

**FACULTY OF CIVIL ENGINEERING****SUBJECT CARD**

**Name in English:** Advanced computer aided engineering  
**Name in Polish:** Zaawansowane komputerowe wspomaganie projektowania  
**Main field of study (if applicable):** *Civil Engineering*  
**Specialization (if applicable):** Civil Engineering  
**Level and form of studies:** ~~1st~~/ 2nd level\*, full-time / ~~part-time~~\*  
**Kind of subject:** obligatory / ~~optional~~ / ~~university-wide~~\*  
**Subject code:** CEB007761  
**Group of courses:** ~~YES~~ / NO\*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			<b>30</b>		
Number of hours of total student workload (CNPS)			<b>60</b>		
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	<del>Examination</del> / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points			<b>2</b>		
including number of ECTS points for practical (P) classes			<b>2,0</b>		
including number of ECTS points for direct teacher-student contact (BK) classes			<b>1,2</b>		

\* delete as appropriate

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Able to identify and to define loads acting on complex building structures.
2. Knows standards and the guidelines and regulations for the design of buildings and their components.
3. Has a developed theoretical knowledge and skills for dimensioning and construction of elements and complex building structures.
4. Has the ability to model complex 2D and 3D structures using FEM.

**SUBJECT OBJECTIVES**

- C1. Developing and strengthening ability of applying methods of modeling and design of complex, spatial constructions using computer programs.
- C2. Understanding the theoretical foundations of computer modeling of complex buildings and the interpretation and verification of results, including the issues of non-linearity and dynamic range.
- C3. Acquiring the ability to select and use the software used in design practice for solving spatial complex buildings.

SUBJECT EDUCATIONAL EFFECTS	
<b>Relating to knowledge:</b>	
PEK_W01	Knows and understands the principles of computer-aided modeling, calculation and dimensioning of complicated spatial structures and solving mechanics and structural analysis of 2D and 3D in the linear and non-linear statics, dynamics and stability.
<b>Relating to skills:</b>	
PEK_U01	Can select and use computer programs for analysis and design of complex structures.
PEK_U02	Can model in the environment of the finite element method, defines calculation model; can define and perform advanced linear and non-linear analysis of complex 2D and 3D engineering structures.
PEK_U03	Can properly interpret and critically evaluate the results of numerical analysis of complex engineering structures.
<b>Relating to social competences:</b>	
PEK_K01	Able to work on the implementation of tasks independently or in a team project (preparation of presentations and report-projects); is responsible for the accuracy of the results of the work and its correct interpretation.
PEK_K02	Is aware of the need to increase knowledge in the field of contemporary techniques and software for the design of building structures.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Lec1		
...		
	<b>Total hours</b>	

Form of classes - class		Number of hours
Cl1		
...		
	<b>Total hours</b>	

Form of classes - laboratory		Number of hours
Lab1	Introduction: Training of health and safety rules. Discussion of the examination rules. Set a schedule of classes. Overview and introduction to computational programs used in relation to the 3D problems.	2
Lab2	Presentation of the principles of computer modeling using FEM of complex engineering structures - examples for 3D bar structures, plates and shields.	2
Lab3	Presentation of the principles of computer modeling using FEM of complex engineering structures - examples for shells and solids.	2
Lab4	Analysis of the possibilities of using software to support engineering design for use in the verification of the results of laboratory tests.	2
Lab5	Solving examples of complex building and engineering structures - examples prepared by the students.	2
Lab6	Solving examples of complex building and engineering structures - examples prepared by the students.	2

Lab7	Solving examples of complex building and engineering structures - examples prepared by the students.	2
Lab8	Solving examples of complex building and engineering structures – verification test.	2
Lab9	Modeling and solving examples of complex constructions in terms of research - design of plates and shields (eg Lusas).	2
Lab10	Modeling and solving examples of complex constructions in terms of research - design of shells and solids (eg Lusas).	2
Lab11	Construction optimization problems – introduction to modeling (eg Solver).	
Lab12	Construction optimization problems of bar structures – solving examples (eg Solver).	2
Lab13	Construction optimization problems of bar structures – solving examples (np. Solver).	2
Lab14	Shape optimization problems (eg ESO).	
Lab15	Summary. Discussion. Final verification. Crediting.	2
	<b>Total hours</b>	<b>30</b>

Form of classes - project		Number of hours
Proj1		
...		
	<b>Total hours</b>	

Form of classes - seminar		Number of hours
Sem1		
...		
	<b>Total hours</b>	

TEACHING TOOLS USED	
N1.	Laboratory: multimedia presentations, defining and solving of problems using software, discussion of results.
N2.	Contact hours.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_U03	Verification test - solution examples during lab.
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	Presentation and report of solution of own design problem.
$P = 0,4 \times F1 + 0,55 \times F2 + 0,05 \times \text{PRESENCE}$		

PRIMARY AND SECONDARY LITERATURE	
<b><u>PRIMARY LITERATURE:</u></b>	
[1]	Zienkiewicz O. C., Taylor R. L., Zhu J. Z., The Finite Element Method, Sixth Edition, McGraw-Hill, 2005.
[2]	McCormack J., Structural Analysis Using Classical and Matrix Methods, John Wiley & Sons, 2007.
[3]	Rombach G. A., Finite-element design of concrete structures, Practical problems and their solutions, ICE publishing, 2011.
[4]	Arora J. S., Optimum design, McGraw-Hill, Inc., 1989 (ex.).
[5]	Program manuals (Robot, Lusas).
<b><u>SECONDARY LITERATURE:</u></b>	
[1]	<a href="http://www.issmo.org/">http://www.issmo.org/</a> .
[2]	<a href="http://www.esa.auckland.ac.nz/teaching">http://www.esa.auckland.ac.nz/teaching</a> .
[3]	Computers & Structures, <i>Elsevier</i> ; <a href="http://www.elsevier.com">http://www.elsevier.com</a> .
[4]	Structural and Multidisciplinary Optimization, <i>Springer-Verlag</i> ; <a href="http://vls2.icm.edu.pl">http://vls2.icm.edu.pl</a> .
[5]	Akin J. E., Finite elements analysis concepts via SolidWorks, World Scientific, 2010.
[6]	Rombach G.A., Finite-element design of concrete Structures, ice publishing, 2011.
SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)	
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MEMBERS OF THE EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)	
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**Advanced computer aided engineering**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY *Civil Engineering*  
AND SPECIALIZATION **Civil Engineering**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives ***	Programme content ***	Teaching tool number ***
<b>Knowledge</b>				
<b>PEK_W01</b>	K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2S_CEB_W16, K2S_CEB_W22	C1, C2	Lab1 - Lab15	N1
<b>Skills</b>				
<b>PEK_U01</b>	K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2S_CEB_U18, K2S_CEB_U19, K2S_CEB_U23	C1, C2, C3	Lab1 - Lab15	N1, N2
<b>PEK_U02</b>	K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2S_CEB_U18, K2S_CEB_U19, K2S_CEB_U23	C1, C2, C3	Lab1 - Lab15	N1, N2
<b>PEK_U03</b>	K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2S_CEB_U18, K2S_CEB_U19, K2S_CEB_U23	C1, C2, C3	Lab1 - Lab15	N1, N2
<b>Social competence</b>				
<b>PEK_K01</b>	K2_K01, K2_K02, K2_K03	C3	Lab1 - Lab15	N1
<b>PEK_K02</b>	K2_K01, K2_K02, K2_K03	C3	Lab1 - Lab15	N1

\*\* - enter symbols for main-field-of-study/specialization educational effects

\*\*\* - from table above