COURSE CATALOGUE

SUBJECT FORMS

FACULTY: Civil Engineering

MAIN FIELD OF STUDY: *civil engineering*

in area of technical science

EDUCATION LEVEL: ~~1st /~~ 2nd * level, ~~licencjat / inżynier / magister~~ ~~/~~ magister inżynier (MSc) studies*

FORM OF STUDIES: full-time ~~/ part-time~~*

PROFILE: general academic ~~/ practical~~ *

SPECIALIZATION*: Civil Engineering

LANGUAGE OF STUDY: English

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FACULTY: Civil Engineering

MAIN FIELD OF STUDY: *civil engineering*

in area of technical science

EDUCATION LEVEL: ~~1st /~~ 2nd * level, ~~licencjat / inżynier / magister~~ ~~/~~ magister inżynier (MSc) studies*

FORM OF STUDIES: full-time ~~/ part-time~~*

PROFILE: general academic ~~/ practical~~ *

SPECIALIZATION*: Civil Engineering

LANGUAGE OF STUDY: English

SEMESTER 1

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Mathematics – selected topics**
Name in Polish:	**Matematyka – wybrane zagadnienia**
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:	**CEB007261**
Group of courses:	**~~YES /~~ NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**	**15**			
Number of hours of total student workload (CNPS)	**60**	**30**			
Form of crediting	Examination ~~/ crediting with grade~~ *	~~Examination~~ / crediting with grade *	Examination~~-~~/ crediting with grade *	Examination / crediting with grade *	Examination~~-~~/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**	**1**			
including number of ECTS points for practical (P) classes		**0,9**			
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**	**0,6**			

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of mathematical analysis in the following areas: basic concepts of topology, differential and integral calculus of functions of one variable, differential and integral calculus of functions of several variables.
2. Knows the basic types of ordinary differential equations and elementary methods of integration. From the first order equations - equation with separated variables, homogeneous equations, linear equations, Bernoulli equation. With a range of higher order differential equations - the theory of linear equations. Knows the basic methods of solving systems of ordinary differential equations - elimination method and the method of Euler.
3. Knows the basic concepts, theorems and methods of linear algebra, algebra of polynomials and analytic geometry.

SUBJECT OBJECTIVES

C1. To familiarize students with the most common partial differential equations of second order used in mechanics.

C2. The acquisition by students of elementary methods of solving partial differential equations.

C3. Acquisition of intuition about the relationship of mathematically formulated boundary

	value problems with problems solved in structural mechanics.
C4.	To familiarize students with contemporary, based on the theorems of functional analysis, methods of formulation and solving boundary value problems.
C5.	To familiarize students with the mathematical foundations of the finite element method.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	gain knowledge in the basics of the theory of partial differential equations
PEK_W02	recognize elements of contemporary mathematical analysis
PEK_W03	gaining knowledge about modern methods of solving boundary value problems
Relating to skills:	
PEK_U01	properly distinguish between types of equations and boundary value problems
PEK_U02	has the ability to bring to a canonical form of linear equations of order 2, can use a Fourier method, correctly distinguishes between types of equations and boundary value problems
PEK_U03	gaining basic skills in differentiation distribution
PEK_U04	gaining basic skills in the formulation and numerical solution of complex boundary problems
Relating to social competences:	
PEK_K01	can work to resolve the tasks independently and in a team (participation in discussions on auditorium exercises in analyzing problems reported by other students)
PEK_K02	learn to think logically, clearly formulate issues and to resolve them within a specific theory and the specific assumptions

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Motto: "We will not talk unnecessary things" (Stanislaw Ignacy Witkiewicz Shoemakers) <u>Basic concepts:</u> guide to the basic concepts of topological conventions signs, basic definitions, classification - linear equations, half-linear quasi-linear examples.	1
Lec2	<u>Linear partial differential equations of second order on the plane</u> Classification, characteristic equation, performance, bringing hyperbolic, parabolic and elliptical to a canonical form.	2
Lec3	<u>The d'Alembert and Fourier</u> solution of the equation string by d'Alembert method, solution of the equation strings and heat flow equation Fourier method (separation of variables).	2
Lec4	<u>Laplace equation</u> physics issues leading to the Laplace equation, harmonic functions, removing the fundamental solution, maximum principle, uniqueness of solutions.	2
Lec5	<u>Normed spaces</u> linear spaces, normed metric spaces, functional spaces, Banach space, unitary space, Hilbert space, the Pythagorean theorem, theorem on orthogonal projection.	2

Lec6	Sobolev spaces compactly supported functions, linear functionals, distribution, distribution derivatives, Sobolev space, spatial properties of H^1.	2
Lec7	Generalized solutions of elliptic equations II row Weak formulation of boundary value problems, Lax-Milgram theorem, application of Lax-Milgram theorem.	2
Lec8	Methods of variational equations The method of least squares orthogonal projection method, Galerkin method, Ritz method.	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1	Solving problems of the simplest methods of integration of partial differential equations	1
Cl2	Imports of second order linear equations to canonical form	2
Cl3	Imports of second order linear equations to canonical form Solving boundary value problems by the method of separation of variables	2
Cl4	Solving the boundary problems containing the Laplace equation	2
Cl5	Solving the problems relating to properties of normed spaces	2
Cl6	Solving the problems relating to properties of Sobolev space	2
Cl7	Solving problems concerning the application of Lax-Milgram theorem (proof uniqueness of solutions). Solving problems using Galerkin and Ritz methods.	2
Cl8	Solving problems using Galerkin and Ritz methods. Colloquium (45 minutes)	2
	Total hours	**15**

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: traditional form - definitions, theorems and proofs in all written on the blackboard.
N2. Lectures and exercises: longer examples presented theorems and methods.
N3. Classes: Discussion within a group of students of different abilities to solve problems.

N4. Prepared lists and tasks on the website [2] for independent solution and opportunities for presentation and discussion exercises. The complete solution will be served at exercises, and some posted on the [2].

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 (classes)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_K01 PEK_K02	assess the activities of students in solving problems formulated at the list of tasks
P1 (classes)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_K02	final assessment on the basis of the final test (45 minutes), including assessments for the activity
P2 (lecture)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_K02	Final Exam - tasks to solve

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1. R.V. Churchill, J.W.Brown, Fourier Series and Boundary Value Problems, McGraw-Hill Book Company, New York 1978.

[2] http://www.ib.pwr.wroc.pl/wpula

SECONDARY LITERATURE:

[1] W. Puła, Mathematics. A Short introduction to Ordinary and Partial Differentia Equqtions, Politechnika Wrocławska, 2011.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego:

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MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mathematics – selected topics
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 *****
Knowledge				
PEK_W01	K2_W01	C1, C2	Lec1-Lec4 Cl1-Cl3	N1-N4
PEK_W02	K2_W01	C4-C5	Lec5- Lec7 Cl5-Cl7	N1-N4
PEK_W03	K2_W01	C4-C5	Lec1, Lec7, Lec8 Cl3, Cl4, Cl8	N1-N4
Skills				
PEK_U01	K2_U08	C1, C3, C4	Lec1,Lec2, Lec7 Cl1, Cl2, Cl4	N1-N4
PEK_U02	K2_U08	C1,C2	Lec2, Lec3 Cl2, Cl3	N1-N4
PEK_U03	K2_U08	C4, C5	Lec6	N1-N4
PEK_U04	K2_U08	C4, C5	Lec7, Lec8	N1-N4
Social competence				
PEK_K01	K2_K01, K2_K02	C2, C3	Cl1-Cl8	N2-N4
PEK_K02	K2_K03, K2_K06	C1-C5	Cl1-Cl8 Lec1-Lec8	N1-N4

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Selected topics in geo-engineering – Foundations**
Name in Polish:	**Wybrane zagadnienia geoinżynierii – Fundamenty**
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:	**CEB007361**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**30**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,5**			**1,2**	

*cross out if not applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

P1. Fundamentals of bearing constructions in civil engineering, fundamentals of strength of materials and soil mechanics.
P2. Basic types of foundations for different simple geoengineering conditions, geotechnical categories GC1 and GC2, construction processes of foundations, functional and environmental aspects of foundations depending on the type of object, loadings, soil conditions and water in soils.
P3. Principles of soil-structure interacion for undeformable foundations, embedded walls, retaining structures; calculation of the bearing capacity, stability of slopes, calculation of soil and water pressure.
P4. Design of basic concrete elements, like beams, footings and columns; reinforcement calculation.
P5. Solving of the simplest linear ordinary differential equations with constant coefficients.

SUBJECT OBJECTIVES

C1. Ability in modelling of the soil-structure interaction for deformable foundations on deformable subsoil; contact stresses redistribution, changes of internal forces, mining influences as a static excitation.
C2. Knowledge of mathematical solutions to simple deformable foundations on the elastic subsoil, the Winkler model and the elastic halfspace; application of differential equations.
C3. Building an engineering intuition in prediction of internal forces in foundations, non-uniform

settlements and rational analysis of structures interacting with the subsoil.

C4. Gaining knowledge in more complex problems of the earth pressure prediction, generalizations of the Coulomb solution.

C5. Developing knowledge and ability of application of methods of the earth pressure reduction, stability improvement, shaping of retaining walls.

C6. Understanding necessity of safety in geotechnical design – design approaches with partial safety factors due to the Eurocode EC7-1.

C7. Developing skills in design of foundations.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	student gains a theoretical knowledge in applications of ordinary differential equations towards calculation of deformable foundation beams, as well as piles and walls embedded in soils, a better understanding of the method of virtual forces (the Bleich method) - being a prototype for the boundary element method,
PEK_W02	understands a theoretical background of the method of partial safety factors in geoengineering, uses the design approaches required by the Eurocode EC7-1 – the GEO stability criteria in this group,
PEK_W03	understands problems of soil-structure interaction on the example of elastic subsoils, knows how to design retaining constructions transmitting large loadings on the soil – particularly non-vertical forces, gets a background to identify poor engineering solutions,
Relating to skills:	
PEK_U01	student can define and apply appropriate calculation models for deformable foundations and deformable soils, analyses internal forces in foundations and combinations of such actions (also for mining excitations),
PEK_U02	can interpret the special role played by elastic fixities of constructions in the soil, is aware of fundamental shortcomings in commercial codes of CAD for CE designers,
PEK_U03	becomes skillful in modelling of the soil-structure interaction problems, can calculate more complex foundations within the geotechnical category 2 and 3,
Relating to social competences:	
PEK_K01	student improves the ability to work alone and in a group of designers (due to discussions with other students during class-projects and with the teacher),
PEK_K02	drills in logical thinking, clear formulation of theses and requirements, concentration on given tasks – within a given theory and set margins of assumptions.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	<u>Examples of the soil-foundations interaction</u>: Role of the foundation stiffness, influence of a superstructure stiffness and the subsoil compressibility on contact forces and structural behaviour	1
Lec2	<u>Linear calculation models of the subsoil compressibility</u>: Global models – the Winkler subsoil, the Pasternak one, the Kerr one *etc.*, local models – the elastic halfspace, finite elastic layers; rational selection of the most adequate linear model, real-soil behaviour and application limits of the linear models	1
Lec3	<u>Calculation of simple foundations resting on the linear elastic subsoil</u>: Foundation beams – the fundamental solution, the basic solutions, boundary conditions, the method of Bleich (virtual forces applied outside the real beam), the method of polynomial expansions by Zavrijev; beams, piles, walls, foundation grids, foundation slabs	2

Lec4	Elements of the mining geoengineering: Types of mining deformations and the prediction methods, parameters of the ground surface subsidence, mining categories, tolerance of engineering objects to deformations, the simplest construction principles; practical examples	3
Lec5	Types and construction of retaining structures: Massive (gravity) retaining walls, light (cantilever) retaining walls, structures embedded in soil, reinforced-soil retaining structures; general stability criteria ULS(GEO) and SLS due to Eurocode EC7-1	1
Lec6	Earth pressure theories: The Coulomb-Mohr solutions, the Rankine-Mohr approach, the Coulomb-Poncelet method for the active earth pressure, the Coulomb-Poncelet method for the passive earth pressure, the Müller-Breslau expressions, the Rankine-Mohr approach, the Prandtl solution; the Caquot & Kerisel charts (EC7-1)	3
Lec7	Practical cases of the earth pressure calculations: Angular cantilever walls; role of cohesion - the method of corresponding states of stresses; bearing capacity GEO against the soil heave **Final test #1 (45min)**	2
Lec8	Geoengineering faults and failures: Insufficient geotechnical data, misinterpretation of soil behaviour, design errors, not correct construction processes, unexpected changes of conditions and poor recognition of environmental influences, faults during the repair/rescue action; A case history – The Leaning Tower of Pisa. **Final test #2 (45min)**	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Design Project #1 – Foundation beam on a mining area: analysis of the situation, project data, calculation methods	1
Proj2	foundation length estimation (linear soil reaction, beam bending moments)	1
Proj3	foundation width estimation (ULS-GEO), shaping of the beam cross section	2
Proj4	Selection of the soil model, estimation of model parameters, solving of the infinite beam for the acting forces	3
Proj5	Solving of the finite beam – the use of the Bleich virtual forces	3
Proj6	analysis of mining deformations and mining forces	2
Proj7	concrete design; construction drawings	2
Proj8	Project defense/project acceptance - an evaluation test	2
Proj9	Design Project # 2 – Cantilever retaining wall: analysis of the situation, project data, input shaping, setting of loadings	2

Proj10	the Rankine earth pressure, checking of the stability ULS-GEO	2
Proj11	the Poncelet earth pressure, checking of the stability ULS-GEO	2
Proj12	concrete design of the wall and the foundation slab (cantilevers)	2
Proj13	construction details, construction drawings	2
Proj14	Project defense/project acceptance - an evaluation test	2
Proj15	final acceptance	2
	Total hours	**30**

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: recalling practical examples from geotechnical expertise, sketches and drawings. N2. Lecture and Project: more complex calculation examples can be downloaded from the author's web site [5]. N3. Project: individual consulting, discussion of problems in a group of students. N4. List of problems and calculation tasks for a self-study can be downloaded from the author's web site [5] – some of them are accompanied by hints, answers or full solutions.

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 (Project)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U03 PEK_K01 PEK_K02	Systematical – every week – checking of the student's progress during classes and consulting hours
P1 (Project)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U03 PEK_K01 PEK_K02	Final defense of each of two projects; detailed questions about the project, discussion of student's errors or mistakes; project corrections and improvements.
P1 (Lecture)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03 PEK_K02	Two final tests during two last lectures; wide spectrum of questions and calculation tasks (theoretical, practical, interdisciplinary and holistic ones)

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Bond A., Harris A., Decoding Eurocode 7. *Taylor & Francis*, 2008. [2] Cernica J., Geotechnical engineering: Foundation design. *John Wiley & Sons*, 1995. [3] Henry J., Foundation engineering, 1990. [4] Lancellotta R., Geotechnical engineering, *A.A. Balkema*, 1995*; Spon Press*, 2008. [5] Reese L.C., Isenhower W.M., Wang S.-T., Analysis and design of shallow and deep foundations. *John Wiley & Sons*, 2006. [6] Eurocode EC7-1. Geotechnical design, Part 1. **[7]** www of world-leading foundation companies. **SECONDARY LITERATURE:** [1] Selvadurai A.P.S., Elastic analysis of soil-foundation interaction, *Elsevier*, 1979. [2] Other Eurocodes and national codes in CE. [3] http://www.ib.pwr.wroc.pl/brzakala

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Selected topics in geo-engineering – Foundations
AND EDUCATIONAAL 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 *****
Knowledge				
PEK_W01	K2_W01, K2S_CEB_W16	C1, C2, C7	Lec1-Lec3	N2-N4
PEK_W02	K2_W06, K2S_CEB_W20	C4-C6	Lec5 Proj3 Proj10-Proj12	N2-N4
PEK_W03	K2_W08, K2S_CEB_W19	C1-C5	Lec1-Lec8 Proj1-Proj15	N1-N4
Skills				
PEK_U01	K2_U04, K2_U05, K2S_CEB_U20	C2, C4, C6, C7	Lec1-Lec8 Proj1-Proj15	N1-N4
PEK_U02	K2_U09, K2_U16, K2S_CEB_U22	C1-C3	Lec1-Lec8 Proj1-Proj15	N1
PEK_U03	K2_U10, K2_U17, K2S_CEB_U23	C2, C4, C7	Proj1-Proj15	N2, N4
Social competence				
PEK_K01	K2_K03	C2, C4, C7	Proj1-Proj15	N2-N4
PEK_K02	K2_K06	C1-C6	Proj1-Proj15 Lec1-Lec8	N1-N4

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in Polish:	**Konstrukcje betonowe – obiekty**
Name in English:	**Concrete Structures - objects**
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:	**CEB007561**
Group of courses:	**~~YES~~ / NO***

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

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possesses the knowledge of general mechanics, mechanics (strength) of materials and the rules of general designing of building constructions.
2. Student is able to define correctly the construction and their elements calculation models, that are used for analytical and computer analysis of complex constructions.
3. He knows the principles of forming, dimensioning and constructing complex reinforced concrete structur of the building and engineering objects.
4. He is able to use selected computer software that enables to design selected complex reinforced concrete constructions.

SUBJECT OBJECTIVES

C1. Familiarizing students with the rules of designing complex reinforced concrete constructions as a rational joint of beams, columns, shells, plates and beam-walls.

C2. Forming the ability of independent modelling and analyzing complex, diversified reinforced concrete structures using analytical and computer calculations.

C3. Familiarizing students with the principles of forming, calculating and constructing main reinforced concrete elements forming up: the supporting construction of volume general building and engineering building objects such as industrial buildings and multi-storey framework buildings as well as roofs, walls, bottoms and foundation of liquids tanks, silos and reinforced concrete tower buildings.

C4. Reaffirming the ability of an effective cooperation in a project team including the multi-field character of project process.

SUBJECT EDUCATIONAL EFFECTS
Relating to knowledge:
PEK_W01 Student knows and comprehends the rules of idealizing, numerical modelling and analyzing the complex reinforced concrete structures.
PEK_W02 Student possesses profoundly wide knowledge of analysis, dimensioning and constructing the complex reinforced concrete structures.
PEK_W03 Student is familiar with the principles of static work under the influence of diversified loads over the beam and column reinforced concrete constructions, slab reinforced concrete constructions, beam-walls reinforced concrete constructions and shell reinforced concrete constructions.
Relating to skills:
PEK_U01 Student is able to classify and analyze analytically or numerically the complex reinforced concrete structures in relation to varied forces, and consequently, to critically assess the obtained results.
PEK_U02 Student is able to design the complex reinforced concrete constructions and prepare a necessary project documentation.
Relating to social competences:
PEK_K01 Student is aware of importance of non-technical aspects in an engineer's work as well as of indispensability of continuous learning.
PEK_K02 Student effectively cooperates with a project team and respects the safety regulations to protect himself and the project team members during work.

PROGRAMME CONTENTS		
Form of classes - lecture		**Number of hours**
Lec1	Forming principles and outline of the analysis of a column-and-girder-frame construction of the industrial buildings with overhead traveling cranes.	2
Lec2	Forming, analyzing and constructing reinforced and prestressed single- and multi-span two-way reinforced concrete slabs.	2
Lec3	Forming, analyzing and constructing solid web girders and prestressed roof trusses.	2
Lec4	Designing overhead crane girders and single- or double-tee columns in industrial reinforced concrete buildings.	2
Lec5	Forming and designing the construction of the multi-storey framework reinforced concrete buildings.	2
Lec6	Designing column-and-girder constructions. Reinforcing the slab floor against punching.	2
Lec7	Forming, analyzing and constructing reinforced concrete beam- walls; designing folded plate covers.	2
Lec8	Outline of the principles of forming and usage of the reinforced concrete shells as the thin-walled constructions, used in volume general building and industrial building objects.	2
Lec9	General rules of forming the thin-walled covers. Designing monolithic and prefabricated reinforced concrete domes.	2
Lec10	Designing underground, on-the-ground and tower reinforced concrete tanks for liquids.	2
Lec11	Designing the underground and on-the-ground box-shaped (rectangular shaped) tanks for liquids used in municipal and industrial building	2
Lec12	An outline of forming and designing cooling towers, reinforced concrete chimneys and other reinforced concrete tower objects. Technological background of thin-walled reinforced concrete constructions' erection.	2

Lec13	Forming slender and corpulent silo bins as well as silo batteries in corn elevators. Principles of setting loads in silos and the outline of studies on the influence of loose materials on the silo's construction elements.	2
Lec14	Designing silos and bunkers with the diversified heights, detached and blocked ones.	2
Lec15	Technological aspects of designing thin-walled constructions made of concrete; the rules of performing proofed expansion joints and working joints.	2
	Total hours	**30**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Handing out the project topics in a field of complex reinforced concrete constructions in the form of domes and cylindrical and rectangular shaped tanks for liquids.	2
Proj2	Conditions for preparation of two initial geometrical construction variants; talking over a choice of construction materials and technological background of discussed construction variants.	2
Proj3	Approval of variant choice for a project use; talking over the rules of creating calculation models used for static analysis performed with the help of the following methods: analytical, Finite Element Method (FEM) or simplified methods	2
Proj4	Presenting the rules of compiling loads in a construction and defining the extreme inner forces. Describing the characteristics of defining the loads in tanks for liquids.	2
Proj5	Talking over static calculations with the use of analytical methods and FEM for the selected construction variant. Checking up the results applying the simplified methods.	2
Proj6	Selection of the parts of the analysed constructions for further analysis and dimensioning. Discussion over the rules of preparing building and working drawings of thin-walled reinforced concrete structures.	2
Proj7	Taking over the results of statical analysis and characteristics of thin-walled elements' dimensioning, taking into consideration ultimate and serviceability limit states	2
Proj8	Discussion over the typical mistakes and faults in analysis and preparation of the construction drawings.	2
Proj9	Discussion over the dimensioning results of the selected parts of a construction.	2
Proj10	Initial evaluation of the submitted drafts of reinforcement members.	2
Proj11	Discussion over the characteristics of outlining the thin-walled cross-sections and forming trusses and connection zones of construction component	2

	elements.	
Proj12	Evaluation of cross-section geometry, insert placement and submitted assembly and working drawings	2
Proj13	Talking over the rules of applying technical characteristics and guidelines on gathering the final project documentation.	2
Proj14	Final evaluation of submitted working drawings.	2
Proj15	Collection of the projects. Crediting with notes. Final summing-up.	2
	Total hours	**30**

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture – Informative lecture, problem-solving lecture, multimedia presentations. N2. Project – Discussing over the project requirements, overview of possible solutions , consultations

EVALUATION OF SUBJECT EDUCATIONAL RESULTS ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational result numer (reference)	Method of evaluating educational result achievement
P (project)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_K02	Completion of a project and its presentation
P (lecture)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02	Exam
P (laboratory etc.) =		
P (lecture) =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

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[1 Budownictwo Przemysłowe, t. XIII. Zbiorniki, zasobniki, silosy, kominy i maszty. Arkady, Warszawa 1966.
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Concrete Structures - objects
AND EDUCATIONAAL 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 *****
Knowledge				
PEK_W01	K2S_CEB_W16, K2_W06, K2_W07, K2_W08	C1, C2, C3	Lec1 to Lec15 Proj2 to Proj14	N1 N2
PEK_W02	K2S_CEB_W18, K2_W07	C1, C3, C4	Lec1 to Lec15 Proj2 to Proj14	N1 N2
PEK_W03	K2S_CEB_W16, K2_W04	C1, C2	Lec1 to Lec15 Proj2 to Proj14	N1 N2
Skills				
PEK_U01	K2S_CEB_U18, K2S_CEB_U19, K2_U09, K2_U11	C2, C3	Lec1 to Lec15 Proj2 to Proj14	N1 N2
PEK_U02	K2S_CEB_U18, K2_U11, K2_U12	C1, C2, C3, C4	Lec1 to Lec15 Proj2 to Proj14	N1 N2
Social competence				
PEK_K01	K2_K01, K2_K02	C2, C4	Lec1 to Lec15 Proj2 to Proj14	N1 N2
PEK_K02	K2_K03	C4	Proj1 to Proj15	N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Metal structures - objects**
Name in Polish:	**Konstrukcje metalowe - obiekty**
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:	**CEB007661**
Group of courses:	**~~YES~~ / NO***

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

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Is able to determine: the cases of actions, calculation of their intensity, making of their right combination for an individual building systems.
2. Has a knowledge of the mechanics of buildings, strength of materials, shaping of elements and connections used in metal structures.
3. Is able to design and calculate connections according to PN-EN 1993-1-1, PN-EN 1993-1-5, PN-EN 1993-1-8.
4. Has a knowledge of the modelling of structures in MES and the ability to use computer software.

