COMPUTER ANALYSIS OF MATERIAL AND STRUCTURES

Subject code: **11.9-WILŚ- BUD- KAM- IB27**

Subject type: Obligatory

Language of instruction: English

Responsible for the subject: Person conducting lectures

Providing education: Department of Building Mechanics

Type of class	Number of classes per semester	Number of classes per week	Semester	Type of credit	ECTS points
Full time studies					2
Lecture	15	1	IV	credit with a grade	
Laboratory	15	1		credit with a grade	
Part time studies					
Lecture	9	1	IV	credit with a grade	
Laboratory	9	1		credit with a grade	

SUBJECT OBJECTIVE:

The objective of the course is to teach the principles of numerical modelling of building materials and structures using available computer software. Learning modern methods.

INITIAL REQUIREMENTS:

Building mechanics. Strength of materials. Computational methods (full-time studies).

SUBJECT SCOPE:

Lecture

Basics of RM-Win, Soldis, PL-Win and Abaqus software. Introduction to computer modelling of engineering systems. User Interface. Defining the model of structural geometry, support conditions, material parameters and loads. Documentation of calculations. Basic material models. Analysis of structures using RM-Win, Soldis and Abaqus software. Determining the distribution of internal forces and displacement states for flat rod systems (trusses, beams, frames). Computer analysis of stress and deformation states of a material point. Determination of tensor components of the stress and strain tensor in rotated coordinate systems. Determination of geometrical characteristics and core of the cross-section, and distribution of stresses in bars with complex cross-sections. Determination of displacements and deformations of structures loaded in the INSTRON machine by means of the ARAMIS and PONTOS optical measurement system. Checking the stability condition (buckling) of one-branch poles. Determination of deflections and distribution of internal forces in slabs. Presentation and interpretation of calculation results.

Laboratory

Learning to use basic computer software: RM-Win, Soldis, PL-Win and Abaqus. Computational verification of design exercises performed as part of the subjects: Materials durability and Building mechanics. Demonstration of operation of the INSTRON testing machine and systems for optical displacement measurement and determination of strain on selected areas of the ARAMIS and PONTOS structures.

Educational methods:

Lecture - conventional lecture,
Laboratory - laboratory exercises

EDUCATION RESULTS:

Results after completion of the course	Symbol	Verification method	Type of class
Knowledge			
The student has basic knowledge of structure modelling using FEM (finite element methods). He knows the basic material models for materials used in construction. The student has a basic knowledge of finite elements and finite element mesh quality	**K_W12**	test	L
Abilities			
Student can model any structural element (lattice, frame, shield, plate). The student can introduce any material parameters for linear elastic materials (isotropic and orthotropic materials). The student is aware of the possibility of modelling materials with regard to plasticity and can define boundary conditions and apply load to a defined structure	**K_U04**	Test, a credit for reports	Lab
The student can calculate stresses and displacements in a modelled task. The student can display results in the form of contour maps of stresses on finite elements. The student can use available computer software to perform static analysis of uncomplicated construction using the finite element method	**K_U07**		
Social competences			
The student is aware of the numerical modelling techniques used. The student is aware of the benefits and limitations of using software	**K_K01**	conversation during lectures initiated by the teacher; checking competences during the introduction to classes	L, Lab
The student is aware of existing limitations. The student is ready to learning new, more advanced tools	**K_K05**		

REQUIREMENTS TO OBTAIN A CREDIT:

Lecture — A positive grade for a test with points:

56% - 65% correct answers	satisfactory
66% - 75%	satisfactory plus
76% - 85%	good
86% - 93%	good plus
94% - 100%	very good

Laboratory — The condition for a credit is a positive grade for all reports from laboratory exercises prepared as part of the laboratory programme and for a written test.

STUDENT WORK:

Interaction with the teacher 15l+15lab+5cons, total	35 h,
Preparation for the test	15 h,
Projects – individual work 2proj x 5h	10 h,
Total 35+15+10	60 h,
ECTS for the subject 60/30	2 ECTS.

BASIC LITERATURE:

1. Bąk R., Burczyński T.: Wytrzymałość materiałów z elementami ujęcia komputerowego, WNT, Warsaw 2001 http://www.mes.polsl.gliwice.pl
2. Chmielewski T., Nowak H.: Wspomaganie komputerowe CADCAM. Mechanika budowli: metoda przemieszczeń, metoda Crossa, metoda elementów skończonych, WNT, Warsaw 1996.

COMPLEMENTARY LITERATURE:

1. Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Wyd. PW, Warsaw 2005.
2. Bluehill & Fast Track Material Testing Software Tutorial, INSTRON 2007.
3. Aramis & Pontos Manual, GOM 2007.
4. ABAQUS instrukcja

SYLLABUS PREPARED BY

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