibliography

Basic
1. Wei-Chau Xie, Differential equations for engineers, Cambridge University Press 2010
2. M. Asghar Bhatti, Fundamental Finite Element Analysis and Applications with Mathematica and MATLAB Computations, John Wiley& Sons, Inc., Hoboken,NewJersey, 2005
3. A.J.M. Ferreira, MATLAB Codes for Finite Element Analysis Solids and Structures Solid Mechanics and Its Applications, Springer, 2008
4. Y.W. Kwon & H. Bang, The Finite Element Method Using MATLAB, CRC Press, 2000
5. E. Onate, Structural Analysis with the Finite Element Method. Linear Statics. VOL.1 Basis and Solids, Springer, 2013
6. E. Onate, Structural Analysis with the Finite Element Method. Linear Statics. VOL.2 Beams, Plates and Shells, Springer, 2013
Additional
1. J.C. Butcher, Numerical Methods for Ordinary Differential Equations, John Wiley & Sons, Ltd., 2003
2. A.P.Boresi, K.P.Chong, S.Saigal, Approximate Solution Methods in Engineering Mechanics, John Wiley & Sons, Inc.,2003

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	41	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	59	2,50