STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Optional CAD**		Code **1010101161010100660**
Field of study **Civil Engineering First-cycle Studies**	Profile of study (general academic, practical) **general academic**	Year /Semester **3 / 6**
Elective path/specialty **-**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **30** Classes: **-** Laboratory: **45** Project/seminars: **-**		No. of credits **5**
Status of the course in the study program (Basic, major, other) **other**	(university-wide, from another field) **university-wide**	
Education areas and fields of science and art		ECTS distribution (number and %**)**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	- basic knowledge in the field of mathematics and physics - basic knowledge in the field of computer science and programming
2	**Skills**	- uses available sources of information - can solve basic engineering problems
3	**Social competencies**	- can work in a team

Assumptions and objectives of the course:

-

652/5000

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.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. has knowledge of basic (classical and modern) methods of numerical analysis - [P6S_WG]
2. knows the principles and methods used to create numerical models of buildings and phenomena in the field of construction - [P6S_WG]

Skills:

1. can build models and apply them to solve typical problems in construction - [P6S_UW]
2. umie dobrać stosowaną metodę i zastosować ją do rozwiązania typowych problemów w budownictwie - [P6S_UK]

Social competencies:

1. can work independently and in a team taking on different roles in it - [P6S_KO]
2. has the ability to critically evaluate the results of his own work - [P6S_KK]

Assessment methods of study outcomes

-Colloquium in the form of open questions
-Design
-Assessment of participation and activity in classes

Point thresholds:
100-90% of the maximum number of points - bdb
90-80% of the maximum number of points - db +
80-70% of the maximum number of points - db
70-60% of the maximum number of points - dst +
60-50% of the maximum number of points - dst

Course description

Lecture 1. Introduction. Computer aided engineering in civil engineering - a review of issues.
Lecture 2. Approximate methods for solving differential equations. Methods of Euler and Runge-Kutta.
Lecture 3. Introduction to the methods of weighted residuals. Colocation point method.
Lecture 4. Methods of weighted residuals. The method of sub-areas of collocation, the method of least squares.
Lecture 5. The Galerkin method. Formulation of the weak methods of Galerkin.
Lecture 6. Formulation of the finite element method for the 1D problem - the formulation of Galerkin.
Lecture 7. The finite element method - the 1D bar element - the formulation of Galerkin and using the virtual work equation. CALFEM - introduction
Lecture 8. Finite 2D lattice element and 2D finite element
Lecture 9. Problems of flat state of stress (PSN) and flat deformation state (PSO). Finite element CST and LST.
Lecture 10. Finite elements quadrangular for PSN and PSO.
Lecture 11. Isoparametric expression of elements in 2D. Numeric integration
Lecture 12. Isoparametric expression of elements in 2D (continued).
Lecture 13. Elements of optimization in engineering practice
Lecture 14. Elements of optimization in engineering practice (continued)

Ćwiczeń / lab / projects
1. Introduction
2. Euler's method, modifications of the Euler method
3. Rungego-Kutta's methods
4. The Ritz and Rayleigh methods - Ritz
5. Methods of weighted reserves
6. Methods of weighted reserves (continued)
7. Colloquium 1
8. MES lattice - CalFem
9. Beam / FEM Frame - CalFem
10. PSN / PSO MES - CalFem
11. PSN / PSO MES - CalFem (continued)
12. 2D MES heat flow - CalFem
13. 2D MES heat flow - CalFem (continued)
14. Colloquium 2

Basic bibliography:

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 bibliography:

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.

Result of average student's workload		
Activity		**Time (working hours)**
Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	120	4
Contact hours	30	1
Practical activities	90	3