SUBJECT OBJECTIVES

C1. To acquaint students with primary structure and the skeleton of industrial buildings, long span coverings, typical structures of tanks, siloses for bulk materials, chimneys, towers masts and multi-storey buildings, and English appropriate terminology.

C2. To acquaint students with the rules of setting the static schemes for mentioned above systems regarding their specify of actions, determining the internal forces by simplified and accurate methods of static calculations.

C3. Training of dimensioning of steel cross-sections and members.

C4. Developing of skills of the rational shaping of different steel structural members, division on field components, calculation of shop and site connections.

C5.	Developing of skills of description of building design and executive design, descriptive part, calculation and graphical part for different steel structures based on the example of the space regular structure.
C6.	Training of the cooperation and integration of Polish and foreign students in exchange of experience, knowledge and team work.
C7.	To deepen and strengthen the knowledge of the English terminology appropriate for different types of steel structures.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Has an enlarged knowledge of: advanced topics of the strength of materials, analysis and shaping of complex steel structures, calculation of adequacy of connections of different types.
PEK_W02	Knows and understands the rules of analysis of static schemes and stability for complex strut and skin structures by simplified methods (substitutional simple schemes) and accurate methods (computer programs).
Relating to skills:	
PEK_U01	Is able to shape the overall geometry and the cross-sections for different types of steel structures and to set their assembling components based on the static and strength analysis.
PEK_U02	Has the ability to model and design the complex structural elements in the building and executive design.
PEK_U03	Develop the skills of designing steel structures according to Eurocode3 in English.
Relating to social competences:	
PEK_K01	Shows a willingness to improve professional and personal skills, extends the knowledge of technical English language.
PEK_K02	Appreciates the importance of mutual support and teamwork skills, communicates effectively in technical English vocabulary related to civil engineering.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Primary structure of industrial buildings	2
Lec2	Skeleton members and cladding	2
Lec3	Bracings of industrial buildings - types and geometry	2
Lec4	Dead and imposed loads	2
Lec5	Dimensioning of main members of industrial buildings	2
Lec6	Dimensioning of main members of industrial buildings (continuation)	2
Lec7	Anchorage of main and secondary columns in the foundations	2
Lec8	Construction of long - span coverings – flat and barrel structures	2
Lec9	Construction of long - span coverings – domes	2
Lec10	Construction of long - span coverings – cable structures	2
Lec11	Tangs for liquids and silos for bulk materials	2
Lec12	Chimneys – actions, construction, design	2
Lec13	Towers – actions, construction, design	2
Lec14	Masts – actions, construction, design	2
Lec15	Skeletons of multi – storey buildings	2
	Total hours	**30**

Form of classes - class	**Number of hours**

Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Edition of tasks related to the space covering – discussion of rules and conditions of gaining the credit- general characteristics of steel space structures	2
Proj2	Discussion of static schemes of space structures	2
Proj3	Discussion and presentation of geometry of the space structures	2
Proj4	Dead and imposed loads acting on roof coverings	2
Proj5	Simplified calculations of space structures based on the beam and plate analogy	2
Proj6	Simplified calculations of space structures based on the beam and plate analogy (continuation)	2
Proj7	Accurate static computation based on computer programs (creation of models)	2
Proj8	Dimensioning of strut elements under axial or/and axial and bending – creation of zones	2
Proj9	Types of joints used in space structures – patent and other constructions	2
Proj10	Options of joints related to the overall geometry and assembly concept	2
Proj11	Presentation and analyses of existing student works	2
Proj12	Discussion of general rules related to the executive design for steel structures	2
Proj13	Discussion of general rules of execution of assembling and shop drawings for steel structures	2
Proj14	Discussion of current issues related with the points (proj6 - proj13)	2
Proj15	Successive testing of students' skills and the level of progress in the execution of the given task (proj6 – proj13)	2
	Total hours	**30**

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: informative lecture, problem lectures, multimedia presentation N2. Project: traditional and multimedia presentation, consultations

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 (project)	PEK_U01	Evaluation of calculation and graphical parts of the design
	PEK_U02	
	PEK_U03	
F2 (project)	PEK_W02	Activity during problem discussions
P=0,6xF1+0,4xF2 (project)		
P (lecture)	PEK_W01	Examination
	PEK_W02	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Gaylord E.H.,Gaylord Ch.N., Stallmeyr J.E., Design of steel structures, Mc Graw-Hill, Inc., 1992
[2] Newman A., Metal building systems, design and specifications, Mc Graw-Hill., New York 1997
[3] Łubiński M., Żółtowski W., Konstrukcje metalowe, część 2, Arkady, Warszawa 2004
[4] Biegus A., Stalowe budynki halowe, Arkady, Warszawa 2003
[5] Rykaluk K., Konstrukcje stalowe. Kominy, wieże, maszty, Oficyna Wydawnicza PWr, Wrocław 2005
[6] Trahair N.S. and others, The behaviour and design of steel structures to EC3, Fourth edition, Taylor & Francis Group, London and New York 2008
[7] Makowski Z.S., Analysis, Design and Construction of braced Barrel Vaults, Elsevier Applied Science Publishers, London 1985

SECONDARY LITERATURE:

[1] Bródka J. I inni., Przekrycia strukturalne, Arkady, Warszawa 1985
[2] Nooshin H., Third International Conference on Space Structures, London 1984

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metal structures - objects
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 ***
Knowledge				
PEK_W01	K2_W01,K2_W02, K2_W06, K2_W07, K2S_CEB_W16	C1,C3	Lec1 to Lec15	**N1**
PEK_W02	K2_W04, K2_W05, K2_W06, K2_W07, K2_W09	C1,C2	Lec1 to Lec15	**N1**
Skills				
PEK_U01	K2_U01, K2_U04, K2_U12, K2S_CEB_U18	C3,C4	Proj2 to Proj15	**N5**
PEK_U02	K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2S_CEB_U19	C3,C4,C5	Proj1 to Proj15	**N5**
PEK_U03	K2_U02, K2_U05, K2_U06	C3,C4,C5,C7	Proj2 to Proj15	**N5**
Social competences				
PEK_K01	K2_K01,	C6,C7	Lec1 to Lec15	**N1**
PEK_K02	K2_K02, K2_K03	C6	Proj1 to Proj15	**N5**

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

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)			**30**		
Number of hours of total student workload (CNPS)			**60**		
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points			**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points for direct teacher-student contact (BK) classes			**1,2**		

* 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	
Relating to knowledge:	
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.
Relating to skills:	
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.
Relating to social competences:	
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		
…		
	Total hours	

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

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
	Total hours	**30**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

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 = 0,4xF1+0,55xF2+0,05xPRESENCE		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[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).
SECONDARY LITERATURE:
[1] http://www.issmo.org/.
[2] http://www.esc.auckland.ac.nz/teaching.
[3] Computers & Structures, *Elsevier*; http://www.elsevier.com.
[4] Structural and Multidisciplinary Optimization, *Springer-Verlag*; http://vls2.icm.edu.pl.
[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.

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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 ***
Knowledge				
PEK_W01	K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2S_CEB_W16, K2S_CEB_W22	C1, C2	Lab1 - Lab15	N1
Skills				
PEK_U01	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
PEK_U02	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
PEK_U03	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
Social competence				
PEK_K01	K2_K01, K2_K02, K2_K03	C3	Lab1 - Lab15	N1
PEK_K02	K2_K01, K2_K02, K2_K03	C3	Lab1 - Lab15	N1

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Hydraulics in Civil Engineering**
Name in Polish:	**Hydraulika w budownictwie**
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:	**CEB007861**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**15**	
Number of hours of total student workload (CNPS)	**30**			**30**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *	~~Examination~~ / crediting with grade *	Examination-/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**1**	
including number of ECTS points for practical (P) classes				**1,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**1,0**			**0,6**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possesses knowledge of the areas of mathematics and physics, basic hydraulics, geology and hydrogeology.
2. Student possesses knowledge of the basic property of the solid body and liquids.

SUBJECT OBJECTIVES

C1. Gaining knowledge in the range of hydraulics laws, with hydrostatics and hydrodynamics
C2. Gaining knowledge in the range of pressure pipe flow and open channel flow, in steady and unsteady movement.
C3. Gaining knowledge in the range of porous media water flow.
C4. Gaining knowledge in the range of hydraulic calculations including: hydrostatic force acting on the flat and curved surfaces, simple hydraulic systems calculation, open channel designing, determining of bridges and culverts cross-sections, designing of solid and temporary dewatering systems,.
C5. Gaining knowledge of realizing laboratory measurements in the range of hydrostatics and hydrodynamics.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:	
PEK_W01	Knows and understands the basic hydraulics laws in the range of hydrostatics and hydrodynamics, with the equations describing laminar and turbulent flows of compressible and non compressible fluid (Navier-Stokes and Reynolds equations)
PEK_W02	Knows theory of laminar and turbulent flow in pressured pipes, with Bernoulli's equation, equations for friction and local loss of head calculation.
PEK_W03	Gaining knowledge in range of open channel flow calculations, with Chezy equation, calculations principles of most hydraulically efficient cross-section, knows theory of critical movements.
PEK_W04	Knows theory of porous media flow and gaining knowledge in range of simplified hydraulic filtration model.
PEK_W05	Gaining knowledge in range of hydro-engineering structures, with siphons and syphons, bridges and culverts.
Relating to skills:	
PEK_U01	Gaining skills of hydrostatic force calculation on flat and curved surfaces, buoyancy force of submerged solid body.
PEK_U02	Gaining skills of orifices outflow and weir discharge calculation.
PEK_U03	Gaining skills of simple water system calculation, consists of series or parallel pipes.
PEK_U04	Gaining skills of open channel project.
PEK_U05	Gaining skills of horizontal or vertical drainage system calculation of building trench.
PEK_U06	Gaining skills of small bridge or culvert cross-section calculation.
PEK_U07	Gaining skills of laboratory and ground measurements in the range of flow velocity and discharge, stage or depth of water flow
Relating to social competences:	
PEK_K01	Is able to work individually on the realization of strict designing problem or in the team during realizing of ground or laboratory measurements.
PEK_K02	Is conscious of necessity knowledge widening in the range of contemporary technologies in hydraulics and computer programs for designing of hydro-engineering structures.

PROGRAMME CONTENT		
Form of classes – lecture		**Number of hours**
Lec1	Short history of hydraulics as the science. Fundamental physical properties of water. Newton' law. Forces in fluid field. Pressure definition and its properties. Hydrostatics force on flat and curved surfaces. Buoyancy – Archimedes's law.	2
Lec2	Principles of fluid flow. Types of fluid motion in pipes and open channels. Basic hydraulics equations – continuity equation, energy equation, and momentum equation. Reynold's experiment. Water flow in pipes. Friction factor for laminar and turbulent flow.	2
Lec3	Water flow in closed conduits or pipes, local head losses. Designing of simple pressured pipes. Designing of siphons and syphons – calculating examples. Partially full closed conduits.	2
Lec4	Designing of the most hydraulically efficient open channels. Calculating of stage – discharge relation for natural river cross-section. Numerical models of open channel flow. Specific energy definition with open channel flow. Critical water flow in open channels. Calculating examples.	2
Lec5	Gradually and rapidly varied flow. Hydraulic jump as the example of rapidly varied flow. Differential equation of gradually varied flow in open channels – artificial and natural ones. Unsteady water flow in closed conduits and in open channels.	2

Lec6	Water outflow through orifices. Weirs and their classification in the range of constructional solutions and hydraulics of the water flow. The principles of weirs calculations. Calculation of road culverts. Spillways and stilling basins of the dams creating storage reservoirs. Control cross-sections of hydro-engineering structures.	2
Lec7	Ground and laboratory measurements, of pressure, water stages, water depths, velocity or flow discharge. The principles of ground water flow. Darcy's and Dupuit's Law. Laminar and turbulent ground water flow.	2
Lec8	Class test	1
	Total hours	**15**

Form of classes – class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes – laboratory		**Number of hours**
Lab1		
...		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Hydrostatic force calculation on flat and curved surfaces, determining of direction of acting and point of force imposing.	2
Proj2	Project of water supply system of construction site, with determining of water requirement, the choice of source of water uptake, the choice of diameter of supply pipe.	2
Proj3	Project of sewage system, with waste water balance, choice of waste water receipt, the choice of diameter of sewage conduit.	2
Proj4	Discharge calculation in open channels. Project of optimal cross-section of an open channel.	2
Proj5	Determining of flow condition on the chosen length of natural river, with water passing through bridge or culvert cross-section with HEC-RAS numerical model.	7
	Total hours	**15**

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Laptop with Power Point for multimedia presentation. N2. Computer programs in computer laboratory of Institute of Geotechnics and Hydrotechnics, for realizing of project exercises.

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 (lecture)	PEK_W01 ÷ PEK_W05	
P = F1 (lecture)		Written test – questions on theory and practical problems.
E2 (project)	PEK_U01 ÷ PEK_U07	
P = F2 (project)		Customize of the multi elemental project.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. A. Chadwick, J. Morfett, M. Borthwick. Hydraulics in Civil and Environmental Engineering. Taylor & Francis Group – Spon Press. London 2004.
2. M. Kay. Practical Hydraulics. Taylor & Francis Group – Routledge. New York 2008.
3. R.J. Houghtalen, N.F.C. Hwang, A. Akan Osman. Fundamentals of Hydraulic Engineering Systems. Pearson Education, Inc. New Jersey 2010.

SECONDARY LITERATURE:

1. A. Prakash. Water resources engineering kandbook of essential methods and design. ASCE Press 2004.
2. R.M. Khatsuria. Hydraulics of Spillway and Energy Dissipators. Marcel Dekker 2005.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulics in Civil 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 *****
Knowledge				
PEK_W01	K2_W01, K2_W02, K2S_CEB_W17	C1, C4	Lec1, Proj1	**N1, N2**
PEK_W02	K2_W01, K2_W02, K2S_CEB_W17	C2, C4	Lec2	**N1**
PEK_W03	K2_W01, K2_W02, K2_W06, K2S_CEB_W17	C1, C2, C4	Lec3, Proj2	**N1, N2**
PEK_W04	K2_W01, K2_W02, K2_W06, K2_W14, K2S_CEB_W17	C1, C3, c4	Lec7	**N1**
PEK_W05	K2_W01, K2_W02, K2_W06, K2_W14, K2S_CEB_W17	C1, C4	Lec3, Lec4, Lec5, Lec6, Proj5	**N1, N2**
Skills				
PEK_U01	K2_U01, K2-U03, K2S_CEB_U20	C1, C4	Lec1, Proj1	**N1, N2**
PEK_U02	K2_U01, K2_U03, K2_U19 K2S_CEB_U20	C1, C4	Lec5, Lec6	**N1**
PEK_U03	K2_U01, K2_U03, K2_U19 K2_U20, K2S_CEB_U20	C1, C2, C4	Lec2, Lec3, Proj2	**N1, N2**
PEK_U04	K2_U01, K2_U03, K2_U19 K2_U20, K2S_CEB_U20	C1, C2, C4	Lec2, Lec4, Proj4	**N1, N2**
PEK_U05	K2_U01, K2_U02, K2_U19 K2_U20, K2S_CEB_U20	C1, C3, C4	Lec7	**N1**
PEK_U06	K2_U01, K2_U02, K2_U19 K2S_CEB_U20	C1, C4	Lec6, Proj5	**N1, N2**
PEK_U07	K2_U06, K2_U017, K2_U19 K2S_CEB_U20	C5	Lec7	**N1**
Social competence				
PEK_K01	K2_K02, K2_K03	C4	Proj1 to Proj5	**N2**
PEK_K02	K2_K02	C4	Lec1 to Lec8	N1

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Theory of elasticity and plasticity**
Name in Polish:	**Teoria sprężystości i plastyczności**
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:	**CEB008361**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**	**15**			
Number of hours of total student workload (CNPS)	**60**	**60**			
Form of crediting	~~Examination~~ / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**	**2**			
including number of ECTS points for practical (P) classes		**0,8**			
including number of ECTS points for direct teacher-student contact (BK) classes	**1,1**	**0,6**			

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has necessary knowledge of selected topics of mathematics and physics as a base of structural analysis.
2. The student has knowledge of structural mechanics and strength of materials.
3. The student has knowledge of partial differential equations and Fourier series.

SUBJECT OBJECTIVES

C1. Introduction to three dimensional problem of theory of elasticity
C2. Presentation of physical basis and assumptions in plane problems.
C3. Presentation of assumptions, equations and analytical solutions in Kirchhoff theory of thin plates
C4. Presentation of assumptions, equations and analytical solutions in Kirchhoff-Love theory of thin shells
C5. Introduction to theory of plasticity. Presentation of limit load theory for thin plates.
C6. To set a conviction about necessity of knowledge continuous extension in field of theory of elasticity and plasticity.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student knows and understands the equilibrium, geometrical and physical relations for linear-elastic, isotropic body.
PEK_W02	The student knows and understands the differences between linear and nonlinear descriptions and isotropic anisotropic bodies.
PEK_W03	The student knows and understands assumptions, internal forces definitions and boundary conditions in plates and shells.
PEK_W04	The student knows and understands the differences between bending and membrane shells theories.
PEK_W05	The student knows and understands basic terms of theory of plasticity, definitions and theorems of limit load theory.
Relating to skills:	
PEK_U01	The student recognizes properly plane problems and thin plates or shells issues.
PEK_U02	The student is capable of use analytical solutions for selected discs, plates and membrane shells problems.
PEK_U03	The student is capable of evaluate limit load for plates using kinematic approach.
Relating to social competences:	
PEK_K01	The student has a conviction about necessity of knowledge continuous extension in field of theory of elasticity and plasticity.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction. Index notation. Stress tensor: differential equilibrium equation	2
Lec2	Stresses tensor (cont.): kinetic boundary conditions, transformation, invariants, principal stresses and directions.	2
Lec3	Continuous body motion: Lagrange and Euler description, strain tensors, compatibility equations. Linear elastic material models. General Hooke's law. Theory of elasticity equations set. Lame and Beltrami-Mitchell equations.	2
Lec4	Elastic strain energy. Total potential energy. Virtual work principle. Lagrange theorem. Stable and unstable equilibrium.	2
Lec5	Plane problems. Airy stress function for plane stress.	2
Lec6	Plane problem in polar coordinates – application of Airy stress function, third order differential equation for axial symmetry case.	2
Lec7	Thin plates. Kirchhoff theory: assumptions, stresses and internal forces, equilibrium equations, boundary conditions.	2
Lec8	Analytical solutions for plates. Rectangular plate – Navier approach.	2
Lec9	Plate stability. Second order bending theory.	2
Lec10	Annular plates. Fourth and third order differential equations for axial symmetry case.	2
Lec11	Thin shells. Assumptions. Geometrical description. Stresses distribution and internal forces. Bending theory application for cylindrical container.	2
Lec12	Membrane theory for shells of revolution. Equilibrium equations. Analytical solutions for spherical and conical geometry and axis-symmetrical load.	2
Lec13	Basis of theory of plasticity: plastic body models, general plasticity conditions, plasticity conditions for plates, Definitions and theorems of limit load theory.	2
Lec14	Lecture summary. Examples of test tasks.	2
Lec15	Test	2
	Total hours	**30**

Form of classes - class		Number of hours
Cl1	Index notation – application examples.	1
Cl2	Stress tensor components transformation. Invariants, principal stresses and directions calculation.	2
Cl3	Application of Airy stress function in solution of plane stress problems.	2
Cl4	Plane problem in polar coordinates – stress concentration caused by a circular hole.	2
Cl5	Navier solution for plates.	2
Cl6	Hyperboloid membrane shell – different geometry parameterization	2
Cl7	Kinematic approach to limit load evaluation for rectangular and circular plates.	2
Cl8	Test.	2
	Total hours	**15**

Form of classes - laboratory		Number of hours
Lab1		
...		
	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: traditional form.
N2.	Classes: analytical solutions of lecture related problems.
N3.	Office 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
P (classes)	PEK_W01, PEK_W03, PEK_W05, PEK_U01 PEK_U02, PEK_U03.	test
P (lecture)	PEK_W01, PEK_W03, PEK_W05, PEK_U01	test

	PEK_U02, PEK_U03.	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: 1. Stephen P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw-Hill, 1970. 2. A.I. Lurie and A.K. Belyaev, Theory of Elasticity (Foundations of Engineering Mechanics), Springer, 2005. **SECONDARY LITERATURE:** 1. Y. C. Fung, Foundation of Solid Mechanics, Prentice-Hall, New Jersey 1965. 2. Kyuichiro Washizu, Variational methods in elasticity and plasticity, Pergamon Press, 1982.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory of elasticity and plasticity
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 ***
Knowledge				
PEK_W01	K2_W01, K2_W02, K2_W04, K2S_CEB_W16	C1, C2, C6	Lec1 ÷ Lec6 Cl1 ÷ Cl4	N1, N2, N3
PEK_W02	K2_W01, K2_W02, K2_W04, K2S_CEB_W16	C1, C6	Lec3, Lec4, Lec9	N1, N3
PEK_W03	K2_W01, K2_W02, K2_W04, K2S_CEB_W16	C3, C4	Lec7 ÷ Lec12, Cl5, Cl6	N1, N2, N3
PEK_W04	K2_W01, K2_W02, K2_W04, K2S_CEB_W16	C4, C6	Lec11, Lec12	N1, N3
PEK_W05	K2_W01, K2_W02, K2_W04, K2S_CEB_W16	C5, C6	Lec13, Cl7	N1, N2, N3
Skills				
PEK_U01	K2_U02, K2_U04, K2_U08, K2S_CEB_U19, K2S_CEB_U23	C2, C3, C4	Lec5 ÷ Lec12, Cl3 ÷ Cl6	N1, N2, N3
PEK_U02	K2_U02, K2_U06, K2_U08, K2S_CEB_U19, K2S_CEB_U23	C2, C3, C4	Lec5, Lec10, Lec12, Cl3 ÷ Cl6	N1, N2, N3
PEK_U03	K2_U02, K2_U06, K2_U08, K2S_CEB_U19, K2S_CEB_U23	C5	Cl7	N2, N3
Social competence				
PEK_K01	K2_K01	C6	Lec1, Lec3, Lec4, Lec9, Lec11, Lec13 ÷ Lec15, Cl1, Cl6, Cl8	N1, N2, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Selected topics in structural mechanics**
Name in Polish:	**Statyka budowli – wybrane zagadnienia**
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:	**CEB008461**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**	**15**	**15**		
Number of hours of total student workload (CNPS)					
Form of crediting	Examination ~~/ crediting with grade~~ *	~~Examination~~ / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**3**	**1**	**1**		
including number of ECTS points for practical (P) classes		**0,5**	**1,0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**1,1**	**0,7**	**0,7**		

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge and skills in the determination of internal forces (internal) and the rules for their labeling for plane rod systems statically determinate.
2. The student knows solving methods of statically determinate rod systems and can effectively determine the reactions and internal forces (internal) in the rod system.
3. The student has a theoretical basis and the ability to apply the principle of virtual work to determine static variables in statically determinate systems such as beams, frames and trusses.

