STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Numerical Analysis		**1010102121010101980**
Field of study: **Civil Engineering Second-cycle Studies**	Profile of study (general academic, practical): **general academic**	Year /Semester: **1 / 2**
Elective path/specialty: **Structural Engineering**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **30** Classes: **15** Laboratory: **15** Project/seminars: **-**		No. of credits: **3**
Status of the course in the study program (Basic, major, other): **major**	(university-wide, from another field): **from field**	
Education areas and fields of science and art: **technical sciences** **Technical sciences**		ECTS distribution (number and %): **3 100%** **3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basics of partial differential equations, basics of nonlinear structural mechanics
2	**Skills**	Solving static and dynamic linear problems by the finite element method
3	**Social competencies**	Social competencies

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 - [K_W01, K_W03]
2. The finite element method, its implicit and explicit approaches, applied to solving nonlinear structural problems - [K_W03, K_W01]
3. Advanced numerical methods applied to nonlinear static and dynamic problems, contact problems, buckling and post-buckling stability analysis, basics of computational fluid dynamics. - [K_W04]

Skills:

1. Solving advanced practical problems by numerical methods - [K_U04, K_U06]
2. Modeling by the finite element method advanced boundary and initial-boundary problems - [K_U06, K_U04]
3. Usage of a commercial finite element program to practical complex engineering problems - [K_U18]

Social competencies:

1. Student understands needs of cooperation in solving theoretical and practical engineering problems - [K_K03]
2. Student is aware of needs for affordable share their expertise in the field of computationa mechanics - [K_K05]
3. Student sees needs for a systematic deepening and broadening its competence - [K_K01]

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 is given to solving coupled problems, where Fluid-Structure Interaction, as an example, shows one of an engineering problem that is being solved today. Many problems involved today the contact problems: techniques used in solving such problems are introduced during a course as well. Buckling and post-buckling analysis 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.

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	15
2. Classes	15
3. Labs	15
4. Final exam	15

Student's workload

Source of workload	hours	ECTS
Total workload	75	3
Contact hours	60	2
Practical activities	40	2