

STUDY MODULE DESCRIPTION FORM		
Name of the module/subject Numerical Analysis		Code 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: 2 Classes: 1 Laboratory: 1 Project/seminars: -		No. of credits 2
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 technical sciences		ECTS distribution (number and %) 3 100%
Responsible for subject / lecturer: dr inż. Witold Kąkol email: witold.kakol@put.poznan.pl tel. 61 665 21 06 Wydział Budownictwa i Inżynierii Środowiska ul. Piotrowo 5, 60-965 Poznań		
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 computational 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	60	2
Contact hours	45	1
Practical activities	15	1