SUBJECT OBJECTIVES

C1. Learning the methodology of determining displacements in statically determinate systems and gaining the skills of displacement determination in plane rod systems from mechanical and non-mechanical loads.

C2. Learning the methodology of solving of statically indeterminate systems by the force method and develop skills of determining internal forces (internal) in flat rod systems from mechanical and non-mechanical loads.

C3. Learning the methodology of solving of geometrically indeterminate systems by the displacement method and gaining skills of determining internal forces (internal) in plane rod systems subjected to non-mechanical loads.

C4.	Learning the methods of determining the influence lines and gaining skills of their determination in the case of plane rod systems; statically determinate and indeterminate.
C5.	Gaining skills of solving simple rod structural systems using analytical methods as well as modeling, solving and verifying the results using computer computational software.
C6.	Gaining awareness of the continuing education need to improve own competences in the modern computer programs for structural analysis issues.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student has an in-depth knowledge of principles of structural mechanics with respect to statically determinate and indeterminate bar structures.
PEK_W02	The student knows solving methods of internal forces and displacements of statically determinate and indeterminate plane bar structures subjected to mechanical and not mechanical loads.
PEK_W03	The student knows methods of influence line determination for statically determinate and indeterminate bar systems
Relating to skills:	
PEK_U01	The student can perform static analysis of plane bar structures statically determinate and indeterminate which can be subjected to mechanical or non-mechanical loads.
PEK_U02	The student can determine influence lines of bar structures statically determinate and indeterminate.
PEK_U03	The student can properly define computational model of plane bar structures and their components, and carry out analysis of internal forces and displacements determination.
Relating to social competences:	
PEK_K01	The student is able to work on the implementation of tasks independently or in a team (individual preparation of reports and cooperative problem solving in the classroom)
PEK_K02	The student is aware of the need to increase knowledge in the field of contemporary techniques and programs for calculation of building structures.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction. Discussion of the topic subject. Principles of virtual work for rod systems. Reciprocity theorems. Elastic constrains.	2
Lec2	Determination of displacement field in plane rod structures subjected to mechanical load. Methods for effective numerical integration of internal forces charts. Examples.	2
Lec3	Impact of support displacements and temperature variation on the movement of statically determinate systems. Examples.	2
Lec4	The force method for plane rod systems. Theoretical basis. Derivation of the canonical equations.	2
Lec5	Determination of the displacement field of the rod system using the method of forces. Examples.	2
Lec6	The force method. Determination of internal forces induced by mechanical loading. Verification of the correctness of the solution. Examples.	2
Lec7	Determination of the displacement field induced by support's	2

	displacement using the force method. Examples.	
Lec8	Determination of the displacement field induced by temperature variation using the force method. Examples.	2
Lec9	Displacement method. Theoretical foundations.	2
Lec10	Displacement method. Transformation's rules according to the theory of first-order. Formulation of the canonical equations of displacement method. Verification of the correctness of the solution.	2
Lec11	Displacement method. Determination of internal forces induced by mechanical loads. Examples.	2
Lec12	Displacement method. Determination of internal forces induced by non-mechanical loads. Examples.	2
Lec13	Method of influence line determination in statically determinate and indeterminate rod structures. Theoretical foundations.	2
Lec14	Influence line determination using static approach. Examples.	2
Lec15	Influence line determination using kinematic approach. Examples.	2
	Total hours	**30**

Form of classes - class		**Number of hours**
Cl1	Preliminary information. Introduction into force method. Solving a simple example presenting methodology of governing system of equations forming according to the force method.	2
Cl2	The force method: determination of internal forces induced by mechanical loads. Computational examples.	2
Cl3	The force method: determination of internal forces induced by non-mechanical loads. Computational examples.	2
Cl4	Displacement method – introduction. Computational example presenting the main idea of the displacement method.	2
Cl5	Displacement method: determination of internal forces induced by mechanical loads. Computational examples.	2
Cl6	Displacement method: determination of internal forces induced by non-mechanical loads. Computational examples.	2
Cl7	Influence lines: kinematic and static approach. Computational examples.	2
Cl8	Influence lines. Further computational examples.	1
	Total hours	**15**

Form of classes - laboratory		**Number of hours**
Lab1	Introductory information. The theme of the 1st laboratory exercise. The calculation example with presentation of the computer software. Performing own calculations with computer computational software and results discussion.	2
Lab2	Further calculations with the computational program based on the force method. Calculation example.	2
Lab3	The 1st laboratory exercise. The case of support displacement and temperature variation. Performing own numerical calculation.	2
Lab4	Test verifying the student knowledge regarding the 1st laboratory exercise. The theme of 2nd laboratory exercise. Displacement method. Calculation example. Performing own numerical calculation.	2
Lab5	Numerical calculation of rod structure using the computer software based on the displacement method. The mechanical loading case.	2

Lab6	Numerical calculation of rod structure using the computer software based on the displacement method. The case of support displacement and temperaturę variation.	2
Lab7	The computer software of influence line determination. The final test.	2
Lab8	The final verification of laboratory reports.	1
	Total hours	**15**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Classic lecture. Multimedial presentation.
N2.	Laboratory: classic and multimedial presentation regarding laboratory, presentation of computer software, examples of problem solution with computer software..
N3.	Consulting. Teaching materials prepared by the teacher.
N4.	Class: classic and multimedial presentation, solving the examples.

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(laboratory)	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Test verifying knowledge regarding 1st laboratory exercise. Active participation during class.
F2(laboratory)	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Test verifying knowledge regarding 2nd laboratory exercise. Active participation during class.
P (laboratory) = F1 x 1/2 + F2 x 1/2		
F1(class)	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Test verifying student knowledge of force method. Active participation during class.
F2(class)	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Test verifying student knowledge of displacement method. Active participation during class.
P (class) = F1 x 1/2 + F2 x 1/2		
P (lecture)	PEK_W01, PEK_W02, PEK_W03, PEK_K02	Final written exam – questions on theory and practical problems.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1. Przemieniecki S., Theory of Structural Analysis, MacGraw-Hill, New York, 1968.
[2] Meller M., English through civil engineering, Politechnika Koszalińska – Wyd. Uczelniane, 1998.
[3] Mase G.E., Theory and problems of continuum mechanics, MacGraw-Hill, New York, 1970.
[4] Pilkey W.D., Wunderlich W., Mechanics of structures. Variational and computational methods, CRC Press, Boca Raton, 1994.

SECONDARY LITERATURE:

[1] 1. Ross C.T.F., Finite element methods in structural mechanics, 1985.
[2] Reddy J.N., Applied functional analysis and variational methods in engineering, MacGraw-Hill, New York, 1986.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Selected topics in structural mechanics
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 *****
Knowledge				
PEK_W01	K2_W03, K2_W04, K2_W05, K2S_CEB_W16	C1, C2, C3, C4	Lec1 - Lec12	N1,N3
PEK_W02	K2_W04, K2_W05, K2S_CEB_W16	C2, C3	Lec4 - Lec12	N1,N3
PEK_W03	K2_W04	C4	Lec13, Lec14, Lec15	N1,N3
Skills				
PEK_U01	K2_U06, K2_U07, K2_U09, K2S_CEB_U19	C1, C2, C3, C5	Lab1 - Lab6, Cl1 - Cl6	N2, N3, N4
PEK_U02	K2_U07, K2S_CEB_U19	C4, C5	Lab7, Cla7, Cla8	N2, N3, N4
PEK_U03	K2_U07, K2S_CEB_U19	C2, C3, C4, C5	Lab1 - Lab7	N2, N3
Social competence				
PEK_K01	K2_K03	C5	Lab1 - Lab7, Cl1 - Cl8	N2, N3, N4
PEK_K02	K2_K01	C6	Lab1 - Lab7	N2, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in Polish:	**Etyka inżynierska**
Name in English:	**Engineering Ethics**
Main field of studies:	**Civil Engineering**
Specialization (if applicable):	**Civil Engineering**
Level and form of studies:	**~~1st~~/ 2nd* level, full-time / ~~part-time~~***
Subject type:	**~~obligatory /~~ optional / university-wide***
Subject code	**FLH020361**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					**15**
Number of hours of total student workload (CNPS)					**60**
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points					**2**
including number of ECTS points for practical (P) classes					**1,5**
including number of ECTS points for direct teacher-student contact (BK) classes					**0,6**

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
Basic knowledge from the field of humanities and social sciences.

SUBJECT OBJECTIVES
C1. Obtaining knowledge on general and professional ethics.
C2. Learning how to identify and analyze moral dilemmas related to engineering professions.
C3. Introducing and analyzing the content of professional codes of ethics for engineers.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_HUM W08	Students obtain knowledge on recognized standards of professional ethics and basic knowledge on the concept of intellectual property.
Relating to skills:	
PEK_HUM U01, U02	The student is capable of using essential ethical literature independently and is able to work with normative texts on professional ethics, i.e. codes of ethics. Based on the knowledge of different ethical theories, the student is able to identify ethical dilemmas in engineering practice and use them as models helpful in indentifying patterns of ethical conduct.
Relating to social competences:	
PEK_HUM K01, K02, K05	The student is aware of the importance of non-technical aspects of engineering of a chosen specialty and understands the consequences of engineering activity in terms of its environmental and social impact as well as their responsibility for making decisions; the student understands the need for constant learning; the student correctly identifies and analyzes dilemmas related to their profession.

PROGRAMME CONTENT		
Form of classes - Seminar		**Number of hours**
Sem 1	Introduction: morality, ethics, law.	1
Sem 2	Main ethical theories: criteria for justification of moral judgments; the structure of a moral dilemma.	2
Sem 3	The status, goals and functions of professional engineering ethics.	2
Sem 4	Structure and functions of professional codes of ethics for engineering professions.	2
Sem 5	Professional obligations and responsibilities of engineers in ethical perspective.	2
Sem 6	Engineers responsibility toward society.	2
Sem 7	Ethical dilemmas in engineering professions: case study analyses.	2
Sem 8	Intellectual property; copyrights. Ethical and legal dilemmas, case study analyses.	2
	Total hours	**15**

TEACHING TOOLS USED
N1: Multimedial presentation. N2: Report. N3: Discussion.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
F1	PEK_HUM W08 PEK_HUM U01 PEK_HUM K01, K05	Presentation in a multimedial or report form.
F2	PEK_HUM U01, U02 PEK_HUM K02, K05	Prepared participation in discussion.
P=F1+F2	PEK_HUM W08 PEK_HUM U01, U02 PEK_HUM K01, K02, K05	Weighted average of evaluation F1 (2/3 of concluding mark) and evaluation F2 (1/3 of concluding mark).

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Chyrowicz B., O sytuacjach bez wyjścia w etyce, Kraków 2008

[2] Budinger T.F., Budinger M. D., Ethics of Emerging Technologies: Scientific Facts and Moral Challenges, Hoboken, New Jersey 2006.

[3] Galewicz W. [red.], Moralność i profesjonalizm. Spór o pozycję etyk zawodowych, Kraków 2010.

[4] Harris C., Pritchard M., Rabins M., Engineering Ethics. Concepts and Cases, Wadsworth 2009.

[5] Sieńczyło-Chlabicz J [red.], Prawo własności intelektualnej, Warszawa 2009.

SECONDARY LITERATURE:

[1] Chyrowicz B. [red.], Etyka i technika w poszukiwaniu ludzkiej doskonałości, Lublin 2004.

[2] Jonas H., Zasada odpowiedzialności. Etyka dla cywilizacji technologicznej, tłum. M. Klimowicz, Kraków 1996.

[3] Małek M. Mazurek E., Serafin K., Etyka i technika. Etyczne, społeczne i edukacyjne aspekty działalności inżynierskiej, Wrocław 2014.

[4] Ossowska M., Normy moralne. Próba systematyzacji, Warszawa 2003.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering Ethics
AND EDUCATIONAL OUTCOMES 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***
Knowledge				
PEK_HUM W08	K2_W15	C1, C2, C3	Sem1-Sem8	N1, N2, N3
Skills				
PEK_HUM U01 **PEK_HUM U02**	K2_U01 K2_U02	C1, C2, C3	Sem4-Sem8	N1, N2, N3
Social competence				
PEK_HUM K01 **PEK_HUM K02** **PEK_HUM K05**	K2_K01 K2_K02 K2_K04	C1, C2, C3	Sem1-Sem8	N1, N2, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in Polish:	**Etyka w biznesie**
Name in English:	**Ethics in business**
Main field of studies:	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Level and form of studies:	**~~1st~~/ 2nd* level, full-time / ~~part-time*~~**
Subject type :	**~~obligatory /~~ optional / university-wide***
Subject code	**FLH020461**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in the University (ZZU)					**15**
Number of hours of total student workload (CNPS)					**60**
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For a group of courses mark (X) for the final course					
Number of ECTS points					**2**
including number of ECTS points for practical (P) classes					**1,5**
including number of ECTS points for direct teacher-student contact (BK) classes					**0,6**

***delete as applicable**

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Text interpretation ability
2. Basic abilities in performing analysis and synthesis

\SUBJECT OBJECTIVES

C1. Analysis of the significance and role of ethics in modern business
C2. Resolve problems relating to social responsibility to the surroundings
C3. The appearance and analysis of the situation in which ethical problems may arise
C4. Sensitize students to the ethical problems

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_HUM_W08	Student has knowledge necessary to understand economic, legal, social and beyond technical factors of engineering activities and their using in engineering practice.
Relating to skills:	
PEK_HUM_U01	Student is able to obtain information from the literature, databases and other carefully selected sources, also in English or another foreign language recognized as the language of international communication in the area studied direction; can integrate the information obtained, to make its interpretation, as well as to draw conclusions and formulate reasoned opinions.
Relating to social competences:	
PEK_HUM_K05	Student properly recognizes and settles dilemmas connected with professional activity.

PROGRAMME CONTENT		
Form of classes - seminar		**Number of hours**
Se 1	Introduction to business ethics	1
Se 2	Ethics in economic activity	1
Se 3	Protection of intellectual property versus ethics	1
Se 4	Economic crises as a source of change in moral values	2
Se 5	Ethical trade	1
Se 6	Corporate Social Responsibility	2
Se 7	Ecoethic	2
Se 8	Ethics in Marketing	2
Se 9	Areas of of modern ethical finance	1
Se10	Manipulation, corruption, lies and abuses in business	2
	Total hours:	**15**

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
F1	PEK_HUM_W08 PEK_HUM_U01	Activity on the lectures, presentation
F2	PEK_HUM_W08 PEK_HUM_K05	Activity on the lectures, presentation
P=F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] B. Klimczak, Etyka gospodarcza, Wrocław 1996.
[2] P. M. Minus, Etyka w biznesie, Warszawa 1995.
[3] E. Sternberg, Czysty biznes. Etyka biznesu w działaniu, Warszawa 1998.

SECONDARY LITERATURE:

[1] G. D. Chrissides, J. H. Kaler, Wprowadzenie do etyki biznesu, Warszawa 1999.
[2] A. Chaufen, Kradzież a rozwój gospodarczy, Warszawa 2006.
[3] C. Porębski, Czy etyka się opłaca, Kraków 1997.
[4] Podstawy marketingu, pod red. J. Altkorna, Kraków 2004.
[5] M. Bąk, P. Kulawczuk, A. Szcześniak, Strategia polskiego biznesu wobec korupcji, Warszawa 2001.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ethics in business
AND EDUCATIONAL OUTCOMES FOR MAIN FIELD OF STUDY
Civil Engineering
AND SPECIALIZATION **Civil Engineering**

Subject educational outcome	**Correlation between subject educational outcome and educational outcome defined for the main field of study and specialization (if applicable)****	**Subject objectives*****	**Programme content*****	**Teaching tool number*****
Knowledge				
PEK_HUM_W08	K2_W15	C1, C2, C3, C4	Se1- Se10 Se3, Se5-Se6, Se10 Se2- Se10 Se1- Se10	N1, N2, N3,N4
Skills				
PEK_HUM_U01	K2_U01	C1-C4	Se1-Se10	N2, N3,N4
Social competence				
PEK_HUM_K05	K2_K04	C1-C4	Se1- Se10	N1, N2, N3,N4

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF FUNDAMENTAL PROBLEMS OF TECHNOLOGY
CHAIR OF EXPERIMENTAL PHYSICS
FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Physics of modern materials**
Name in Polish:	**Fizyka nowoczesnych materiałów**
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:	**FZP007163**
Group of courses:	**~~YES /~~ NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**				
Number of hours of total student workload (CNPS)	**30**				
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	**0,5**				

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
Competences at mathematical analysis and general physics confirmed by the completed 1st degree studies of technical major.

SUBJECT OBJECTIVES	
C1	To posses the fundamental knowledge on physical effects determining the properties of modern materials and the knowledge necessary for proper understanding of the physical process in the nano-scale, and the applications of the modern materials.
C2	To posses fundamental skills of theoretical predictions, design and modelling of the physical properties of modern materials and nanomaterials.
C3	To posses and consolidate the competences allowing for the independent judgment on the influence of the discussed material technologies to the economy, social life and ecology.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Possesses fundamental knowledge in quantum physics and physics of advanced materials and nanomaterials necessary to understand the physical processes determining the new properties of these systems.
Relating to skills:	
PEK_U01	Can solve simple calculational tasks in quantum physics and physics of advanced materials and nanomaterials.
PEK_U02	Can apply practically and technically the acquired knowledge on the modern materials.
PEK_U03	Is able to extend the knowledge on the modern materials using the information available in nowadays scientific publications.
Relating to social competences:	
PEK_K01	Understands the social, informative and technical meaning of the learned processes regarding the modern materials
PEK_K02	Is aware of the wide interconnection between different branches of the modern material technologies and their relation to the currently conducted fundamental studies, and to respective physical sciences

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Modern materials – review, history, nano-scale, current challenges and application-related demands	1
Lec2	Elements of condensed matter theory and and its relationship to electrical conductivity and optical properties; basic concepts; band gap; electrical conductivity; doping; absorption and emission of light; band gap engineering; semiconductor multicomponent alloys; manufacturing techniques and types of nanomaterials.	2
Lec3	Techniques for testing the structural characteristics and morphology of materials at the nano scale (electron microscopy, scanning electron microscopy, X-ray diffraction, mass spectrometry, etc.).	2
Lec4	Artificially fabricated periodic structures; atomic crystals and photonics crystals; spatial limitation for light; photonic crystals and manufacturing techniques; sample applications of nanostructures and advanced materials (lasers, alternative sources of energy, optical sensors, fiber optic sensors, etc.)	2
Lec5	Heat transport phenomena in volume stable solids, multi-layered and quasi-cristals; heat transfer by radiation and convection; thermal radiation and its use; methods of measurement of thermal conductivity and temperature.	2
Lec6	Carbon nanomaterials – fabrication, physical properties and applications: a. carbon nanotubes; b. graphen – two-dimensional carbon crystal; c. two-dimensional crystals of other materials; d. other carbon-based structures.	2
Lec7	Nanometals and nanofibres: a. Fabrication technologies; b. Physical properties;	2

	c. Application.	
Lec8	Other modern materials: a. dielectrics of high and low dielectric permittivity; b. superconductors; c. composites; d. concretes modified. Crediting colloquy	2
	Total hours	**15**

TEACHING TOOLS USED
N1. Informative lecture and multimedia presentation. N2. Consultations. N3. Independent student work and self-preparation to the course completion.

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
P (lecture)	PEK_W01, PEK_U01, PEK_U02, PEK_U03	Colloquy

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Fundamentals of physics part 5, D. Halliday, R. Rescnick, J. Walker

[2] Low-dimensional semiconductor structures: Fundamentals and device applications, K. Bernham, D. Vvedensky

SECONDARY LITERATURE:

[1] B. Bhushan (Ed.), Springer Handbook on Nanotechnology.

[2] M. F. Ashby, P. J. Ferreira, D. L. Schodek, Nanomaterials, Nanotechnologies and Design.

[3] R. Cotterill, The material world.

[4] D. Vollath, Nanoparticles – Nanocomposites – Nanomaterials. An Introduction for Beginners.

[5] Y. Gogotsi, V. Presser, Carbon Nanomaterials.

[6] Theodore L. Bergman, Frank P. Incropera, Adrienne S. Lavine, Fundamentals of Heat and Mass Transfer, John Wiley&Sons

[7] K. Saraswat, Lectures on Low-k dielectrics, Stanford University: http://web.stanford.edu/class/ee311/NOTES/Interconnect%20Lowk.pdf

[8] K. Kurzydłowski, M. Lewandowska, "Nanomateriały inżynierskie. Konstrukcyjne i funkcjonalne.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Physics of modern materials
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 *****
Knowledge				
PEK_W01	K2_W01, K2_W02	C1,C2,C3	Lec1- Lec5	N1,N2,N3
Skills				
PEK_U01	K2_W01, K2_W02	C1,C2	Lec2, Lec3-Lec5	N1,N3
PEK_U02	K2_W01, K2_W02	C1,C2	Lec4-Lec9	N1,N3
PEK_U03	K2_U01	C1,C2	Self-realized	N2,N3
PEK_U01	K2_W01, K2_W02	C1,C2	Lec2, Lec3-Lec5	N1,N3
Social competence				
PEK_K01	K2_K01, K2_K06	C2,C3	Lec1, Lec3, Lec4, Lec6-Lec9	N1,N3
PEK_K02	K2_K01, K2_K06	C3	Lec1, Lec3, Lec4, Lec6-Lec9	N1,N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

COURSE CATALOGUE

SUBJECT FORMS

FACULTY: Civil Engineering

MAIN FIELD OF STUDY: *civil engineering*

in area of technical science

EDUCATION LEVEL: ~~1st /~~ 2nd * level, ~~licencjat / inżynier / magister~~ ~~/~~ magister inżynier (MSc) studies*

FORM OF STUDIES: full-time ~~/ part-time~~*

PROFILE: general academic ~~/ practical~~ *

SPECIALIZATION*: Civil Engineering

LANGUAGE OF STUDY: English

SEMESTER 2

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Underground structures – urban infrastructure**
Name in Polish:	**Budownictwo podziemne – infrastruktura miejska**
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:	**CEB003962**
Group of courses:	**~~YES~~ / NO***

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

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student possesses knowledge of structural mechanics.
2. The student knows the principles of soil mechanics with relation to civil engineering.
3. The student knows standards of concrete structure designing.

