STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Computer aided design with BIM**		Code **1010101141010109333**
Field of study **Sustainable Building Engineering First-cycle**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 4**
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: **30** Project/seminars: **-**		No. of credits **4**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences**		ECTS distribution (number and %) **4 100%**

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**	- using available sources of information - can solve basic engineering problems
3	**Social competencies**	- can work in a team

Assumptions and objectives of the course:

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 in areas of mathematics, physics, chemistry, biology and other sciences useful in formulating and solving problems associated with sustainable building engineering (civil engineering, environmental engineering and architecture) - [KSB_W01]

2. has knowledge in theoretical mechanics, materials strength and principles of general construction development - [KSB_W04]

Skills:

1. knows how to use information and communication technologies typically used in implementation of engineering activities - [KSB_U02]

2. knows how to make use of select computer software packages to assist in design decisions in sustainable building engineering including software based on BMI technology; knows how to critically assess results obtained of numerical analysis of construction works - [KSB_U09]

Social competencies:

1. understands the need for team work and is responsible for safety of hi work and the work of his team - [KSB_K04]

2. has the skill of critical assessment of results of his work - [KSB_K08]

Assessment methods of study outcomes

- Written colloquium in the form of open questions
- Making the project
- Evaluation of participation and activity in classes

Course description

lectures

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

Laboratories

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. PS / PE MES - CalFem
11. PS / PE 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)

1. Participation in lectures (contact hours)	30
2. Participation in laboratory exercises (contact hours, practical)	30
3. Preparation for laboratories (independent work)	10
4. Preparation for the colloquium (independent work)	10
5. Project implementation (independent work)	15
6. Participation in consultations (contact hours)	3
7. Presence on the exam (contact hours)	2

Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	65	2
Practical activities	30	0