STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Numerical Analysis		**1010102121010113740**

Field of study	Profile of study (general academic, practical)	Year /Semester
Civil Engineering Second-cycle Studies	**(brak)**	**1 / 2**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**English**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours				No. of credits
Lecture: **30**	Classes: **15**	Laboratory: **15**	Project/seminars: **-**	**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basics of theory partial differential equations, basics of linear structural mechanics and nonlinear structural mechanics
2	**Skills**	Solving static and dynamic linear problems by the finite element method
3	**Social competencies**	Awarness of needs for affordable share expertise in the field of computationa mechanics. Awarness of needs for a systematic deepening and broadening competence. Understanding needs of cooperation in solving theoretical and practical engineering problems.

Assumptions and objectives of the course:

-A goal is to learn and practise using the finite element method in solving complex nonlinear structural problems; in statics, dynamics and fluid-structure interaction problems.

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

Knowledge:

1. The finite difference method applied to solving nonlinear partial differential equations - [- [K1_W01, K1_W11]]
2. The finite element method, its implicit and explicit approaches, apllied to nonlinear problemes - [- [K1_W01, K1_W11]]
3. Advanced numerical methods applied to: statics, contact problems, stability analysis, linear and nonlinear dynamics, basics of the computational fluid dynamics - [- [K1_W11]]

Skills:

1. Solving advanced practical problems by numerical methods - [-[K1_U03, K1_U05]]
2. Modeling by the finite element method advanced boundary and initial-boundary problems - [-[K1_U03, K1_U05, K1_U06]]
3. Usage of commercial finite element program to practical complex civil engineering problems - [-[K1_U06]]

Social competencies:

1. Student understands needs of cooperation in solving theoretical and practical engineering problems - [- [K1_U06]]
2. Student is aware of needs for affordable share their expertise in the field of computationa mechanics - [- [K1_K02, K1_K09]]
3. Student sees needs for a systematic deepening and broadening its competence - [- K1_K06, K1_K10]]

Assessment methods of study outcomes

-Course grading:Lectures - end-term exam (min. 60%)Labs - Homework Assignments (min. 60%)Grades:96?100 (A)91? 95 (B)81? 90 (C)71? 80 (D)61? 70 (E)less than 60 - (F)

Course description

-During a course the finite difference method applied to solving partial differential equations is presented, the finite element method, its implicit as well as explicit approaches, are presented as well. An introduction to coupled problems is given, where Fluid-Structure Interaction, as an example, shows one of engineering problems that are being solved today more and more often. Many structural mechanical problems are involving today the contact problems, and techniques used in solving such problems are introduced as well. Buckling and post-buckling analysis and techniques to solve them are given also. The basics of the Computational Fluid Dynamic is introduced.

Basic bibliography:

1. T.Łodygowski, W.Kąkol, Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich, Skrypt PP, 1994, Nr 1779.
2. D.Kincaid, W. Cheney, Analiza numeryczna, WNT Warszawa 2006.
3. A.P.Boresi, K.P.Chong, S.Saigal, Approximate Solution Methods in Engineering Mechanics, John Wiley & Sons, Inc., 2003.
4. Czesław Cichoń, Metody Obliczeniowe - wybrane zagadnienia, Kielce 2005
5. O.C.Zienkiewicz, R.L.Taylor, Finite Element Method, Elsevier 2005

Additional bibliography:

1. An Introduction to Nonlinear Finite Element Analysis by J. N. Reddy, Oxford University Press, 2004
2. Nonlinear Finite Elements for Continua and Structures by T. Belytschko, W. K. Liu, and B. Moran, John Wiley and Sons, 2000
3. Computational Inelasticity by J. C. Simo and T. J. R. Hughes, Springer, 1998

Result of average student's workload

Activity	Time (working hours)
1. Lectures	30
2. Classes	30
3. Labs	15

Student's workload

Source of workload	hours	ECTS
Total workload	75	3
Contact hours	60	2
Practical activities	15	1