SUBJECT OBJECTIVES

C1. Learning the principles of interaction: tunnel support – surrounding rock mass
C2. Gaining the different types of underground structures and various executing technologies.
C3. Skills acquisition of design of reinforced concrete tunnel support.
C4. Skills acquisition of advanced design of tunnel support located at great depth
C5. Skills acquisition of solving, interpreting and verifying of the results of analytical calculations.
C6. Strengthening the ability to work on the task entrusted to and awareness of the need to seek new theoretical and practical solutions.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Student has an in-depth knowledge of analysis, design and construction of underground structures in urban infrastructure.
PEK_W02	Student has an in-depth knowledge of rock mechanics and tunnel support design.
Relating to skills:	
PEK_U01	The student can properly create a computational model of underground structure.
PEK_U02	The student can properly design all the elements of underground structure.
Relating to social competences:	
PEK_K01	The student can works independently or with a team..
PEK_K02	The student is aware of the need to continuously increase own knowledge in the field of design techniques of underground structures.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction - the basic definition and classification of underground urban infrastructure.	2
Lec2	Designing of shallow underground structures.	2
Lec3	Loads acting on shallow underground structures.	2
Lec4	Loads acting on shallow underground structures – further information.	2
Lec5	Executing technologies of shallow tunnels	2
Lec6	Trenchless technologies of shallow tunnels execution	2
Lec7	Specific features of deep tunnels. Advanced ventilation systems of long and deep tunnels..	2
Lec8	Longitudinal profile of deep tunnels and its implication for drainage and ventilation facility.	2
Lec9	Advanced systems of waterproofing of tunnel structure	2
Lec10	Critical depth. Estimating the value of critical depth for excavation located in rock mass governed by: a) Coulomb - Mohr or b) Hoek – Brown failure criterion.	2
Lec11	Deformation earth pressure. The elastic-plastic problem of circular excavation at great depth - Part I: elastic deformation.	2
Lec12	Deformation earth pressure. The elastic-plastic problem of circular excavation at great depth - Part II: plastic deformation.	2
Lec13	Static earth load acting on tunnel support. Engineering methods for assessing static rock pressure. Role of tunnel support mechanical characteristics on rock-tunnel support interaction.	2
Lec14	Parametric evaluation of the quality of the rock mass. Geomechanics classifications: RQD, RMR, Q, GSI.	2
Lec15	New Austrian tunneling method	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
...		
	Total hours	

Form of classes - project		Number of hours
Proj1	Presentation of the scope of the project, the completion and the available literature. Discussion of the design scope.	2
Proj2	Principles of cross-section design of tunnel support - Car tunnel. Discussion on methods of waterproofing of tunnel structure. Individual students work on projects.	2
Proj3	Principles of cross-section design of tunnel support - railway tunnel. Individual students work on projects.	2
Proj4	Practical use of geomechanics classification of rock mass: RMR and GSI	2
Proj5	Presentation of Hoek-Brown failure criterion. Relations enabling estimations of failure criterion parameters based on the GSI classification. Estimation of critical depth.	2
Proj6	The elastic-plastic boundary value problem of circular excavation at great depth: elastic and elastic-plastic solution. Rock mass pressure acting on tunnel support as a function of plastic zone radii.	2
Proj7	The value of rock mass pressure corresponding to maximum radii of plastic zone.	2
Proj8	Verification of the student calculations of rock mass pressure acting on tunnel support.	2
Proj9	Computational model of static interaction in the system: tunnel support – rock mass. Evaluation of parameters of computational model.	2
Proj10	Strength designing of concrete tunnel support.	2
Proj11	Discussion on the students final design of tunnel support and verification of the internal forces of tunnel structure evaluated by students.	2
Proj12	Principles of proper ventilation preservation in tunnel: Pulsfort and Bendelius method.	2
Proj13	The problem of preserving the safety in tunnel. Elements of additional equipment in tunnel.	2
Proj14	Drilling and blasting technologies in tunnel excavation execution.	2
Proj15	Presentation of the final design of tunnel support.	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: classic lecture and multimedial presentations
N2.	Project: solving of calculation example, multimedial presentation,

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 (Project)	PEK_U01, PEK_U02, PEK_K01	Partial evaluation of students design of tunnel support
F2 (Project)	PEK_U01, PEK_U02, PEK_K01	Presentation of the final tunnel design.
P = 0,5xF1+0,4xF2+0,1xPARTICIPATION (projekt)		
F1 (lecture)	PEK_W01, PEK_W02, PEK_K02	Exam

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bieniawski Z. T.: „Engineering Rock Mass Classifications", Wiley, 1989.
[2] Hoek E.: Support of underground excavations in hard rock, 1995.
[3] Megaw T.M.: Tunnels: planning, design, construction, 1983.
[4] Kolymbas D.: Tunneling and tunnel mechanics: a rational approach to tunneling, 2005.

SECONDARY LITERATURE:

[1] Lunardi P.: Design and construction of tunnels, 2008.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Underground structures – urban infrastructure
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 *****
Knowledge				
PEK_W01	K2_W05, K2_W06, K2_W11, K2S_CEB_W20, K2S_CEB_W21	C2, C3	Lec1 – Lec6	N1
PEK_W02	K2_W05, K2_W11, K2_W13, K2S_CEB_W21	C1, C2, C3	Lec7- Lec15	N1
Skills				
PEK_U01	K2_U04, K2_U05, K2_U07, K2S_CEB_U19, K2S_CEB_U22	C3, C4, C5, C6	Proj2 - Proj7, Proj8 - Proj10, Proj12 - Proj14	N2
PEK_U02	K2_U06, K2_U07, K2_U09, K2_U12, K2S_CEB_U19, K2S_CEB_U22	C3, C4, C5, C6	Proj2 - Proj7, Proj8 - Proj10, Proj12 - Proj14	N2
Social competence				
PEK_K01	K2_K03	C5	Proj2 - Proj5, Proj7, Proj9, Proj13, Proj14	N2
PEK_K02	K2_K01	C6	Proj1, Proj4, Proj8, Proj11, Proj13, Proj14	N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Railways**
Name in Polish:	**Koleje**
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:	**CEB004062**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**			**30**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**1,8**	
including number of ECTS points for direct teacher-student contact (BK) classes	**1,0**			**1,1**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability for English language use (understanding, writing and speaking) on B2 level.
2. General, basic knowledge on railroads.
3. Skills of reading and use of maps and technical drawings.
4. Skills of use normal cross sections of railway track.

SUBJECT OBJECTIVES

C1. Acquiring of basic skills to design the layouts of railway tracks and stations.
C2. Acquiring of basic skills to design the railway station drainage systems.
C3. Acquiring of knowledge on layout of railway tracks and stations.
C4. Acquiring of knowledge on various track structures.
C5. Acquiring of basic knowledge on railway works technology.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Knows and understands railway network structure, distinguishes between types of operating posts and knows their function.
PEK_W02	Knows railway infrastructure elements, their function and way of work.
PEK_W03	Distinguishes types of railway track structures, knows their pros and cons.
PEK_W04	Knows conditions of railway infrastructure work (loads and ambient conditions) and understands the matter of their proper drainage and protection.
PEK_W05	Knows basic technologic processes in railway technology.
Relating to skills:	
PEK_U01	Knows how to design a railway line in plane, in profile and in cross section.
PEK_U02	Knows how to design a track layout of a small station and the auxiliary objects for passenger and freight services.
PEK_U03	Knows how to design a drainage system of a railway line and station.
Relating to social competences:	
PEK_K01	Is able to work on completing tasks alone and in group
PEK_K02	Understands the need of collecting and passing to the society information and opinions on engineering activity

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Definitions of the rail road. Basic facts of railway engineering history. Elements of railway infrastructure. Classification of railway lines.	2
Lec2	Elements of track. Technical standards of track.	2
Lec3	Railway track subgrade. Rules for shaping and material requirements. Elements of drainage system of railway lines and stations.	2
Lec4	Kinematics of the train move. Rail-wheel co-operation. Basic assumptions for track geometry calculations.	2
Lec5	Track geometry design in plane and in profile. Railway structure gauge.	2
Lec6	Tramway. History of city transportation. Elements of tramway track. Design of track and platforms.	2
Lec7	Continuous welded track. Track on grade crossing..	2
Lec8	Ballastless track. Track on bridges.	**2**
Lec9	Turnouts. Ladder track. Derailers. Trap points and bump stops. Turning tables and shift tables. Gauntlet track.	2
Lec10	Railways in Poland and in the world. Elements of railway infrastructure. Operation posts. Intermodal transport.	2
Lec11	Stations. Classification, functions, track alignments.	2
Lec12	Basic technologic processes in railway technology.	2
Lec13	Machines and devices in railway technology.	2
Lec14	Modernization of railway lines. Rules for design and applied technologies.	2
Lec15	Final test. Results disscussion.	2
	Total hours	30

Form of classes - class		Number of hours
Cl1		
…		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Organization of work. Requirements and rules. Issuing of the data for the project. Description of the project scope.	2
Proj2	Railway line section in plane. Geometry of the track layout.	2
Proj3	Characteristic cross section of the track. Shaping of embankments at bridges and viaduct.	2
Proj4	Profile of railway line. Geometric correlation between plane, profile and cross section.	2
Proj5	Drainage design. Shaping of ditches in plane, profile and cross section.	2
Proj6	Design of protection layers in subgrade. Students work review (plane, profile).	2
Proj7	Resume of the first part of the project. Students work review (plane, profile, cross sections)	2
Proj8	Introduction to the design of small station. Plane layout, requirements and rules.	2
Proj9	Track alignment and track profile requirements.	2
Proj10	Number and length of station tracks. Calculation of the main auxiliary tracks number.	2
Proj11	Station equipment for passenger and freight services. Calculation of warehouse, stack square and loading ramp.	2
Proj12	Sataion drainage system. Side ditches and shallow drainage in plane, profile and in cross section.	2
Proj13	Elements of drainage system on station –geometric design.	2
Proj14	Cross section of the station. Design of platform, pedestrian grade crossing, footbridge and underpass.	2
Proj15	Resume of the second part of the project. Students work review.	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: multimedia presentation, blackboard
N2.	Design: multimedia presentation, blackboard.
N3.	Design: exemplary design drawing, model of the railway station drainage system.

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 (project)	PEK_U01 PEK_U02 PEK_U03 PEK_W04	project assessment
F2 (project)	PEK_K01 PEK_K02	project assessment
P (project) = 0,65×F1 + 0,2×F2 + 0,15×systematic work (review of the design)		
P (lecture)	PEK_W01 PEK_W02 PEK_W03 PEK_W04 PEK_W05	final test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Dz. U. nr 151.: Rozporządzenie Ministra Transportu i Gospodarki Morskiej w sprawie warunków technicznych, jakim powinny odpowiadać budowle kolejowe i ich usytuowanie.

[2] Dz. U. nr 33.: Rozporządzenie Ministra Transportu i Gospodarki Morskiej z dnia 26 lutego 1996 r. w sprawie warunków technicznych jakim powinny odpowiadać skrzyżowania linii kolejowych z drogami publicznymi i ich usytuowanie (ze zmianami: Dziennik Ustaw Rzeczpospolitej Polskiej Nr 100 z 9.11.2000, pozycja 1082.

[3] Bonnet, Clifford F.: Practical Railway Engineering. London: Imperial College Press, 2005.

[4] Esveld C.: Modern Railway Track, 2nd ed. Zaltbommel: MRT-Productions, 2001.

SECONDARY LITERATURE:

[1] Id-1 (D-1) Warunki techniczne utrzymania nawierzchni na liniach kolejowych - PKP Polskie Linie Kolejowe S.A., Warszawa 2005.

[2] Id-3 (D-4) Warunki techniczne utrzymania podtorza kolejowego - PKP Polskie Linie Kolejowe S.A., Warszawa 2005.

[3] PN-EN 13803-2. Railway applications – Track – Track alignment design parameters, 2007

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Railways
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 ***
Knowledge				
PEK_W01	K2S_CEB_W19	C3	Lec1, Lec6, Lec10, Lec11, Proj8, Proj11, Proj14	N1
PEK_W02	K2S_CEB_W19	C1, C3, C4	Lec1, Lec2, Lec3, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Proj8, Proj11, Proj14	N1
PEK_W03	K2_W06, K2_W07, K2S_CEB_W19	C4	Lec6, Lec7, Lec8, Lec9	N1
PEK_W04	K2S_CEB_W19, K2S_CEB_W21	C1, C2	Lec2, Lec3, Lec5, Lec7, Lec8, Lec11, Proj5, Proj12, Proj13, Proj14	N1
PEK_W05	K2S_CEB_W21	C5	Lec12, Lec13, Lec14	N1
Skills				
PEK_U01	K2_U04, K2_U05, K2S_CEB_W19, K2S_CEB_W21	C1, C2, C3	Lec2, Lec3, Lec5, Proj1, Proj2, Proj3, Proj4, Proj5, Proj6, Proj7, Proj15	N2
PEK_U02	K2_U04, K2_U05, K2_U12, K2S_CEB_W19, K2S_CEB_W21	C1, C2, C3	Lec2, Lec3, Lec11, Proj8, Proj9, Proj10, Proj11, Proj12, Proj13, Proj14, Proj15	N2, N3
PEK_U03	K2_U04, K2_U05, K2_U12, K2S_CEB_W19, K2S_CEB_W21	C1, C2	Lec3, Proj5, Proj6, Proj7, Proj12, Proj13, Proj14, Proj15	N2
Social competences				
PEK_K01	K2_K01, K2_K03	C1, C2	Lec1, Proj1, Proj6, Proj13, Proj15	N2
PEK_K02	K2_K06	C1, C2	Lec1, Lec6, Lec7, Lec8, Proj1, Proj6, Proj15	N1, N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Roads, streets and airports**
Name in Polish:	**Drogi, ulice i lotniska**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Level and form of studies:	**~~1st /~~ 2nd level*, ful-time ~~/ part-time~~***
Kind of subject:	**obligatory / ~~optional~~ / ~~university-wide~~***
Subject code:	**CEB004162**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**			**30**	
Number of hours of total student workload (CNPS)	**60**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination~~=~~/ crediting with grade *	~~Examination~~ / crediting with grade *	Examination~~=~~/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**1,3**			**1,3**	

*cross out if not applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Student knows the basics of mathematical statistics 2. Student knows the basics of roads' and streets' design 3. Student knows the basics of roads' traffic signals design

SUBJECT OBJECTIVES
C1. Familiarizing the students with methodology of traffic forecasting, crossings design (intersections and interchanges), advanced signaling, airports' elements C2. Education skills of: traffic forecasting, crossings design (intersections and interchanges), advanced signaling, airports' elements C3. Strengthening the ability to conduct research in the group

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Student knows how make traffic forecasting
PEK_W02	Student knows the rules of design the road's crossings (intersections and interchanges) and advanced signaling
PEK_W03	Student knows the rules of design the airports' elements
Relating to skills:	
PEK_U01	Student can forecast the traffic
PEK_U02	Student can design the road's crossings (intersections and interchanges) and advanced signaling
PEK_U03	Student can design the airports' elements
Relating to social competences:	
PEK_K01	Student can cooperate with the group in traffic analyses

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Classification. Basic terms and definitions	2
Lec2	Prognoses and modelling of traffic	2
Lec3	Road's design. Multicriteria analyses	2
Lec4	Intersections	2
Lec5	Interchanges	2
Lec6	Traffic engineering – fundamentals	2
Lec7	Control the traffic. Signal planning	2
Lec8	The capacity of roads and junctions	2
Lec9	Elements of airports. Field planning	2
Lec10	Number, length and directions of airport's runways	2
Lec11	Street design	2
Lec12	Planning of public transport	2
Lec13	Calmed traffic. Pedestrians and Cyclists	2
Lec14	Pavements, materials, keeping of roads	2
Lec15	Test	2
	Total hours	**30**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
...		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Introduction	2
Proj2	Prognoses of traffic	2
Proj3	Routing calls from city to airport	2
Proj4	Choice of variant	2

Proj5	Location plan for the selected variant	2
Proj6	Intersection location plan	2
Proj7	Interchange location plan	2
Proj8	Signaling project - preliminary calculations	2
Proj9	Signaling project - accommodation	2
Proj10	Evaluation of traffic conditions for the intersection	2
Proj11	Complement existing work	2
Proj12	Calculate the length and direction of the runways at the airport	2
Proj13	Airfield location plan at the airport	2
Proj14	Project summary	2
Proj15	Mark	2
	Total hours	**30**

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	multimedia presentation
N2.	personal computer, interactive whiteboard (calculations, drawings, descriptions)

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 (project)	PEK_U01	report
F2 (project)	PEK_U02 PEK_K01	report
F3 (project)	PEK_U03	report
P (project) = F1 * 0,3 + F2 * 0,4 + F3 * 0,3		
P (lecture)	PEK_W01 PEK_W02 PEK_W03	test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Robinson R., Road Engineering for Development, Taylor & Francis, 2004

[2] Wells A.T., Young S., Airport Planning and Management, McGraw-Hill Professional, 2004

[3] Roess R.P., Prassas E.S., McShane W.R., Traffic Engineering (3rd Edition), Prentice Hall, 2004

SECONDARY LITERATURE:

[1] Manual of Uniform Traffic Control Devices (MUTCD) 2003

[2] Highway Capacity Manual (HCM) 2000

[3] Chosen articles from „Journal of Transportation Engineering"

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Roads, streets and airports
AND EDUCATIONAAL 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 *****
Knowledge				
PEK_W01	K2_W01, K2S_CEB_W20	C1	Lec1 – Lec3, Lec11 – Lec14	N1
PEK_W02	K2_W06, K2_W09, K2S_CEB_W20	C1	Lec4 – Lec8	N1
PEK_W03	K2_W06, K2_W09, K2S_CEB_W19	C1	Lec9 – Lec10	N1
Skills				
PEK_U01	K2_U01, K2_U16, K2S_CEB_U22	C2	Proj2 – Proj5	N1, N2
PEK_U02	K2_U08, K2_U12, K2S_CEB_U22	C2	Proj6 – Proj11	N1, N2
PEK_U03	K2_U08, K2_U12, K2S_CEB_U22	C2	Proj12 – Proj14	N1, N2
Social competences				
PEK_K01	K2_K01, K2_K02, K2_K03	C3	Proj6, Proj7	N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in Polish:	**Budownictwo Mieszkaniowe**
Name in English:	**Appartment Building**
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:	**CEB004462**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**			**15**	
Number of hours of total student workload (CNPS)	**60**			**30**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *	~~Examination~~ / crediting with grade *	Examination-/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**1**	
including number of ECTS points for practical (P) classes				**1,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**1,1**			**0,6**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of the building engineering of the first degree of engineering studies, especially in building structures and concrete structures.
2. The student has knowledge of basic mechanics and strength of materials to the extend necessary for the design of buildings.
3. The student knows the standards requirements relating to loads for buildings and design of the building structures.

SUBJECT OBJECTIVES

C1. Learning the principles of architectural and structural requirements for designing multi-storey apartment buildings.
C2. Introduction of structural characteristic of concrete large slab systems with particular attention pied on the possibilities of their modernization and renovation.
C3. Introduction of technological and structural solutions used in modern apartment building systems based on the monolithic technology.
C4. Developing personal skills for determining loading regimes and internal forces in multi-storey stiffening walls weakened by internal openings.
C5. Developing personal skills for assessment of spatial rigidity of multi-storey structures.
C6. Strengthening the ability to work in a team task and making students aware of the need to constantly expand knowledge of modern technology concerning erection of apartment buildings and their modernization.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student knows and understands the specific structural and functional requirements of modern apartment building engineering.
PEK_W02	The student knows and understands the principles of design and calculation concerning multi-storey buildings which structures are basing on prefabricated and monolithic concrete technology.
Relating to skills:	
PEK_U01	The student is able to identify loading regimes acting on the high multi-storey stiffening walls and define resulting internal forces with particular emphasis on the walls weakened by internal openings.
PEK_U02	The student can do structural calculation of load-bearing and stiffening walls in multi-storey apartment buildings and make an assessment of their spatial rigidity.
Relating to social competences:	
PEK_K01	The student can work independently or in a team task (making relevant report of project).
PEK_K02	The student is aware of the need to constantly expand knowledge of traditional and modern structural solutions for multi-storey apartment buildings. He is also interesting in expanding knowledge concerning modern systems for modernization such structures and testing their technical conditions.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction, aims, scope and plan of the subject. Brief history review of the development of industrialized building engineering in Poland and Europe.	**2**
Lec2	General structural and functional requirements specific to modern apartment building engineering.	**2**
Lec3	Principles of loading regimes acting on the high multi-storey buildings with particular emphasis on wind load conditions.	**2**
Lec4	Principles of determining internal forces in multi-storey concrete structures with particular attention pied on the walls weakened by internal openings.	**4**
Lec5	Overview of concrete large slab systems existing in Polish apartment building engineering. For example, description of W-70, WK-70 and WWP systems. Information concerning possibilities of technical and technological transformations of this type structures.	**4**
Lec6	Verification of multi-spatial rigidity of high concrete buildings including calculation of foundation plate rotation.	**2**
Lec7	Overview of modern concrete monolithic technology designed for multi-storey apartment buildings. For example, description of PERI and DOCA technology.	**4**
Lec8	Overview of potential risks and conditions to ensure the safety of residential high-rise buildings.	**2**
Lec9	Modern system solutions for windows and doors	**2**
Lec10	Modern material systems and solutions for finishing works.	**2**
Lec11	Modern systems and solutions for renovation and modernization of multi-family residential buildings.	**2**
Lec12	Final examination test.	**2**
	Total hours	**30**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Introduction. Characteristic of the project. Schedule and organization of the project work. Issue of individual student subjects and discussion of their scope.	**2**
Proj2	Principles of design and dimensioning of the typical floor drawings.	**2**
Proj3	Identification of typical rigid systems and and calculation of geometrical characteristics of individual structural walls.	**2**
Proj4	Principles of determining wind load regimes for high-rise buildings. Identification of the other loads occurring in multi-storey apartment buildings. Consultation of student projects.	**2**
Proj5	Description of procedures for determining internal forces in multi-storey, concrete walls weakened by internal openings. Consultation of student projects.	**2**
Proj6	Principles of spatial rigidity assessment in multi-storey apartment buildings. Consultation of student projects.	**2**
Proj7	Consultation of student projects.	**2**
Proj8	Assessment of student projects and final recognition.	**1**
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	LECTURE: classic lecture, multimedia presentations, educational films.
N2.	PROJECT: discussion of selected aspects related to designing multi-storey apartment buildings, discussion of proposed design solutions, project realization as a team work
N3.	Consultation of student projects.

