STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Computer Methods and Computer Aided Design		**1010115131010100267**
Field of study	Profile of study (general academic, practical)	Year /Semester
Civil Engineering Extramural Second-cycle	**general academic**	**2 / 3**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Structural Engineering	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
Second-cycle studies	**part-time**	
No. of hours		No. of credits
Lecture: **30** Classes: **-** Laboratory: **15** Project/seminars: **-**		**4**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
major	**from field**	
Education areas and fields of science and art		ECTS distribution (number and %)
technical sciences		**4 100%**
Technical sciences		**4 100%**

Responsible for subject / lecturer:

dr inż. Tomasz Jankowiak
email: tomasz.jankowiak@put.poznan.pl
tel. +48 61-8672814
Wydział Budownictwa i Inżynierii Środowiska
ul. Piotrowo 5 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Mathematics, mechanics of structure and materials, Methods of solving systems of linear and nonlinear equations, differential equations, Strength of materials and structures.
2	**Skills**	Solving systems of algebraic equations, formulating physical problems in the language of mathematics, solve simple differential equations. The calculation of stresses, strains and displacements and internal forces in structures. It has basic programming skills
3	**Social competencies**	Awareness of the need to constantly update and supplement knowledge and skills. Ability to work in groups and creative cooperation..

Assumptions and objectives of the course:

The acquisition of knowledge by students on methods of numerical analysis of the structure and the ability to critically evaluate the results.

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

Knowledge:

1. The student has knowledge of advanced topics of strength of materials, modeling of materials, structures and buildings. - [K_W04]
2. The student has knowledge of solid mechanics, is familiar with the static and dynamic analysis of the structures - [K_W03]
3. The student knows the classification and scope of computer programs supporting the analysis and design of structures. - [K_W08]
4. The student has knowledge of the analysis and optimization of complex structural components and building systems, methods for solving and performing nonlinear analyzes of structures - [K_W09]

Skills:

1. The student is able to perform static, dynamic and stability analysis of buildings - [K_U04]
2. The student uses a specialized programming software for structural analysis - [K_U05]
3. The student is able to define a computer model and perform advanced linear and nonlinear analysis of complex objects. - [K_U06]
4. Student can critically assess the results of numerical analysis of structures - [K_U07]
5. Student can plan and perform laboratory experiments leading to the assessment of endurance of materials and structures - [K_U11]
6. Student can select a tool to solve technical problems - [K_U13]

Social competencies:

1. The student is aware of the need to raise their professional and personal competences - [K_K06]
2. The student is able to work independently and in a team to accomplish a specific task - [K_K01]
3. The student is responsible for the reliability of the results and the work of the team which is working - [K_K02]

Assessment methods of study outcomes

- Lectures - exam in which the student has the task to answer 4 questions concerning the topics discussed in lectures.
- Laboratories - practical completion at the computer - solution of the problem of structural analysis and interpretation of the results.

Course description

1. Presentation of examples of advanced structural calculations using Computer Methods. Application programs support structure calculations.
2. Methods of solving differential equations: Methods of weighted residuals and FEM in approximation of Galerkin. Illustration of methods for example - comparison and analysis of results.
3. Elements of linear algebra. Modeling the mechanics of structures (model and real construction). Matrix formulation of continuum mechanics equations.
4. Algebraisation of analytical problems. The essence of the Finite Element Method (approximation displacement fields, the shape functions). Formulation of FEM and stiffness matrix for the one-dimensional case: truss, beam bending.
5. Implementation of the tasks of the linear FEM (basic steps of method) solving systems of linear algebraic equations. The transformation of the stiffness matrix to the global coordinate system. General remarks about computing environment.
6. Plane stress state. Natural coordinates and isoparametric formulation. Construction of stiffness matrix of the selected elements in 2D. Gauss numerical integration method.
7. Formulation of stiffness of plate elements and 3D. Selected topics in dynamics and stability of the structure.
8. Elements of the optimal design.

Laboratories are conducted in a stand-alone computers. Structure calculations are carried out in an Abaqus. Students independently or in group perform computer analysis:

1) Introduction to Abaqus environment and familiarize yourself with the basic functionality
2) FEM analysis of cantilever beam using solid finite elements
3) FEM analysis of 3D frame
4) FEM analysis of plane stress state and plane strain state in 2D
5) FEA analysis of shell

Basic bibliography:

1. T.Łodygowski, W.Kąkol, Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich, Wydawnictwo Politechniki Poznańskiej, 1997
2. M. Kleiber, Wprowadzenie do metody elementów skończonych, IPPT PAN, 1989

Additional bibliography:

1. T.Jankowiak, Kryteria zniszczenia betonu poddanego obciążeniom quasi-statycznym i dynamicznym, Wydawnictwo Politechniki Poznańskiej, 2011

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. preparation to exam	30
3. participation in laboratories	15
4. Preparation to pass the laboratories	10

Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	47	2
Practical activities	40	2