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
P (project)	PEK_U01 PEK_U02 PEK_K01	The final evaluation of the project

P (lecture)	PEK_W01 PEK_W02 PEK_U01 PEK_U02 PEK_K02	Crediting with grade basing on the final examination test.

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] Petersson H., Analysis of Loadbearing Walls in Multi-storey Buildings, Chalmers University of Technology, Goeteborg, 1974.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Apartment building
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 *****
Knowledge				
PEK_W01	K2_W06, K2_W14, K2S_CEB_W18	C1÷C3	Lec1÷Lec8	N1, N3
PEK_W02	K2_W04, K2_W06, K2_W07, K2S_CEB_W16, K2S_CEB_W18	C1÷C6	Lec1÷Lec8	N1, N3
Skills				
PEK_U01	K2_U02, K2_U04, K2_U05, K2S_CEB_U18,	C4÷C5	Proj2÷Proj7 Lec9÷Lec11	N1, N2
PEK_U02	K2_U02, K2_U06, K2_U11, K2S_CEB_U18	C4÷C5	Proj2÷Proj7 Lec9÷Lec11	N1, N2
Social competences				
PEK_K01	K2_K03, K2_K05, K2_K06	C6	Lec9÷Lec11 Proj2÷Proj7	N1, N2
PEK_K02	K2_K01, K2_K05, K2_K06	C6	Lec4÷Lec8 Proj2÷Proj7	N1, N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Computational mechanics**
Name in Polish:	**Metody komputerowe**
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:	**CEB005362**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**30**		
Number of hours of total student workload (CNPS)	**30**		**60**		
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**0,5**		**1,1**		

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has extended knowledge of linear algebra and analysis as a base of structural analysis.
2. The student has knowledge of structural mechanics, strength of materials and theory of elasticity.
3. The student has basic knowledge of computational methods.

SUBJECT OBJECTIVES

C1. Presentation of energy functionals as a base of computer methods formulation (FEM).
C2. FEM algorithm presentation for thin plate.
C3. Presentation of finite elements used in plates and shells analysis.
C4. Presentation of FEM in geometrically nonlinear and dynamic problems.
C5. FDM extension for thin plates.
C6. Presentation of BEM algorithm.
C7. To set skills of error estimation, results interpretation and verification of computational methods.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student knows theoretical bases of computer algorithms for complex civil engineering structures analysis.
PEK_W02	The student knows FEM discrete modeling techniques for civil engineering structures.
PEK_W03	The student knows FDM algorithm for thin plates.
PEK_W04	The student knows theoretical basis of BEM.
Relating to skills:	
PEK_U01	The student is able to build plate, shells and complex shell-beam FEM discrete models.
PEK_U02	The student uses advanced FEM software dedicated to civil engineering structures analyses.
Relating to social competences:	
PEK_K01	The student is responsible for results reliability and correct interpretation of solution.
PEK_K02	The student has a conviction about necessity of knowledge continuous extension in field of contemporary software dedicated to civil engineering structures analyses.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction. Computer methods classification.	1
Lec2	Linear theory of elasticity variational formulation. Basis of variational calculus. Energy functionals in theory of elasticity: Lagrange, Reissner, Hu-Washizu.	2
Lec3	Lagrange functional for thin plate – FEM algorithm.	2
Lec4	Finite elements for plates modelling: compatible and incompatible rectangular elements.	2
Lec5	Triangular incompatible element. Flat triangular shell element.	2
Lec6	FEM in geometrically nonlinear problems. Nonlinear equilibrium equation. Buckling analysis.	2
Lec7	BEM algorithm for plane problems.	2
Lec8	FEM in structural dynamics.	2
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Initial information. Introduction to FEM software used during course.	2
Lab2	Presentation of FEM software to simple problems of theory of elasticity – plate static and buckling analysis.	2
Lab3	Presentation of FEM software to simple problems of theory of elasticity – comparison of bending and membrane shell theories.	2
Lab4	Students own FEM modelling – geometrical model.	2
Lab5	Students own FEM modelling (cont.) – discrete model.	2
Lab6	Students own FEM modelling (cont.) –model solution, results presentation and interpretation.	2
Lab7	FDM for thin plates. Finite difference operators. Boundary conditions.	2
Lab8	FDM for thin plates. Examples.	2
Lab9	Students own FDM calculations.	2

Lab10	FEM in geometrically nonlinear problems.	2
Lab11	FEM in plane problem. Algorithm of global matrix equations assembling. Nodal parameters derivation. Support reactions calculation.	2
Lab12	Test part 1 – practical computer test with FEM software.	2
Lab13	Test part 2 – FDM task.	2
Lab14	Test for lecture.	2
Lab15	Second time to improve one's marks.	2
	Total hours	**30**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: traditional form.
N2.	Laboratory: multimedia presentations, FEM software, traditional form.
N3.	Office 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
P (laboratory)	PEK_W02, PEK_W03, PEK_U01, PEK_U02, PEK_K01, PEK_K02.	student own modelling with FEM software, test
P (lecture)	PEK_W01, PEK_W02, PEK_U01, PEK_K01, PEK_K02.	test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu, The Finite Element Method, Sixth Edition, McGraw-Hill 2005.
2. Bathe J-K., Finite Element Procedures, Part 1-2, Prentice Hall 1995.
3. Banerjee P. K., Butterfield R., Boundary element methods in engineering science, McGraw-Hill 1981.

SECONDARY LITERATURE:

1. C. A. Brebbia, J. C. F. Telles, L. C. Wrobel, Boundary Elements Techniques, Springer-Verlag, Berlin 1984.
2. Washizu Kyuichiro, Variational methods in elasticity and plasticity, Pergamon Press, 1982.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computational mechanics
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 *****
Knowledge				
PEK_W01	K2_W01, K2_W02, K2_W03, K2_W09, K2S_CEB_W16	C1, C6	Lec2, Lec7	N1, N3
PEK_W02	K2_W03, K2_W05, K2_W09	C2, C3, C4	Lec3 ÷ Lec6, Lec8, Lab11	N1, N2, N3
PEK_W03	K2_W01, K2_W02, K2_W04, K2_W05, K2_U16	C5	Lab7 ÷ Lab9	N2, N3
PEK_W04	K2_W01, K2_W02, K2_W05	C6	Lec7	N1, N3
Skills				
PEK_U01	K2_U02, K2_U04, K2_U07, K2_U08, K2S_CEB_U19	C2, C3, C4, C7	Lab1 ÷ Lab6, Lab10	N2, N3
PEK_U02	K2_U02, K2_U06, K2_U08, K2_U09, K2S_CEB_U19	C2, C3, C4, C7	Lab1 ÷ Lab6, Lab10	N2, N3
Social competence				
PEK_K01	K2_K04	C7	Lab2, Lab3, Lab6, Lab10	N2, N3
PEK_K02	K2_K01	C4, C6	Lec1, Lec6 ÷ Lec8, Lab10	N1, N2, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in Polish:	**Dynamika**
Name in English:	**Dynamics**
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:	**CEB007962**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**		
Number of hours of total student workload (CNPS)	**60**		**30**		
Form of crediting	Examination / ~~crediting with grade~~ *	Examination / crediting with grade *	~~Examination-~~/ crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**		**1**		
including number of ECTS points for practical (P) classes			**1,0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**0,7**		**0,6**		

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student possesses knowledge of the areas of mathematics and physics necessary for the analysis of dynamics of structures.
2. The student knows the principles of analysis of bar structures statics.
3. The student has the necessary knowledge of structure designing and strength of materials.
4. The student has the necessary knowledge of the dynamics of one-degree-of-freedom systems (ones consisting of mass points, stiff discs and/or deformable bars).

SUBJECT OBJECTIVES

C1. Gaining an in-depth knowledge of dynamic loads and the evaluation of civil engineering structures' vibrations.
C2. Learning the principles of solving the eigenproblem for multiple-degree-of-freedom systems (discrete or discretized).
C3. Learning the principles of solving the problem of harmonic forced vibration for multiple-degree-of-freedom systems(discrete or discretized).
C4. Gaining basic knowledge of designing dynamically loaded structures.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student has an in-depth knowledge of engineering problems in structure dynamics.
PEK_W02	The student knows the principles of analysis of natural vibration of discrete systems and discretized bar structures.
PEK_W03	The student knows the principles of harmonically forced vibrations analysis, using both the direct method and the modal transformation method.
PEK_W04	The student has knowledge of the basic types of exciting vibration of civil engineering structures
Relating to skills:	
PEK_U01	The student can create a discrete dynamic computation model of a bar system.
PEK_U02	The student can formulate equations of motion of discrete bar systems using the Force Method and Displacement Method
PEK_U03	The student can solve eigenproblems of discrete dynamic systems.
PEK_U04	The student can determine the full dynamic load of the structure.
PEK_U05	The student can determine the envelopes of the dynamic cross-section forces under harmonic excitation.
PEK_U06	The student can determine the analytical solution of an equation of motion of a one-degree-of-freedom system in special cases of excitation.
Relating to social competences:	
PEK_K01	The student is conscious of the need for furthering their knowledge of the dynamics of civil engineering structures through ongoing self-study.
PEK_K02	The student is conscious of the possibility that vibration of the designed structures can have negative effects.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Aims, scope and plan of the subject. Overview of the engineering problems in structural dynamics. Dynamic degrees of freedom and generalized coordinates. Continuous and discrete dynamic models of deformable bar structures. Examples of determining the number of dynamic degrees of freedom of discrete bar systems, the degree of static and geometric (kinematic) indeterminacy. Geometric indeterminacy in the dynamic sense.	2
Lec2	Second order Lagrange's equations. Systems of coordinates and their transformations. The energetic balance and the matrix equation of motion of a discrete system. Elastic bonds in discrete bar systems, the definition of the displacement and stiffness matrices. Examples of calculating the displacement matrix in statically determinate and indeterminate systems.	2
Lec3	Examples of calculating the stiffness matrices in geometrically determinate and indeterminate systems. Examples of forming an equation of motion of a discrete system: a beam supporting structure for a rotating motor. Examples of determining the mass matrix and the generalized vector of the exciting forces in discrete bar systems.	2
Lec4	The eigenproblem of a discrete system. Example of analysis of the natural vibration of a simply supported beam with three dynamic degrees of freedom, the eigenforms of the vibration. Free vibration of the discrete system. Damping in civil engineering structures. Models of damping and the force transferred to foundations in discrete systems.	2
Lec5	The kinetostatic method. The principles of designing dynamically excited structures. The state of strain and state of strength. The idea of dynamic envelopes of cross-section forces . Harmonically excited steady-state vibration in discrete systems (direct method). Example of determining the	2

	dynamic envelopes of cross-section forces for a bar system with a discrete mass distribution.	
Lec6	The Orthogonality Priniple of natural vibration, the modal transformation method. Harmonic excitation in a one-degree-of-freedom system. The use of the modal transformation method for analysing harmonically excited steady-state vibration in multi-degree-of-freedom systems. The dynamics of a stiff solid on elastic ground.	2
Lec7	The use of the modal transformation method for analysing harmonic vibration of a block foundation. Special cases of excitation in a one-degree-of-freedom system: inertial excitation and kinematic excitation.	3
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1	Elements of the matrix and vector calculus.	2
Lab2	One-degree-of-freedom systems.	2
Lab3	Arranging the elastic and damping bonds (in parallel, in series and mixed).	2
Lab4	Superposition of vibration. Beating.	2
Lab5 Lab6 Lab7	Discrete systems – beams and frames. The force method and the displacement method. Eigenproblem – eigenfrequency and eigenforms. Harmonically forced vibrations. Dynamic envelopes of the cross-section forces.	7
	Total hours	**15**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	classic lecture
N2.	multimedial presentation
N3.	Examples of problem solutioin with the use of computer programs.

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
F (computer laboratory)	PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_U05 PEK_U06	Active participation during class
P (lecture)	PEK_W01-PEK_W04 PEK_U01- PEK_U06 PEK_K01, PEK_K02	Written test – questions on theory and practical problems.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Z. WÓJCICKI, J. GROSEL, Structural Dynamics, WUT (PRINTAP Łódź, Wrocław 2012, http://www.studia.pwr.wroc.pl/materialy/526/civil_engineering.html

[2] Teaching materials, http://www.studies.pwr.wroc.pl/teaching_materials/448/civil_engineering.html

SECONDARY LITERATURE:

[1] J. LANGER, Dynamika budowli, Oficyna Wydawnicza PWr, Wrocław, 1980

[2] T. CHMIELEWSKI, Z. ZEMBATY, Podstawy dynamiki budowli, ARKADY, Warszawa, 1998

[3] M. KLASZTORNY, Mechanika. Statyka. Kinematyka. Dynamika., DWE, Wrocław 2000.

[4] R. LEWANDOWSKI, Dynamika konstrukcji budowlanych, Wyd. Polit. Poznańskiej, Poznań 2006.

[5] Z. OSIŃSKI, Tłumienie drgań, PWN, Warszawa, 1997.

[6] S. KALISKI, Mechanika techniczna, drgania i fale, PWN, Warszawa,1986.

[7] R. GUTOWSKI, W.A. SWIETLICKI, Dynamika i drgania układów dynamicznych, PWN, Warszawa, 1986.

[8] G. RAKOWSKI i in., Mechanika Budowli – ujęcie komputerowe, t.2, Arkady 1992.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dynamics
AND EDUCATIONAAL 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 *****
Knowledge				
PEK_W01	K2_W01, K2_W03, K2_W04, K2_W05, K2S_CEB_W22	C1, C4	Lec1 do Lec4,	N1-N3
PEK_W02	K2_W04, K2_W05	C2	Lec4-Lec5	N1, N3, N4
PEK_W03	K2_W04, K2_W05	C3, C4	Lec6	N1, N3, N4
PEK_W04	K2_W04, K2_W05	C1	Lec7	N1
Skills				
PEK_U01	K2_U03, K2_U06, K2_U07, K2_U16	C2, C3	Lab1	N1 do N3
PEK_U02	K2_U03, K2_U06	C2, C3	Lab2	N1 do N3
PEK_U03	K2_U03, K2_U06, K2_U07, K2_U09, K2S_CEB_U19	C2	Lab3	N1 do N3
PEK_U04	K2_U03, K2_U05, K2_U06	C1, C3	Lab4	N1 do N3
PEK_U05	K2_U03, K2_U05, K2_U06	C3	Lab5	N1 do N3
PEK_U06	K2_U03, K2_U06	C1	Lab6	N1 do N3
Social competences				
PEK_K01	K2_K01	C1, C4	Lec1 do Lec7 Lab1 do Lab7	N1 do N3
PEK_K02	K2_K02	C1, C4	Lec1 do Lec7 Lab1 do Lab7	N1 do N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Bridges**
Name in Polish:	**Mosty**
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:	**CEB008062**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**			**30**	
Number of hours of total student workload (CNPS)	**60**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**2**	
including number of ECTS points for practical (P) classes				**2.0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**1.3**			**1.3**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Identifies structural elements
2. Identifies parameters of a structure
3. Identifies physical values used in mechanics

SUBJECT OBJECTIVES

C1. Introduction to basic terms of bridge engineering
C2. Introduction to modern construction methods
C3. Introduction to structural analysis methods
C4. Strengthening of work in group

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Knows and understands basic ideas of bridge engineering
PEK_W02	Knows the layout of structural elements as well as non-structural elements
PEK_W03	Knows analysis methods and modelling of bridge structures
PEK_W04	Knows modern construction methods
PEK_W05	Knows selected methods of bridge testing
Relating to skills:	
PEK_U01	Properly distinguishes bridge elements
PEK_U02	Is able to describe selected construction methods
PEK_U03	Properly describes selected methods of bridge testing and structural modelling
PEK_U04	Is able to do basic structural analysis
PEK_U05	Makes the drawings of bridge structures according to the rules
PEK_U06	Is able to design the superstructure of girder span in the field of main girders and slab
Relating to social competences:	
PEK_K01	Is able to work alone or in group
PEK_K02	Is aware of a need of updating the knowledge related to bridge testing

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction, bridge infrastructure, basic terminology	2
Lec2	Bridge classification, static systems of bridges, bridge components	2
Lec3	Bridge supports, bridge accessories, bridge bearings	2
Lec4	Structural analysis of bridge structures	2
Lec5	Numerical modelling and computer tools for structural analysis	2
Lec6	Concrete bridges – classification and structural details	2
Lec7	Concrete bridges – structural analysis	2
Lec8	Steel & composite bridges – classification and structural details	2
Lec9	Steel & composite bridges – structural analysis	2
Lec10	Masonry bridges – classification, structural details & analysis	2
Lec11	Construction methods	2
Lec12	Testing methods	2
Lec13	Bridges defects	2
Lec14	Exploitation and maintenance problems	2
Lec15	Test	2
	Total hours	**30**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
...		
	Total hours	

Form of classes - project		Number of hours
Proj1	Introduction, formal information, distribution of project subjects, description of the project's scope.	2
Proj2	Basic design rules for bridge substructure, shaping the bridge surroundings (typical sizes of piers and abutments according to formal requirements).	2
Proj3	Design rules for bridge superstructure, determination of bridge span lengths, selection of bridge girder's height, dimensions of main structural elements of a bridge (slab, transverse beams), bridge accessories (pavements, barriers, railings, drainage, expansion joints), examples.	2
Proj4	Description of conceptual drawings – rules for drawing, descriptions, scales, thickness of lines, variants of the conceptual design.	2
Proj5	Initial calculations – scope, basic assumptions, methods of analysis, collecting of loads.	2
Proj6	Initial calculations – finding internal forces with application of influence lines.	2
Proj7	Initial calculations – dimensioning of girders at bending. Basic rules for designing of reinforcement (thickness of bars and cover, distances between bars).	2
Proj8	Detailed calculations – bridge superstructure modelling by means of FEM, presentation of exemplary models.	2
Proj9	Detailed calculations – analysis of bridge main girders by means of FEM method: collection and application of loads, finding the internal forces.	2
Proj10	Detailed calculations – creation of envelopes of internal forces, loading scenarios and combinations.	2
Proj11	Detailed calculations – ultimate limit state of bridge girder at bending and shearing, envelopes of resistance.	2
Proj12	Technical drawings of a bridge girder – scope and rules for drawing; details of reinforcement design (anchorage length, bending radius, hook, overlapping, joining of bars).	2
Proj13	Technical description of the designed bridges.	2
Proj14	Individual consultations of student projects.	2
Proj15	Passing the projects.	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: presentations, slides, making the drawings on the blackboard
N2. Project: presentations, slides, ma king the drawings and schemes on the blackboard, examples of calculations
N3. Individual meetings

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 (proj)	PEK_U04	Individual task – conceptual drawings
F2 (proj)	PEK_U05	Individual task – first stage of calculations
F3 (proj)	PEK_U06 PEK_K01	Individual task – detailed design
P=0.2xF1+0.1xF2+0.7xF3		
P (lect)	PEK_W01 PEK_W02 PEK_W03 PEK_W04 PEK_W05 PEK_K02	Test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1 Parke G., Hewson N., *ICE manual of bridge engineering*, Thomas Telford Limited, 2008.
[2] Tonias D. E., Zhao J. J., *Bridge Engineering: Rehabilitation, and Maintenance of Modern Highway Bridges*. McGraw-Hill Professional. 2006.
[3] *Bridge engineering handbook* / ed. by Wai-Fah Chen and Lian Duan. 2000.
[4] Mondorf P., *Concrete Bridges*, Routledge, 2006.
[5] Ghosh U.K., *Design and Construction of Steel Bridges*, Taylor & Francis; 2006.
[6] Collings D., *Steel-Concrete Composite Bridges*, Thomas Telford, 2005.
[7] Hirt M., Lebet J.P. *Steel Bridges: Conceptual and Structural Design of Steel and Steel-Concrete Composite Bridges*, CRC Press, 2013.
[8] Hendy C.R., Smith D.A., *Designers' Guide to EN 1992 Eurocode 2: Design of Concrete Structures: Concrete bridges*, Thomas Telford, 2007.
[9] Hendy C. R., Murphy C. J., *Designers' Guide to EN 1993-2 Eurocode 3: Design of Steel Structures: Steel Bridges*, Thomas Telford, 2007.
[10] Hendy C.R., Johnson R.P., *Designers' Guide to EN 1994-2 Eurocode 4 : Design of Steel and Composite Structures: General Rules and Rules for Bridges*. Taylor & Francis; 2006.

SECONDARY LITERATURE:

[1] David J., Brown, Bridges – Three thousand Years of Defying Nature, Mitchell Beazley, Octopus Publishing Group, London 1993-2005

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Bridges** 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 *****
Knowledge				
PEK_W01	K2_W07, K2S_CEB_W19	C1	Lec1 ÷ Lec14	N1, N3
PEK_W02	K2_W04, K2_W06, K2_W07, K2S_CEB_W19	C1, C2, C3	Lec1 ÷ Lec14	N1, N3
PEK_W03	K2_W03, K2_W05, K2S_CEB_W19	C1, C3	Lec1 ÷ Lec14	N1, N3
PEK_W04	K2_W10, K2S_CEB_W21	C1, C2	Lec1 ÷ Lec14	N1, N3
PEK_W05	K2S_CEB_W19	C1, C2	Lec1 ÷ Lec14	N1, N3
Skills				
PEK_U01	K2_U02, K2_U04, K2S_CEB_U22	C1	Lec1 ÷ Lec14	N1, N2, N3
PEK_U02	K2S_CEB_U22	C1, C2	Lec11	N1, N2, N3
PEK_U03	K2_U11, K2S_CEB_U22	C2, C3	Lec5, Lec12	N1, N2, N3
PEK_U04	K2_U05, K2_U07, K2_U08, K2S_CEB_U22	C3	Proj2 ÷ Proj7	N2, N3
PEK_U05	K2_U12, K2S_CEB_U22	C1, C3	Proj4, Proj13	N2, N3
PEK_U06	K2_U11, K2S_CEB_U19, K2S_CEB_U22	C1, C2, C3	Proj2 ÷ Proj14	N2, N3
Social competences				
PEK_K01	K2_K01, K2_K03	C4	Lec1 ÷ Lec15	N2, N3
PEK_K02	K2_K02	C1, C2, C3	Proj2 ÷ Proj15	N2, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Construction techniques and processes**
Name in Polish:	**Technologia robót budowlanych**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Level and form of studies:	**~~1st /~~ 2nd level*, ful-time ~~/ part-time~~***
Kind of subject:	**obligatory / ~~optional / university-wide~~***
Subject code:	**CEB008662**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**30**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	Examination ~~/ crediting with grade~~ *	Examination / crediting with grade *	Examination~~=~~/ crediting with grade *	~~Examination~~ / crediting with grade *	Examination~~=~~/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,7**			**1,2**	

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge on building materials and theory of structures.
2. The student is capable to design and elaborate structural analysis of basic building structures.
3. The student is familiar with organization of production processes in construction industry.

SUBJECT OBJECTIVES

C1. to transfer the knowledge on construction techniques and processes

C2. to train competencies for identification and resolving of considerable problems concerning execution of construction processes which are part of a complex construction project

C3. the prepare the alumni for self-dependent managerial positions focused on construction works and supervision of teams in construction industry

C4. to get the ability for self-study and continuous learning of new problems being permanently created in construction practice, corresponding to development of building materials and building technology.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	the student knows modern building materials and products as long as scope of their application on a construction site.
PEK_W02	the student has advanced knowledge on performing the main type of construction works (earthworks, concrete works, assembly of structure, finishing works).
PEK_W03	the student has advanced knowledge on production processes which are used in housing and industrial objects construction.
PEK_W04	the student has advanced knowledge on some selected types of complex construction works, which are specially demanded on a present building market (as: glazing facades, etc.).
Relating to skills:	
PEK_U01	can plan and prepare the investment process for execution phase, including time planning of works, planning the machinery employment, programming of the site work brigades.
PEK_U02	can identify the technical risks which may the project be faced to during the execution of a given design specification and also can define the technical tools for reducing or eliminating the risk.
Relating to social competences:	
PEK_K01	the student is aware of need of permanent increasing of professional and personal competencies by means of formal and not formal training exercises on new construction technology problems.
PEK_K02	the student is aware about importance of technical and non-technical aspects and effects of engineering activities, like their influence on the environment and responsibility allocated to it.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Advanced problems on earthworks: quality control testing, protection of deep excavations, dewatering of excavations, machinery, soil transportation, etc. Temporary structures on site.	3
Lec2	Methods of new retaining structures in construction. Top-down method of building construction.	2
Lec3	Advanced problems on concrete construction works: quality site testing, special types of formworks, etc.	2
Lec4	Industrial floor technology	2
Lec5	Advanced problems on structural assembly. Stability of structures during assembly phase.	2
Lec6	Execution methods of glazed facades	2
Lec7	Fire protection in construction	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Presentation of the overall scope of the project exercise which consist of: planning of all construction works / site processes needed to construct the building object defined individually for each student. Detailed guidance for all required parts of the project report content.	4
Proj2	Concept plan. Breakdown of the whole construction project into stages.	4
Proj3	Machinery and work brigades selection and allocation.	2
Proj4	Evaluation of time and cost of the planned works.	4
Proj5	Gantt chart of works. Critical activities.	2
Proj6	Detailed specification of particular site works operations, including specificatiosn of eventual temporary structures and scaffoldings needed for execution of planned operations.	4
Proj7	Detailed engineering drawings presenting all stages of the construction works execution. Text part of specification of the works.	4
Proj8	Presentation of reports with group discussion	2
Proj9	Final presentation of reports with final evaluating (final grades)	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
LECTURE N1. Regular lecture with multi-media presentation. Presentation of construction site case studies. Presentation of selected data taken from real projects completed before. N2. Contact hours for students. **PROJECT** N3. Presentation of the scope and step-by-step the whole process of elaborating the report N4. Presentation performed by students, demonstrating the intermediate project exercise results. N5. Contact hours for students.

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
P (lecture)	PEK_W01, PEK_W02, PEK_W03 PEK_W04	EXAMINATION
P (project)	PEK_U01 PEK_U02	Check of the final report, considering as a supplement, the student's verbal individual presentation of some report issues.

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: 1. Allen E., Iano J., Fundamentals of building construction. Fifth Edition. Wiley. 2009. 2. Concrete construction engineering handbook (ed. Nawy G.) Second Edition. CRC Press, Taylor & Francis Group, 2008. 3. Cooke R., Building in the 21st century. Blackwell Publ. 2007. 4. Emmitt S., Gorse Ch.A., Barry's advanced construction of buildings. Wiley-Blackwell Publ. 2010. 5. Fleming E., Construction Technology an illustrated introduction. Blackwell Publ. 2005. 6. Illingworth J. R., Construction methods and planning. Chapman & Hall, 2000. 7. Singh J., Heavy construction: planning, equipment and methods. AA Balkema, 2001. 8. Temporary Works – Principles of Design and Construction. Ed.: Grant M., Pallett P.F..ICE Publ. 2012 **SECONDARY LITERATURE:** 1. Nunnually S.W., Construction Methods and Management. Eight Edition. PEARSON, 2011.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Construction techniques and processes
AND EDUCATIONAAL 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 *****
Knowledge				
PEK_W01	K2_W10, K2S_CEB_W21	C1, C2, C3, C4	Lec1 do Lec5	N1, N2,
PEK_W02	K2_W11, K2_W14, K2S_CEB_W21	C1, C2, C3, C4	Lec1 do Lec5	N1, N2,
PEK_W03	K2_W11, K2_W13, K2S_CEB_W21	C1, C2, C3, C4	Lec1 do Lec6	N1, N2,
PEK_W04	K2_W11, K2S_CEB_W21	C1, C2, C3, C4	Lec1 do Lec6	N1, N2.
Skills				
PEK_U01	K2_U01, K2_U13, K2_U16,	C1, C2, C3, C4	Proj1 do Proj8	N3, N4, N5
PEK_U02	K2_U14, K2S_CEB_U23	C1, C2, C3	Proj1 do Proj8	N3, N4, N5
Social competence				
PEK_K01	K2_K01, K2_K02	C3, C4	Lec1 do Lec6	N1
PEK_K02	K2_K04	C2	Lec1 do Lec6	N1

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

COURSE CATALOGUE

SUBJECT FORMS

FACULTY: Civil Engineering

MAIN FIELD OF STUDY: *civil engineering*

in area of technical science

EDUCATION LEVEL: ~~1st /~~ 2nd * level, ~~licencjat / inżynier / magister~~ ~~/~~ magister inżynier (MSc) studies*

FORM OF STUDIES: full-time ~~/ part-time~~*

PROFILE: general academic ~~/ practical~~ *

SPECIALIZATION*: Civil Engineering

LANGUAGE OF STUDY: English

SEMESTER 3

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Sztuczna inteligencja w inżynierii lądowej**
Name in Polish:	**Artificial intelligence in civil engineering**
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:	**CEB006063**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**		
Number of hours of total student workload (CNPS)	**30**		**60**		
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**		**0,6**		

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in civil engineering – types of structures and processes
2. Skill in application of basic computer techniques

SUBJECT OBJECTIVES

C1. Learning the fundamental techniques used in computer tools with elements of artificial intelligence – applied in civil engineering

C2. Development of ability to design, computer implementation and testing of simple expert tools with elements of artificial intelligence

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student knows and understands methods of knowledge acquisition and representation in expert systems
PEK_W02	The student knows methodology of design, computer implementation and testing of knowledge-based expert systems with elements of artificial intelligence
Relating to skills:	
PEK_U01	The student has skill to independent acquisition of knowledge in civil engineering
PEK_U02	The student has skill to design, computer implementation and testing of simple expert tools with elements of artificial intelligence, supporting decisions in civil engineering
Relating to social competences:	
PEK_K01	The student is able to unaided solving the problems and is also prepared to a team-work (laboratory reports, laboratory exercises)

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction to the lectures: aims, scope and plan of the course. Basic literature and examination rules. Artificial intelligence – what is this? Basic terms and definitions.	1
Lec2	Artificial intelligence in expert systems – classification, architecture, evolution, directions of development. Expert systems and range of their application in civil engineering.	2
Lec3	Technologies of knowledge acquisition and representation in computer systems. Knowledge bases and data bases. Expert functions in computer systems supporting management.	2
Lec4	Artificial neural networks – conception, architecture, training and testing techniques, applications.	2
Lec5	Fuzzy logic – fuzzy problems, linguistic variables, fuzzy reasoning procedures, testing, applications.	2
Lec6	Expert systems based on knowledge – design and implementation. Technology of hybrid networks in expert systems.	2
Lec7	Examples of artificial intelligence applications in civil engineering – expert tools supporting structure analysis and infrastructure management.	2
Lec8	Colloquium	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1	General introduction: organization, crediting rules. Distribution of individual tasks, discussion of each task.	1
Lab2	Technologies of knowledge acquisition and computer representation – examples from selected fields of civil engineering.	2
Lab3	Technology of artificial neural networks creation – introduction to computer software.	2
Lab4	Practical design, training and testing of artificial neural networks.	2
Lab5	Individual task – conceptual design.	2
Lab6	Individual task – knowledge acquisition.	2

Lab7	Individual task – computer implementation and testing.	2
Lab8	Presentation of results and evaluation of the report.	2
	Total hours	**15**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: multimedia presentations of all parts of the course programme, presentation of computer software supporting bridge management.
N2.	Laboratory: multimedia presentations, software presentations, data preparation, data input and processing by means of computer systems, analysis and discussion of the results.
N3.	Individual consultations.

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
P (lecture)	PEK_W01, PEK_W02	Colloquium
P (laboratory)	PEK_U01, PEK_U02, PEK_K01	Final laboratory report, active work in laboratory

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1. Russell S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall, 2009.
[2] Samarasinghe S., Neural Networks for Applied Sciences and Engineering: From Fundamentals Complex Pattern Recognition, Auerbach Publications – Taylor & Francis Group, 2006.
[3] Wang P. P., Ruan D., Kerre E. E., Fuzzy Logic: A Spectrum of Theoretical and Practical Issues, Springer, 2007.

SECONDARY LITERATURE:

[1] 1. Gurney K., An Introduction to Neural Networks, Taylor & Francis e-Library, 2005.
[2] Liebowitz J., The Handbook of Applied Expert Systems, CRC Press, 1999.
[3] Nguyen H. T., Prasad N. R., Walker C. L., Walker E. A., A First Course in Fuzzy and Neural Control, CHAPMAN & HALL/CRC, 2003.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Artificial intelligence in civil 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 ***
Knowledge				
PEK_W01	K2_W11, K2_W12, K2S_CEB_W22	C1, C2	Lec1 to Lec8	N1, N3
PEK_W02	K2_W12, K2S_CEB_W22	C1, C2, C3	Lec1 to Lec8	N1, N3
Skills				
PEK_U01	K2_U16, K2_U17, K2S_CEB_U23	C2, C3	Lec1 to Lec3, Lab1, Lab2, Lab5, Lab6	N1, N2, N3
PEK_U02	K2_U16, K2_U17, K2S_CEB_U23	C2, C3	Lec4 to Lec7, Lab1, Lab4 to Lab8	N1, N2, N3
Social competences				
PEK_K01	K2_K01, K2_K03	C3	Lab2 to Lab8	N2, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Modern testing methods for non-destructive inspection of building structures**
Name in Polish:	**Nowoczesne metody badań nieniszczących konstrukcji budowlanych**
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:	**CEB006163**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**		
Number of hours of total student workload (CNPS)	**30**		**60**		
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ crediting with grade *	Examination / crediting with grade *	Examination~~-~~/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2.0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**0.6**		**0.6**		

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student possesses knowledge of the areas of basic aspects of building structures, building materials and concrete structures.
2. The student knows the principles of building materials and testing their strength parameters.

SUBJECT OBJECTIVES

C1. Introduction of modern testing methods for quality control of building materials and structures during their erection.
C2. Introduction of modern testing methods for quality control of existing building structures.
C3. Learning modern testing systems for NDT examination of building structures.
C4. Developing skills of basic and advanced testing procedures for building structures examination necessary for evaluation of their technical conditions.
C5. Strengthening the ability to work in a team and making students aware of the need to constantly expand knowledge of modern testing methods for building structures examination.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student knows and understands the specific implementation of quality control of building materials and structures during their erection.
PEK_W02	The student knows and understands the specific implementation of quality control of existing building structures with particular attention focused on the evaluation of their technical conditions.
Relating to skills:	
PEK_U01	The student is able to plan and carry out test procedures components of building structures and interpret the results of the evaluation of their quality and mechanical properties.
PEK_U02	The student can evaluate the technical condition of building structures using modern non-destructive testing methods.
PEK_U03	The student has the skills necessary to use modern non-destructive testing systems.
Relating to social competences:	
PEK_K01	The student can work independently or in a team task.
PEK_K02	The student is aware of the need to constantly expand knowledge of both traditional and modern testing methods for building structures examination.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction, aims, scope and plan of the subject. Brief history review of the development of testing methods addressed for building structures.	**2**
Lec2	Characteristics of modern testing methods for non-destructive evaluation of "in-situ" concrete compressive strength (LOK-Test, CAPO-Test, COMA-Test).	**2**
Lec3	Nondestructive evaluation of concrete tensile strength using "pull-off" measurements.	**1**
Lec4	"In-situ" nondestructive evaluation of concrete water permeability by means of GWT method.	**1**
Lec5	Characteristics of modern testing methods for non-destructive evaluation of corrosion risk assessment of building structures (Rainbow-Test, Aquamerck Test, Rapie Chloride Test, Corrosion Mapping Systems – Bloodhound, Galva Pulse).	**2**
Lec6	Modern testing methods for non-destructive examination of structural integrity of building structures („Impact-Echo").	**3**
Lec7	Modern testing methods for non-destructive examination of structural integrity of building structures (Impulse Response, infrared thermography, ultrasonic tomography	**2**
Lec8	Modern methods for locating and identifying the reinforcing steel bars (Cover-Master, Profometer, Ground Penetrating Radar, radiography).	**1**
Lec9	Final examination test	**1**
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Introduction. Safety regulations. General description of non-destructive testing methods. Introduction to laboratory exercises with ultrasonic measurements	2
Lab2	Short test nr 1. Exercises no 1 - ultrasonic measurements. Determination of ultrasonic pulse velocity in different building materials.	2
Lab3	Short test nr 2. Principles of the concrete compressive strength evaluation by means of rebound measurements. Introduction to laboratory exercises. Overview of available testing systems and measurement techniques. Interpretation of obtained results.	2
Lab4	Short test nr 3. Exercises no 2 - rebound measurements.	2
Lab5	Exercises no 3 – Evaluation of the concrete compressive and tension strength by means of "pull-out" and "pull-off" measurements.	2
Lab6	Exercises no 4 - Localization and identification of the reinforcing steel bars in concrete structures. Non-destructive cover layer measurements.	2
Lab7	Exercises no 5 - Non-destructive moisture measurements of different materials.	2
Lab8	Short test nr 4. Summary and final recognition.	1
	Total hours	**15**

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. LECTURE: classic lecture, multimedia presentations, educational films. N2. LABORATORY: practical laboratory tests, preparation of test reports, discussion of the results obtained N3. Consultation

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 (L1-L2)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 1
F2 (L2-L3)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 2, Assessment of the Exercises no 1 Discussion of the results obtained
F3 (L4-L5)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 3, Assessment of the Exercises no 2 Discussion of the results obtained
F4 (L5-L8)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 4, Assessment of the Exercises no 3, 4 and 5 Discussion of the results obtained
P (laboratory) = 0,60 x average rating of short tests results+ 0.4 x average rating of test reports evaluation		
P (lecture)	PEK_W01 PEK_W02 PEK_U01 PEK_U02 PEK_K02	Crediting with grade basing on the final examination test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Sansalone M.J., W.B. Streett W.B., Impact-Echo Nondestructive Evaluation of Concrete and Mansory, Buullbrier Press, 1977.

[2] Schickert G., Wiggenhauser H., Non-Destructive Testing in Civil Engineering. Berlin, 1995.

[3] Bungey J.H., Millard S.G., M.G., Testing of Concrete in Structures, 4th Edition, Taylor&Francis, London and New York, 2006.

[4] Breysse D., Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combinated Techniques, State of the Art, Report of the RILEM Technical Committee 207-INR, Springer Dordrecht Heidelberg London New York, 2012

SECONDARY LITERATURE:

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modern testing methods for non-destructive inspection of building structures
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 ***
Knowledge				
PEK_W01	K_W06, K_W14, KS_CEB_W22,	C1÷C2 + C5	Lec1÷Lec8	N1, N3
PEK_W02	K_W06, K_W14, KS_CEB_W22,	C1÷C2 + C5	Lec1÷Lec8	N1, N3
Skills				
PEK_U01	K_U02, K_U15, KS_CEB_U21, KS_CEB_U23	C3÷C4	Lab1÷Lab7	N2 N3
PEK_U02	K_U02, K_U15 KS_CEB_U21, KS_CEB_U23	C3÷C4	Lab1÷Lab7	N2 N3
PEK_U03	K_U02, K_U15 KS_CEB_U21	C3÷C4	Lab1÷Lab7	N2, N3
Social competences				
PEK_K01	K_K03, K_K05, K_K06	C5	Lec1÷Lec8 Lab1÷Lab7	N1, N2
PEK_K02	K_K01, K_K05, K_K06	C5	Lec1÷Lec8 Lab1÷Lab7	N1, N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Hydrology for building engineers**
Name in Polish:	**Hydrologia dla inżynierów budownictwa**
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:	**CEB006363**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**		
Number of hours of total student workload (CNPS)	**30**		**60**		
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**		**0,6**		

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student possesses knowledge of the areas of mathematics, applied statistics, hydraulics and hydrology, geology and hydrology

SUBJECT OBJECTIVES	
C1.	Gaining a knowledge on the calculation of the water balance and determination of its constituents for river basins.
C2.	Acquiring knowledge and skills for calculating extreme flows for the catchment controlled and uncontrolled.
C3.	The acquisition of knowledge in the field of mathematical modeling of hydrological phenomena.
C4.	Strengthening the ability to work in a project team and the awareness of the need to find new solutions to theoretical and practical hydrologic calculations for sizing of hydraulic structures.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student knows and understands the rules for the calculation of water balance and its components for river basins.
PEK_W02	The student has in-depth expertise in the implementation and development of hydrometric measurements.
PEK_W03	The student knows the rules for calculating extreme flows in the catchment controlled and uncontrolled.
PEK_W04	The student has expertise in modeling the outflow of water from the catchment.
Relating to skills:	
PEK_U01	The student establishes correlations based on hydrometric measurements.
PEK_U02	The student prepares a detailed water balance for the catchment.
PEK_U03	The student can calculate statistical methods extreme water flows.
PEK_U04	The student determines water flow in the basin uncontrolled.
PEK_U05	The student creates a simple model for the catchment uncontrolled.
Relating to social competences:	
PEK_K01	The student can work independently on the performance of a task or project team during the hydrological calculations.
PEK_K02	The student is aware of the need to increase knowledge in the field of modern computational techniques in hydrology for design of hydraulic structures and communication

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Problems and tasks of hydrology for engineers	1
Lec2	Water balance. Determination of the balance equation components.	2
Lec3	Hydrometry. Measurements of water levels, the flow velocity and water discharge.	2
Lec4	Hydrography. Observations gauges. Rating curve. Hydrograph.	2
Lec5	Transfer of a hydrological information.	1
Lec6	Determination of probable maximum and minimum flows.	2
Lec7	Determination of maximum flow for small catchments.	2
Lec8	Basics of mathematical modeling of hydrological phenomena.	2
Lec 9	Test	
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1	Water-economy balance	2
Lab2	The development of hydrologic curves.	4
Lab3	The calculation of the maximum probable flow in the controlled catchment.	4
Lab4	The calculation of the maximum probable flow in a small uncontrolled catchment.	2
Lab5	Construction of the flood hydrograph.	2
Lab6	Crediting of the laboratory.	1
	Total hours	**15**

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentations lecture content N2. Laboratory: multimedia presentations, defining and solving problems using the software, N3. Consultation in the form of direct meetings and via e-mail

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
P (lecture)	PEK_W01 PEK_W02 PEK_W03 PEK_W04	Final test
F (computer laboratory)	PEK_W01 PEK_U02 PEK_K01	Attendance and report writing
F (computer laboratory)	PEK_W02 PEK_U01 PEK_K01	Attendance and report writing
F (computer laboratory)	PEK_W03 PEK_U03 PEK_K01 PEK_K02	Attendance and report writing
F (computer laboratory)	PEK_W03 PEK_U04 PEK_K01 PEK_K02	Attendance and report writing
F (computer laboratory)	PEK_W04 PEK_U05 PEK_K01 PEK_K02	Attendance and report writing
P (laboratory etc) = P = (F1+F2+F3+F4+F5)/5		
P (lecture) =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Brutsaert W., Hydrology. An Introduction, Cambridge University Press, Cambridge, 2010.
2. Chow V. T., Handbook of Applied Hydrology, McGraw-Hill, New York, 1964.
3. Chow V. T., Mays L. W., Maidment D. R., Applied Hydrology, McGraw-Hill, New York, 1988.
4. Davie T., Fundamentals of hydrology, Routledge, Taylor & Francis Group, London and New York, 2010.
5. Shaw E. M., Beven K. J., Chappell N. A., Lamb R., Hydrology in practice, Spon Press, Taylor & Francis Group, Taylor & Francis Group, 2011.

SECONDARY LITERATURE:

1. Baban R., Design of diversion weirs. John Wiley & Sons, 1995.
2. Ghosh S. N., Flood control and drainage engineering, A.A. Balkema/Rotterdam/Brookfield, 1999.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrology for building engineers
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 *****
Knowledge				
PEK_W01	K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22	C1, C4	Wy1, Wy2	N1, N3
PEK_W02	K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22	C1, C4	Wy1, Wy3, Wy4	N1, N3
PEK_W03	K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22	C2, C4	Wy1,Wy5, Wy6, Wy7	N1, N3
PEK_W04	K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22	C3, C4	Wy1, Wy8	N1, N3
Skills				
PEK_U01	K2_U07, K2_U08, K2_CEB_U23	C1, C4	La2	N2, N3
PEK_U02	K2_U07, K2_U08, K2_CEB_U23	C1, C4	La1	N2, N3
PEK_U03	K2_U07, K2_U08, K2_CEB_U23	C2, C4	La3	N2, N3
PEK_U04	K2_U07, K2_U08, K2_CEB_U23	C2, C4	La4	N2, N3
PEK_U05	K2_U07, K2_U08, K2_CEB_U23	C3, C4	La5	N2, N3
Social competence				
PEK_K01	K2_K03, K2_K04, K2_K05	C4	La1 do La5	N2, N3
PEK_K02	K2_K01, K2_K02, K2_K06	C4	Wy1 do Wy8	N1, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Prestressed concrete structures**
Name in Polish:	**Betonowe konstrukcje sprężone**
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:	**CEB006563**
Group of courses:	**YES / ~~NO~~***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**15**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**			**0,6**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses the knowledge and understands basics of the methods used in structural mechanics, knows selected CAD software.
2. Possesses the skills of statical analysis of a bar and spatial structure.
3. Possesses the knowledge of theoretical basics of finite element method and general rules of nonlinear analysis of engineering structures.
4. Possesses the knowledge and understands calculations and detailing of a complex concrete structures – acknowledged by the grade from CEB3361.
5. Possesses the knowledge of codes and standards of design of buildings and elements.
6. Possesses the skills of using internet and other sources for searching general information and information on building engineering, He possesses the skills of using information techiques to communicate and obtaining CAD software.
7. Is responsible for honest results of his work and reliable interpretation.

SUBJECT OBJECTIVES

C1. Forming up of skills of computing and detailing of prestressed concrete structures.
C2. Learning of carrying out of multidimensional structural analysis the prestressed structures.
C3. Gaining of the knowledge of prestress techniques and methods.
C4. Gaining of the knowledge of limit state analysis of prestressed concrete structures.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Possesses the knowledge concerning computation and detailing of complex prestressed structures.
PEK_W02	Possesses the knowledge and understands design rules of complex precast and monolithic prestressed concrete structures.
Relating to skills:	
PEK_U01	Knows how to design precast or monolithic prestressed element or part of a structure being prestressed.
PEK_U02	Knows how to check required ultimate and serviceability limit states related to prestressed structures.
PEK_U03	Possesses the knowledge how to use respective codes, standards and literature
Relating to social competences:	
PEK_K01	Knows how to extend the knowledge on contemporary concrete structures and design methods.
PEK_K02	He is responsible for honest results of his design.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	The concept of prestressing, historical review, definitions, diferences between prestressed and reinforced concrete.	1
Lec2	Concrete used in prestressed structures, mechanical, physical and deformational properties, HPC and special concrete.	1
Lec3	Prestressing steel – strength, deformations, types and geometry, durability.	1
Lec4	Pretensioned concrete – bond between steel and concrete, prestressing methods and devices.	1
Lec5	Posttensioned concrete – cable and achnorage types, ducts, methods of prestressing and injection, elements folded from segments	1
Lec6	Axisymmetric structures, tanks, pipes, special prestressing methods.	1
Lec7	Design calculation of prestressed element, linear stress and limit states method, loss of prestress force in pre- and post-tensioned concrete.	1
Lec9	Design of pretensioned beams, selection of section's dimensions, prestressing force, design situations, ultimate and serviceability limit states, detailing.	1
Lec10	Projektowanie belek kablobetonowych, kształtowanie przekroju i trasy kabli, stany graniczne, strefa przypodporowa i strefa docisku, belki ciągłe	1
Lec11	Design of prestressed compound structures, protection against delimitation, capacity, cracking and deflection, reinforcement detailing.	1
Lec12	Structures prestressed with unbonded tendons.	1
Lec13	Examples of prestressed structures – roofs and floors (girders, hollow core and TT slabs, shell elements), halls and frame structures, tanks, bridges, viaducts.	1
Lec14	Mass production elements – ties, pipes, electrical poles, gantry beams, etc. .	1
Lec15	Durability of prestressed structures, corrosion of concrete and reinforcement, fire and fatigue resistance.	1
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
	Total hours	

In the frame of the project – computer exercises (15 hours) with applying of the packet of statistical and geostatistical programs of ISATIS – the version of Isatis 2013.1, dongle key USB connected with the software Isatis purchased in the Firm Geovariances, Avon, Ecole des Mines de Paris, France.

Form of classes - project		Number of hours
Proj1	Subject area scope, projects titles submission.	1
Proj2	Basic assumption and rules.	1
Proj3	Examples of structures.	1
Proj4	Preliminary calculations of elements dimensions.	1
Proj5	Rules governing modelling of a structure in computing software.	1
Proj6	Verification of static computation. Load combinations used in ultimate and serviceability limit states.	1
Proj7	Calculation of prestress loss: instantaneous loss.	1
Proj8	Calculation of prestress loss: instantaneous loss.	1
Proj9	Calculation of prestress loss: rheologicalloss..	1
Proj10	Calculation of prestress forces used in design.	1
Proj11	Limitation of stress during tensioning.	1
Proj12	Checking ultimate limit states.	1
Proj13	Checking servicebility limit states.	1
Proj14	Detailed problems related to anchorage, shear and fatigue.	1
Proj15	Drawings of prestressed structures.	1
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: Information lecture, problematic lecture, multimedial presentations.
N2. Project: Presentation of the project scope, examples of structures, direct collaboration and discussion with Students.

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 (evaluation of loads and preliminary dimensions of a structure)	PEK_W01 PEK_U01 PEK_U03 PEK_K01 PEK_K02	Evaluation of the project part

F2 (static computations with load combinantions finshed)	PEK_W01 PEK_U01 PEK_U03 PEK_K01 PEK_K02	Evaluation of the project part
F3(prestress loss calculated)	PEK_W01 PEK_W02 PEK_U01 PEK_U03 PEK_K01 PEK_K02	Evaluation of the project part
F4 (calculations of limit states finished)	PEK_W01 PEK_W02 PEK_U01 PEK_U03 PEK_K01 PEK_K02	Evaluation of the project part
F5 (drawing and specification finished)	PEK_W01 PEK_W02 PEK_U01 PEK_U02 PEK_U03 PEK_K01 PEK_K02	Evaluation of the whole project with grade
P = 0,1xF1+0,2xF2+0,2xF3+0,2xF4+0,3xF5		
P (lecture)	PEK_W01 PEK_W02 PEK_K01	Colloquium

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Teng S., Kong F. K.: Reinforced and Prestressed Concrete: Eurocodes Taylor & Francis Ltd; 2009.

[2] Navy E. G.: Pre-stressed Concrete. A Fundamental Approach. Prentice Hall, Upper Saddle River, New Jersey 07458, 2000.

SECONDARY LITERATURE:

[1] Ghali A.: Circular storage tanks and silos. E & FN Spon, London 2000.

[2] Raju N. K., Pre-stressed concrete, 2008.

[3] Fogarasi G., Pre-stressed concrete technology, 1986.

[4] Hurst M. K.: Prestressed Concrete Design Taylor & Francis, 1998.

[5] EN 1992-1-1: Eurocode 2: Design of concrete structures-Part 1-1: General rules and rules for buildings.

[6] EN 1992-3: Eurocode 2: Design of concrete structures-Part 3: Liquid retaining and containing structures.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Prestressed concrete structures
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 *****
Knowledge				
PEK_W01	K2_W06, K2_W07, K2_W09, K2_W10, K2S_CEB_W16, K2S_CEB_W22	C1, C3, C4	Wy1-Wy8 Pr1-Pr14	N1 N2
PEK_W02	K2_W07, K2_W09, K2_W10, K2S_CEB_W16, K2S_CEB_W22	C2,	Wy9-Wy10 Pr9-Pr12	N1 N2
Skills				
PEK_U01	K2_U04, K2_U05, K2_U11, K2_U12, K2_U17, K2S_CEB_U18, K2S_CEB_U23	C1, C2,C4	Wy1-Wy8 Pr1-Pr14	N1 N2
PEK_U02	K2_U04, K2_U05, K2_U11, K2_U12, K_U17, K2S_CEB_U18, K2S_CEB_U23	C4	Wy9-Wy10 Pr9-Pr12	N1 N2
PEK_U03	K2_U01	C3,C4	Wy11-Wy15	N1
Social competence				
PEK_K01	K2_K01	C3	Wy1-Wy15	N1
PEK_K02	K2_K03	C1, C2	Pr1-Pr14	N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Timber structures**
Name in Polish:	**Konstrukcje drewniane**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Level and form of studies:	**~~1st /~~ 2nd level*, ful-time ~~/ part-time~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB006663**
Group of courses:	**YES / ~~NO~~***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**15**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**			**0,6**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student is able to identify and make a statement loads on components and building structures.
2. The student has knowledge of general mechanics, strength of materials, and general principles of shaping structures.
3. The student knows the rules and the guidelines and codes for the design of buildings and their components.
4. The student has a theoretical basis. He has the ability to calculating and construction elements and basic building structures of concrete, steel, timber and masonry structures.

SUBJECT OBJECTIVES

C1. Knowledge of anatomy of the Wood and rulet of timber grading in terms of the proper use of the structures.

C2. Knowledge of the principles for calculating of solid and complex elements made with solid and glued laminatem timber

C3. Knowledge of the rules for the implementation of connectors for mechanical fasteners, car pentry joints and glued joints. The ability to determine the capacity and vulnerability connectors.

C4.	Knowledge of the principles of protection of timber structures against biological corrosion and fire.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Student knows contemporary, modern building materials and he knows the basic elements of manufacturing them.
PEK_W02	Student has expanded knowledge of analysis, design and calculating of timber structures.
Relating to skills:	
PEK_U01	Student can design a modern timber structures, also glulam structures.
PEK_U02	Student can make a graphical project documentation in selected computer program.
Relating to social competences:	
PEK_K01	Student is aware of the need to improve professional and personal skills. student complements and extends knowledge of modern processes and technologies related to civil engineering through formal and informal training
PEK_K02	Student knows and understands the consequences of non-technical aspects and engineering activities. Sstudent understands the impact of these decisions on the environment and he understands the responsibility for decisions.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Examples of historical and contemporary objects made of timber. General discussion of the problems of design of timber structures	2
Lec2	Anatomy of the wood, the effect of anisotropy on the physical and mechanical properties of the material. Natural characteristics of wood and defects.. Specifying the basic mechanical properties. Customary target sizes of structural timber. Principles of visual and machine grading of wood, the grading class and strength class. Engineered wood products - the types and properties.	3
Lec3	Design of timber structures according to the PN-EN 1995. General rules, ultimate limit states, serviceability limit state, the basis of structural analysis.	2
Lec4	Connectors in timber structures. Joints timber-timber, plate- timber, steel-timber by using nails, screws, bolts, dowels, split-rings connectors, toothed-plates connectors, nail plates.	2
Lec5	The bases for calculating the fire resistance according to EN 1995. The requirements for fire resistance. The effect of interaction in case of fire. Methods for calculating the load capacity.	2
Lec6	Glued laminated timber. The parameters of the material, production, technology, connection details. Examples of applications.	2
Lec7	Historic timber structures. Biological corrosion in timber structures. Wood insects and wood-destroying fungi.	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		

	Total hours	

Form of classes - project		**Number of hours**
Proj1	Explanation of the examination. Set a schedule of classes and transitional periods. General introduction to the design of timber structures. Deal subjects design classes.	2
Proj2	Explanation of the project no. 1 Beams made with the use of mechanical fasteners.	2
Proj3	Explanation of the project no. 1 Spaced columns with packs or gussets and lattice columns	2
Proj4	Explanation of the project no. 2 Design rules for joint in timber structures by using dowel type fasteners, toothed-plates connectors and nail plates.	2
Proj5	Explanation of the project no. 3 Glued laminated timber beams. calculation of tapered, double tapered, curved and pitched cambered beams.	2
Proj6	Explanation of the project no. 3 Load capacity of glulam elements in case of fire.	2
Proj7	Pass classes on the basis of completed projects	3
	Total hours	**15**

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentations N2. Project: presentation of selected computer-aided design software

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 (project)	PEK_U01, PEK_U02 PEK_K02	project
F2 (project)	PEK_W02, PEK_U01.	test
F3		
P = 0.4×F1 + 0.5×F2 + 0.1× presence (project)		
P (lecture)	PEK_W01, PEK_W02 PEK_K01	test

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] Buczkowski W. i in. (2009) Budownictwo ogólne. Tom 4 – Konstrukcje budynków. Arkady, Warszawa.
[2] Kotwica J. (2011) Konstrukcje drewniane w budownictwie tradycyjnym. Arkady, Warszawa.
[3] Mielczarek Z. (1994) Budownictwo drewniane. Arkady, Warszawa.

[4] Neuhaus H. (2008) Budownictwo drewniane. Polskie Wydawnictwo Techniczne, Rzeszów.
[5] Nożyński W. (2001) Przykłady obliczeń konstrukcji budowlanych z drewna. WSiP, Warszawa.
[6] Porteous J., Kermani A. (2007) Structural Timber design to Eurocode 5. Blackwell Publishing, Oxford.
[7] Stefańczyk B. i in. (2007) Budownictwo ogólne. Tom 1 - Materiały i wyroby budowlane. Arkady, Warszawa.
[8] Standards:
PN-EN 1995-1-1:2010. Eurokod 5: Projektowanie konstrukcji drewnianych. Część 1-1: Postanowienia ogólne. Reguły ogólne i reguły dotyczące budynków.
PN-EN 1995-1-2:2008. Eurokod 5: Projektowanie konstrukcji drewnianych. Część 1-2: Postanowienia ogólne. Projektowanie konstrukcji z uwagi na warunki pożarowe.
PN-EN 1194:2000. Konstrukcje drewniane. Drewno klejone warstwowo. Klasy wytrzymałości i określenie wartości charakterystycznych.
PN-EN 338:2011. Drewno konstrukcyjne. Klasy wytrzymałości.
PN-B-01042:1999. Rysunek konstrukcyjny budowlany. Konstrukcje drewniane.

SECONDARY LITERATURE:

[1] Becker K., Blass H. (2006) Ingenieurholzbau nach DIN 1052. Einführung mit Beispielen. Ernst&Sohn, Berlin.
[2] Erler K. (2004) Alte Holzbauwerke: beurteilen und sanieren. Huss-Medien Verlag Bauwesen, Berlin.
[3] Herzog T., Natterer J., Schweitzer R. i in. (2003) Holzbau Atlas. Birkhäuser, Edition Detail, München.
[4] Jasieńko J. (2003) Połączenia klejowe i inżynierskie w naprawie, konserwacji i wzmacnianiu zabytkowych konstrukcji drewnianych. DWE, Wrocław.
[5] Larsen H., Enjily V. (2009) Practical Design of Timber Structures to Eurocode 5. Thomas Telford, London
[6] Mönck W., Rug W. (2008) Holzbau. Bemessung und Konstruktion.. Verlag Bauwesen, Berlin
Thelandersson S., Larsen H.J., Ed. (2003) Timber Engineering. Wiley&Sons, London.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Timber structures
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 *****
Knowledge				
PEK_W01	K2_W10	C1,C4	Lec2,Lec,Lec6	N1
PEK_W02	K2_W05, K2_W06, K2S_CEB_W22	C1,C2,C3,C4	Lec1 – Lec7	N1
Skills				
PEK_U01	K2_U04, K2_U05, K2_U07, K2S_CEB_U23	C2,C3,C4	Proj1 – Proj7	N2
PEK_U02	K2_U12	C2,C3	Proj1 – Proj7	N2
Social competences				
PEK_K01	K2_K01	C1,C2,C3,C4	Lec1 – Lec3, Lec7	N1
PEK_K02	K2_K02	C1,C4	Lec1 – Lec3, Lec7	N1

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Conservation and strengthening of monumental heritage structures**
Name in Polish:	**Konserwacja i wzmacnianie konstrukcji zabytkowych**
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:	**CEB006763**
Group of courses:	**YES / ~~NO*~~**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**15**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**			**0,6**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of general mechanics, strength of materials, and general principles of shaping structures.
2. Possesses the knowledge concerning traditional building construction including historical objects.
3. The student knows the rules and the guidelines and codes for the design of buildings and their components.
4. The student has a theoretical basis. He has the ability to calculating and construction elements and basic building structures of concrete, steel, timber and masonry structures.
5. Possesses the knowledge concerning building materials.

SUBJECT OBJECTIVES

C1. The knowledge concerning technology of strengthening of the elements of the traditional building.
C2. Understanding of the specific calculations of structures after strengthening.
C3. The knowledge concerning characteristic of contemporary strengthening materials, including composites.
C4. The knowledge concerning moisture protections of existing building.
C5. The knowledge concerning doctrine in the conservation of historical constructions.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Pssesses the knowledge concerning methods and technology of strengthening of existing buildings, especially historical objects.
PEK_W02	Possesses the knowledge concerning building materials using in strengthening of historical structures.
Relating to skills:	
PEK_U01	Knows how to choose the appropriate technology of strengthening taking into account the technical state of the building.
PEK_U02	Knows how to prepare the documentation of conservation and strengthening works.
Relating to social competences:	
PEK_K01	Student is aware of the need to improve professional and personal skills.
PEK_K02	Student knows and understands the consequences of non-technical aspects and engineering activities, including the specification of intervention on the historical objects.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Presentation of the range of lecture. Specification and classification of building destruction causes.	2
Lec2	Methods of diagnosis of building destruction causes	2
Lec3	Repair and strengthening of foundations.	2
Lec4	Repair and strengthening of masonry structures.	2
Lec5	Repair and strengthening of timber and glulam structures	2
Lec6	Repair and strengthening of floor structures.	2
Lec7	Technology of drainage and protection of the existing objects against moisture. Specification of conservation and strengthening of historical building. Crediting colloquy.	3
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
La1		
...		
	Total hours	

Form of classes - project		Number of hours
Proj1	Conditions of course crediting. Subject area scope. Plan of the course. Distribution of projects themes.	2
Proj2	The examples of strengthening of foundation and masonry structures strenghtening.	2
Proj3	The examples of strengthening of timber structures.	2
Proj4	The examples of strengthening of floor structures.	2
Proj5	The examples of strengthening of vault structures.	2
Proj6	Individual project consultations. The rules of the final documentation.	2
Proj7	Pass classes on the basis of completed projects.	3
	Total hours	**15**

Form of classes - seminar		Number of hours
Se1		
...		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentations N2. Project: presentation of examples

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 (project)	PEK_W01 PEK_U01 PEK_U02 PEK_K01	Analysis of the projects.
F2 (project)	PEK_W01 PEK_U01 PEK_U02 PEK_K01	Presence
P = 0,85 x F1+0,15 x F2 (project)		
P (lecture)	PEK_W02 PEK_U02 PEK_K02	Test

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Masłowski E., Spiżewska D.,: „Wzmacnianie konstrukcji budowlanych", Arkady, Warszawa 2000 [2] Mitzel A., Stachurski W., Suwalski J.,: „Awarie konstrukcji betonowych i murowych", Arkady Warszawa 1973 [3] Proceedings of the conference „Structural Analysis of Historical Constructions" **SECONDARY LITERATURE:** [1] Proceedings of the conference "PROHITECH" [2] Proceedings of the conference "MURICO"

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Conservation and strengthening of monumental heritage structures
AND EDUCATIONAAL 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 *****
Knowledge				
PEK_W01	K2_W02, K2_W06, K2_W09, K2S_CEB_W22	C1 – C5	Lec1 - Lec7 Proj1 – Proj6	N1, N2
PEK_W02	K2_W10	C1,C3	Lec1 - Lec7 Proj1 – Proj6	N1, N2
Skills				
PEK_U01	K2_U04, K2_U05, K2S_CEB_U21, K2S_CEB_U23	C1,C3,C4,C5	Lec1 - Lec7 Proj1 – Proj6	N1, N2
PEK_U02	K2_U12	C2,C5	Lec1 - Lec7 Proj1 – Proj6	N1, N2
Social competences				
PEK_K01	K2_K01, K2_K06	C1-C4	Lec1, Lec7	N1, N2
PEK_K02	K2_K02	C5	Lec1, Lec7	N1, N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Effective properties of composites – introduction to micromechanics**
Name in Polish:	**Właściwości efektywne kompozytów –wprowadzenie do mikromodelowania**
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:	**CEB006863**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**		
Number of hours of total student workload (CNPS)	**30**		**60**		
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**		**0,6**		

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge regarding continuous mechanics.
2. The student has knowledge and skills in the field of strength of materials.

SUBJECT OBJECTIVES

C1. Learning the methodology of multiscale modelling of composite materials.
C2. Learning the methodology of composite effective properties determination.
C3. Gaining an in-depth knowledge of continuous media mechanics and strength of materials..
C4. Strengthening the ability to work on the task entrusted to and awareness of the need to seek new theoretical and practical solutions.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	The student has an in-depth knowledge of multiscale modelling.
PEK_W02	The student knows theoretical method of composite materials analysis
Relating to skills:	
PEK_U01	The student can perform upscaling using the multiscale technique.
PEK_U02	The student can estimate and determine effective properties of composite materials.
Relating to social competences:	
PEK_K01	The student is able to work on the implementation of tasks independently or in a team (individual preparation of reports and cooperative problem solving in the classroom)
PEK_K02	The student is aware of the need to increase knowledge in the field of composite theory.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction. Principles of micro-macro approach	2
Lec2	Continuous micromechanics. Method of volume and weight averaging.	2
Lec3	Analytical methods of effective properties estimation. Single inclusion problem in diffusion and heat conduction problems.	2
Lec4	Maxwell, Mori-Tanaka and self-consistent estimation schemes.	2
Lec5	Solution of single inclusion problem in elasticity.	2
Lec6	Analytical effective properties estimation schemes for linearly elastic composites.	2
Lec7	Estimation of composite effective properties form digital image of its microstructure	2
Lec8	Final test	1
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Introductory information. Presentation of basic feature of the FlexPDE software. Solving of simple examples.	2
Lab2	Solving diffusion problem in simple structure of periodic composite. Estimation of effective properties.	2
Lab3	Individual work of students. Performing own numerical calculation.	2
Lab4	Individual work of students. Preparation of laboratory reports.	2
Lab5	Numerical determination of Mori-Tanaka and Self-consistent estimates of effective properties.	2
Lab6	Individual work of students. Performing own numerical calculation.	2
Lab7	Individual work of students. Preparation of laboratory reports.	2
Lab8	The final verification of laboratory reports.	1
	Total hours	**15**

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Classic lecture. Multimedial presentation.
N2.	Laboratory: classic and multimedial presentation regarding laboratory, presentation of computer software, examples of problem solution with computer software.

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(laboratory)	PEK_U01, PEK_U02, PEK_K01	Laboratory report.
F2(laboratory)	PEK_U01, PEK_U02, PEK_K01	Laboratory report.
P (laboratory) = P = 0,4xF1+0,4xF2+0,2xParticipation (Laboratory)		
P (lecture)	PEK_W01, PEK_W02, PEK_K02	Final test.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Milton G. W.: The Theory of Composites, Cambridge Univ. Press, 2002.
[2] Torquato S.: Random heterogeneous materials, Springer, 2000.
[3] Hornung U.: Homogenization and porous media, Springer, 1997.
[4] Łydżba D.: Effective properties of composites, Wrocław, 2011.

SECONDARY LITERATURE:

[1] Cherkaev A.: Variational methods for structural optimization, Springer, 2000.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Effective properties of composites – introduction to micromechanics
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 *****
Knowledge				
PEK_W01	K2_W02, K2S_CEB_W22	C1, C3, C4	Lec1 – Lec7	N1
PEK_W02	K2_W05, K2S_CEB_W22	C1, C3, C4	Lec4 – Lec7	N1
Skills				
PEK_U01	K2_U16, K2S_CEB_U23	C1, C2	Lab1 – Lab7,	N2
PEK_U02	K2_U16, K2S_CEB_U23	C1, C2	Lab1 – Lab7	N2
Social competence				
PEK_K01	K2_K03	C4	Lab3, Lab4, Lab6, Lab7	N2
PEK_K02	K2_K01	C4	Lec1 - Lec7	N1

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Methods of applied statistics (geostatistics)**
Name in Polish:	**Metody statystyki stosowanej (geostatystyka)**
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:	**CEB006963**
Group of courses:	~~**YES /**~~ **NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**15**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination~~-~~/ crediting with grade *	~~Examination~~ / crediting with grade *	Examination~~-~~/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**			**0,6**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses the knowledge required in the programme of secondary school, connected with mathematics and information science (computer science).
2. Possesses the knowledge concerning the mathematics, mathematical statistics and information science foundations.
3. Possesses the skills of basic making of mathematical statistics tools and basic information techniques.

SUBJECT OBJECTIVES

C1. Gaining of the knowledge concerning geostatistics foundations (grounds), representing the branch of applied (spatial) statistics, getting acquainted with basic descriptions, definitions and notions applied in geostatistics, such as for example: variogram, covariance, autocorrelation, variograms modeling, cross-validation, kriging, cokriging, interpolation, estimation, simulation, Gaussian models.

C2. Making acquaintance with basic models and techniques applied in linear stationary geostatistics and non-linear, non-stationary geostatistics.

C3. Forming up of skills of carrying out of multidimensional structural (variographic) analysis of variation of parameters (regionalized variables), describing the studied regionalized

	phenomena and of performing of interpolation and estimation of averages values Z* of these parameters, in regular elementary grid.
C4.	Learning of carrying out of multidimensional structural analysis of variation of the studied phenomena and of using of interpolation and estimation techniques and performing of the evaluation of their applying meaning.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Possesses the knowledge concerning an applied geostatistics foundations, taking into account of basic empirical measures of spatial variation and interpolation and estimation techniques, and also concerning their meaning in technical sciences and Earth sciences.
PEK_W02	Knows the foundations (grounds) of subject area (problems) related to the investigating of regionalized phenomena in various areas of knowledge (for instance: civil engineering, geodesy, mining, environment engineering, geology, environment protection) and he understands their meaning during the elaborating and the developing of area (2D), spatial and spatial-time (3D and 4D) geostatistical models.
Relating to skills:	
PEK_U01	Knows how to carry out the evaluation of basic statistics and to calculate isotropic and directional variograms of the studied parameters and determine character and degree their variation, how to describe and characterize an anisotropy of variability of the considered parameters.
PEK_U02	Knows how to calculate variograms, block-diagrams, raster and isoline maps, and on the ground of maps he knows how to perform delineating grid sections along the sections lines, and moreover he knows how to carry out interpretation of the results of geostatistical analyses.
PEK_U03	Knows how to perform grid sections using the generated sets and how to carry out on their ground , for instance, an initial analysis of soil-water conditions for the needs of civil engineering or also geological-mining conditions for the needs of mining.
PEK_U04	Knows how to serve a specialistic geostatistical software, contained in special packet of geostatistical software and knows how to use adequate computer programs, how to copy, elaborate and interpret the results of spatial analyses (geostatistical studies) and how to prepare projects.
Relating to social competences:	
PEK_K01	Knows how to work independently and together with team for the realizing of undertaken task.
PEK_K02	Knows how to use of the grounds of knowledge connected with obliging assumptions existing in geostatistics and how to use suitable analytical algorithms.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Conditions of course crediting. Literature contents. Introduction to geostatistics, basic descriptions, definitions and notions (geostatistics, regionalized phenomena, variogram, covariance, autocorrelation, interpolation, estimation, simulation).	1
Lec2	Basic informations connected with theory of linear stationary geostatistics and non- linear and non-stationary geostatistics.	1
Lec3	Structural analysis of variation of the studied parameters using of variogram function, covariance function and autocorrelation function.	2
Lec4	Modeling of empirical variograms by means of analytical theoretical functions (“geostatistical models”).	1
Lec5	Cross-validation of assumed theoretical models of empirical variograms.	1
Lec6	Investigating of an anisotropy of the studied parameters variation, using the directional variogram function.	1

Lec7	Estimating by applying with quick interpolation techniques and estimation techniques	3
Lec8	Geostatistical simulations	1
Lec9	Practical aspects of applying with kriging and simulation methods	1
Lec10	Fields (areas) of applications of geostatistical methods in country and abroad.	1
Lec11	Crediting colloquy	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1	Subject area scope. Literature contents. Priniciples of BHP. Conditions of course crediting. Admonition of basic geostatistical descriptions, definitions and notations. The elaborating of thematical data bases (2D, 3D), making the ground for geostatistical calculations.	1
Lab2	Geostatistical studies (2D, 3D) of geological-engineering parameters variation of soils and underground waters.	2
Lab3	Geostatistical studies (2D, 3D) of environmental and chemical parameters variation of underground waters.	2
Lab4	Integration of content of data bases containing geological-engineering and environmental parameters values, concerning soil-water environments, i.e soils and underground waters.	2
Lab5	Spatial analyses (2D, 3D) of parameters of mineral resources deposits variation.	2
Lab6	Processing and modeling of geological-mining parameters (data) in mining (3D).	2
Lab7	Non-stationary case study, presented for instance as an analysis of geological and seismic data.	2
Lab8	Images filtering presented for instance as an analysis of geological-engineering, environmental, climatical, deposit and material parameters.	1
Lab9	Course crediting	1
	Total hours	**15**

In the frame of the project – computer exercises (15 hours) with applying of the packet of statistical and geostatistical programs of ISATIS – the version of Isatis 2013.1, dongle key USB connected with the software Isatis purchased in the Firm Geovariances, Avon, Ecole des Mines de Paris, France.

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture – Multimedial presentations. Word presentation. Explanation of some definitions on the black-board. Replying to requestions of students. N2. Project (realized in computer laboratory) – carrying out of thematical projects on computers and reports on the ground of distributed didactic materials and the prepared data bases deriving from own sources (thematic data bases). Word and multimedial presentation, explanation of some definions on the black-board. Direct collaboration and discussion with Students.

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 (computer laboratory)	PEK_WO1, PEK_UO1	Average evaluation on the ground of projects.
F2 (computer laboratory)	PEK_WO1, PEK_UO1, PEK_KO1	Activity during courses.
F3 (computer laboratory)	PEK_WO1, PEK_UO1, PEK_KO1	Participation (presence) in project courses realized in computer laboratory.
F7 (lecture)	PEK_WO1, PEK_UO1	Colloquy
F8 (lecture)	PEK_WO1, PEK_UO1	Presence during lectures.
P (laboratory etc) =		
P (lecture) =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Armstrong M., Basic Linear Geostatistics. Berlin: Springer, 1998, s. 153.
[2] Armstrong M. & Dowd P. A. Editors. Geostatistical Simulations. Kluver Academic Publisher, Dordrecht, p.265, 1994.
[3] Chiles J. P., Delfiner P., Geostatistics: Modeling Spatial Uncertainity. N. Y.: Wiley, (Wiley series in probability and statistics), 1999.
[4] Clark I. & Harper W.V., Practical Geostatistics 2000. Ecosse North America L1c Columbus Ohio, USA, p.342.
[5] Isaaks E., Srivastava R.Mohan, Introduction to Applied Geostatistics. New York Oxford, Oxford University Press, 1989.
[6] Lantuejoul C., Geostatistical Simulation, Models and Algorithms. Berlin: Springer, 2002.
[7] Namysłowska-Wilczyńska B., Geostatystyka Teoria – Zastosowania. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2006 r., s. 265.
[8] Rivoirard J., Introduction to Disjunctive Kriging and Non-linear Geostatistics. Oxford: Clarendon, 1994.
[9] Wackernagel H., Multivariate Geostatistics, An Introduction with Applications. 2 nd edition, Springer – Verlag Berlin Heidelberg New York, 1998, s. 256.

SECONDARY LITERATURE:

[1] Deutsch C. & Journel A, 1998, GSLIB: Geostatistical Software Library and User's Guide. Oxford University Press, New York, Oxford. p. 369.
[2] ISATIS, Isatis Software Manual. Geovariances & Ecole des Mines de Paris, Avon Cedex, France, January 2001, s. 585.
[3] Mucha J.: Metody geostatystyczne w dokumentowaniu złóż., Akademia Górniczo- Hutnicza,

Wydział Geologii, Geofizyki i Ochrony Środowiska, Katedra Geologii Kopalnianej, Kraków 1994., s. 155.
[4] Mucha J.: Struktura zmienności zawartości [Zn] i [Pb] w Śląsko-Krakowskich złożach rud Zn-Pb. Studia, Rozprawy, Monografie nr 108, Wydawnictwo Instytutu Gospodarki Surowcami Mineralnymi i Energią PAN, Kraków 2002, s. 149.
[5] Namysłowska-Wilczyńska B., Zmienność złóż rud miedzi na monoklinie przedsudeckiej w świetle badań geostatystycznych. Prace Naukowe Instytutu Geotechniki i Hydrotechniki Politechniki Wrocławskiej 64, Seria: Monografie 21, Wrocław 1993, s. 207.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

Prof. dr hab. Barbara Namysłowska-Wilczyńska, Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego, Barbara.Namyslowska-Wilczynska@pwr.wroc.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods of applied statistics (geostatistics)
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 ***
Knowledge				
PEK_W01	K2_W01, K2_W09, K2S_CEB_W22	C1,C2,C3,C4	Lec1- Lec8 Proj1-Proj7	N1, N2
PEK_W02	K2_W01, K2S_CEB_W22	C1,C2,C3,C4	Lec1- Lec8 Proj1-Proj7	N1, N2
Skills				
PEK_U01	K2_U01, K2S_CEB_U23	C1,C2	Lec1-W Lec6 Proj1-Proj7	N1, N2
PEK_U02	K2_U03, K2S_CEB_U23	C1-C3	Lec2- Lec8 Proj1-Proj7	N1, N2
PEK_U03	K2_U08, K2_U17, K2S_CEB_U23	C1-C3	Lec7- Lec9 Proj1-Proj7	N1, N2
PEK_U04	K2_U16, K2_U17, K2S_CEB_U19, K2S_CEB_U23	C1-C4	Lec2- Lec10 Proj1-Proj7	N1, N2
Social competence				
PEK_K01	K2_K01, K2_K02, K2_K03, K2_K06	C1-C2	Lec1- Lec7 Proj1-Proj7	N1, N2
PEK_K02	K2_K01, K2_K02, K2_K03, K2_K06	C3-C4	Lec4- Lec10 Proj1-Proj7	N1, N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Adavanced building physics**
Name in Polish:	**Zaawansowana fizyka budowli**
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:	**CEB007063**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**		
Number of hours of total student workload (CNPS)	**30**		**60**		
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**		**0,6**		

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Graduation of civil engineering, environmental engineering architecture or city planning studies.
2. Has knowledge of building construction, technical drawings and general building design.
3. Knows standards, guidelines and regulations about construction and their detail design.
4. Has theoretical basis of detached house design and construction detail solutions.

SUBJECT OBJECTIVES

C1. Gain knowledge about design rules of modern, low energy demand, ecological residential and commercial buildings and their details.
C2. Getting acquainted with renewable energy usage possibilities.
C3. Getting acquainted with regulations of rational energy preservation with taking thermal, visual and acoustic comfort of different rooms into consideration.
C4. Getting basis of design team cooperation to connect form and function with rational energy usage in buildings.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	knows the standards, guidelines and regulations referring to the design of buildings and their components
PEK_W02	possesses knowledge about the influence of building investments on the environment
PEK_W03	has extensive knowledge in the area of selected elements, constructions and building structures
Relating to skills:	
PEK_U01	is able to use advanced specialized tools when searching Internet databases and other sources which can be used to find both general information and other information related to civil engineering; is able to use information technology to communicate and know how to obtain software which is used to aid the work of a designer and the person organizing and managing building processes
PEK_U02	is able to choose a tool (analytical or numerical) in order to solve engineering issues; is able to use selected software which aid modeling and design processes in construction
PEK_U03	has skills to solve tasks referring to selected theoretical issues and also design elements, constructions and building structures
Relating to social competences:	
PEK_K01	is aware of the need to constantly upgrade professional and personal competence in the form of formal or informal education and also improves and develops knowledge in the area of modern processes and technology, related to civil engineering
PEK_K02	is aware of the importance and also understands non-technical aspects and consequences of engineering activity, including influence on the environment and responsibility for implemented decisions
PEK_K03	is able to work independently and cooperate in a team on a specific task; is responsible for both the safety of his work and his subjected team's work

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction, work safety regulations training. Course subjects and passing regulations talk through. Laboratory schedule talk through.	1
Lec2	Advanced problems of steady and transient heat flow through building partitions. Thermal dynamics of building partitions, thermal mass. Rules of proper building envelope design according to heat flow.	2
Lec3	Heat flow through windows and glazed facades. Types of glazing, calculation methods, technological possibilities, visual comfort of building users.	2
Lec4	New technologies in building thermal modernisation and in low energy buildings. Ecological aspect of energy saving in buildings.	2
Lec5	Low energy buildings: rating criteria, classification, design and realisation rules.	2
Lec6	The possibilities of renewable energy use in heat balance improvement of different types of buildings.	2
Lec7	Earth-sheltered buildings: classification, typical construction details, soil heat flow, heat transfer through ground walls and floors, energy conservation problems	2
Lec8	Final test	2
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Laboratory scheme talk through. Excercises talk through. Familiarize with work safety regulations.	1
Lab2	Climate chambers research.	2
Lab3	Heat flow measurements through building walls	2
Lab4	Infrared thermal camera measurements	2
Lab5	Heat flux measurements (pyranometer, pyrgeometer, differential radiometer)	2
Lab6	Building Integrated Photovoltaics (BIPV)	2
Lab7	Thermal comfort	2
Lab8	Computational building physics	2
	Total hours	15

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentation of lecture material and chosen building physics software. N2. Laboratory: multimedia presentation, solution of problems with use of laboratory equipment and software.

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
P1 (laboratory)	PEK_U01 PEK_U02 PEK_U03 PEK_K01 PEK_K02 PEK_K03	Final report from carried out laboratory excercises
P2 (lecture)	PEK_W01 PEK_W02 PEK_W03	Colloquium - test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Beggs C., Energy Management, Supply and Conservation. Elsevier, 2002.
[2] Clark J., Energy Simulation in Building Design. Wiley Company, 2001.
[3] Gratia E., DeHerde A.: Passive Solar Architecture. BRE, 2006.
[4] Hens H., Buildings Physics – Heat, Air and Moisture. Ernst & Sohn, 2007.

[5] Moss K., Heat and Mass Transfer in Buildings. Elsevier, 2007.
[6] Twidell J., Weir T., Renewable Energy Resources. Taylor & Francis, 2006.

SECONDARY LITERATURE:

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
prof. dr hab. inż. Henryk Nowak, Zakład Fizyki Budowli i Komputerowych Metod Projektowania, henryk.nowak@pwr.edu.pl
MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
dr inż. Łukasz Nowak, Zakład Fizyki Budowli i Komputerowych Metod Projektowania, lukasz.nowak@pwr.edu.pl dr Elżbieta Śliwińska, Zakład Fizyki Budowli i Komputerowych Metod Projektowania, elzbieta.sliwinska@pwr.edu.pl PhD students

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced building physics
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 *****
Knowledge				
PEK_W01	K2_W06	C1, C2	Lec1 to Lec 7	N1
PEK_W02	K2_W13	C2, C3, C4	Lec1 to Lec 7	N1
PEK_W02	K2S_CEB_W22	C1, C2, C3, C4	Lec1 to Lec 7	N1
Skills				
PEK_U01	K2_U01	C1, C3	Lab1 do Lab7	N2
PEK_U02	K2_U08	C2, C4	Lab1 do Lab7	N2
PEK_U03	K2_U04, K2S_CEB_U23	C1, C2, C3, C4	Lab1 do Lab7	N2
Social competences				
PEK_K01	K2_K01	C3, C4	Lab1 do Lab7	N2
PEK_K02	K2_K02	C1, C2	Lab1 do Lab7	N2
PEK_K03	K2_K03	C4	Lab1 do Lab7	N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Sustainable housing**
Name in Polish:	**Budownictwo zrównoważone**
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:	**CEB008263**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**15**	
Number of hours of total student workload (CNPS)	**30**			**60**	
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination~~=~~/ crediting with grade *	Examination / crediting with grade *	Examination~~=~~/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**			**0,6**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Graduation of civil engineering, environmental engineering architecture or city planning studies.
2. Has knowledge of building construction, technical drawings and general building design.
3. Knows standards, guidelines and regulations about construction and their detail design.
4. Has theoretical basis of detached house design and construction detail solutions.

SUBJECT OBJECTIVES

C1. Gain knowledge about design rules of modern, low energy demand, ecological residential and commercial buildings and their details.
C2. Getting acquainted with renewable energy usage possibilities.
C3. Getting acquainted with regulations of rational energy preservation with taking thermal, visual and acoustic comfort of different rooms into consideration.
C4. Getting basis of design team cooperation to connect form and function with rational energy usage in buildings.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	knows the standards, guidelines and regulations referring to the design of buildings and their components
PEK_W02	possesses knowledge about the influence of building investments on the environment
PEK_W03	has extensive knowledge in the area of selected elements, constructions and building structures
Relating to skills:	
PEK_U01	is able to use advanced specialized tools when searching Internet databases and other sources which can be used to find both general information and other information related to civil engineering; is able to use information technology to communicate and know how to obtain software which is used to aid the work of a designer and the person organizing and managing building processes
PEK_U02	is able to choose a tool (analytical or numerical) in order to solve engineering issues; is able to use selected software which aid modeling and design processes in construction
PEK_U03	has skills to solve tasks referring to selected theoretical issues and also design elements, constructions and building structures
Relating to social competences:	
PEK_K01	is aware of the need to constantly upgrade professional and personal competence in the form of formal or informal education and also improves and develops knowledge in the area of modern processes and technology, related to civil engineering
PEK_K02	is aware of the importance and also understands non-technical aspects and consequences of engineering activity, including influence on the environment and responsibility for implemented decisions
PEK_K03	is able to work independently and cooperate in a team on a specific task; is responsible for both the safety of his work and his subjected team's work

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Course subjects and passing regulations talk through. Sustainable building design basic information. LCA – building life cycle, total building costs. Environmental influence of buildings.	2
Lec2	Building environmental impact methods. Social, economical and environmental aspects of sustainable building design. Law regulations	2
Lec3	Global and local greenhouse gas emission. Carbon dioxide reduction strategies. Energy production from different fuels. Emission factors. Fuel equity. The primal energy conversion coefficients.	2
Lec4	Classification of low-energy buildings. Building shape coefficient. Basic and advanced building design methods. Heat flow through windows and glazed facades.	2
Lec5	Building thermal mass. Ventilation system, heat recovery, ground-coupled heat exchanger	2
Lec6	Renewable energy resources in global and local scale. Usage in low-energy and passive buildings.	2
Lec7	Examples of low-energy and passive buildings. Applied solutions. Possible solutions to carry in buildings in polish climate.	2
Lec8	Final test	1
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
…		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Project subjects and passing regulations talk through. Handing over design cases. Familiarize with work safety regulations.	1
Proj2	U-value calculations for building partition. Untypical cases	2
Proj3	Correct arrangement for rooms with different functions in horizontal and vertical plane. Daylight access.	2
Proj4	Building shape coefficient. Building thermal mass.	2
Proj5	Optimisation of heat gains and losses in buildings with different purpose.	2
Proj6	HVAC (heating, ventilation, air conditioning) and DHW (domestic hot water) systems	2
Proj7	Renewable energy sources. Usage possibilities in Poland and all over the world.	2
Proj8	Infrared thermography. Thermogram interpretation.	2
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: multimedia presentation of lecture material.
N2.	Project: multimedia presentation of project material. Solving problem with use of MS Office software

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
P1 (project)	PEK_U01 PEK_U02 PEK_U03 PEK_K01 PEK_K02 PEK_K03	Design case accomplishment
P2 (lecture)	PEK_W01 PEK_W02 PEK_W03	Colloquium - test

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Beggs C., Energy Management, Supply and Conservation. Elsevier, 2002. [2] Clark J., Energy Simulation in Building Design. Wiley Company, 2001. [3] Gratia E., DeHerde A.: Passive Solar Architecture. BRE, 2006. [4] Hens H., Buildings Physics – Heat, Air and Moisture. Ernst & Sohn, 2007. [5] Moss K., Heat and Mass Transfer in Buildings. Elsevier, 2007. [6] Twidell J., Weir T., Renewable Energy Resources. Taylor & Francis, 2006. **SECONDARY LITERATURE:**

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
dr inż. Maja Staniec, Zakład Fizyki Budowli i Komputerowych Metod Projektowania, maja.staniec@pwr.wroc.pl
MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sustainable housing
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 *****
Knowledge				
PEK_W01	K2_W06	C1, C2	Lec1 do Lec7	N1
PEK_W02	K2_W13	C2, C3, C4	Lec1 do Lec7	N1
PEK_W02	K2S_CEB_W22	C1, C2, C3, C4	Lec1 do Lec7	N1
Skills				
PEK_U01	K2_U01	C1, C3	Proj1 do Proj7	N2
PEK_U02	K2_U08	C2, C4	Proj1 do Proj7	N2
PEK_U03	K2_U04, K2S_CEB_U23	C1, C2, C3, C4	Proj1 do Proj7	N2
Social competences				
PEK_K01	K2_K01	C3, C4	Proj1 do Proj7	N2
PEK_K02	K2_K02	C1, C2	Proj1 do Proj7	N2
PEK_K03	K2_K03	C4	Proj1 do Proj7	N2

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Construction project management**
Name in Polish:	**Zarządzanie przedsięwzięciami budowlanymi**
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:	**CEB008563**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**	**15**			
Number of hours of total student workload (CNPS)	**30**	**60**			
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**	**2**			
including number of ECTS points for practical (P) classes		**1,5**			
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**	**0,6**			

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge on construction technology and organization
2. The student is capable to elaborate the time schedule, bill of quantity and cost plan of construction projects.
3. The student knows the basic roles of structural design of construction objects

SUBJECT OBJECTIVES

C1. to transfer the knowledge on construction project management
C2. to train competencies for identification and resolving of considerable problems concerning execution of construction processes
C3. the prepare the alumni for self-dependent managerial positions focused on construction works and supervision of teams in construction industry
C4. to get the ability for self-study and continuous learning of new problems solving.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	the student knows procedures of construction projects management, has the knowledge on organization and management of complex construction projects, has the knowledge on evaluation of project economy, supervision of projects, and computer-aided planning of projects.
PEK_W02	the student has knowledge on performing the business in construction industry, does understand basic roles of company finance and knows cost control procedures as long as project time management
PEK_W03	the student knows basic role of construction law regulations and corresponding administration procedures, including environmental regulations, power energy regulations, waste management law, geological law and knows the basic roles of facility management.
Relating to skills:	
PEK_U01	can plan and prepare the investment process for execution phase, including tendering, managing of construction project and fundaments facility management
PEK_U02	can use the advanced tools for internet and other sources searching the building information, can use the IT tools for interpersonal communication and can get and use the software needed for effective organization and management of construction projects.
PEK_U03	can elaborate the time schedule of works, as long as the bill of quantity; also, can evaluate the economy of construction project.
PEK_U04	can evaluate the risk allocated to execution of a construction project
Relating to social competences:	
PEK_K01	the student is aware of need of permanent increasing of professional and personal competencies by means of formal and not formal training exercises on new construction technology problems.
PEK_K02	the student can think and act in entrepreneurial way.

PROGRAMME CONTENT		
Form of classes - lecture		***Number of hours***
Le1	Management models of a construction process. Regulations and administrative procedures related to the construction process. Obligations and rights of the participants.	1
Le2	The investment process: local plan, arrangements, documents, administrative decisions. Feasibility study for construction projects. Principles and scope of a study.	2
Le3	Tender procedures. Types of tenders. Private and public orders. Management of a tender procedure. Insurances in the investment process in construction. Commodity exchanges.	2
Le4	Tenders and contracts in the construction industry. FIDIC	2
Le5	The use of scheduling and network planning in management of engineering investment.	2
Le6	Evaluation of engineering projects effectiveness (NPV, IRR). Cost control of projects.	2
Le7	Construction project progress analysis using Earned Value Method	2
Le8	Crediting test.	2
	Total hours	**15**

Form of classes - classes		Number of hours
Cl 1	Planning the organization of a construction project structure. Planning of the structure of a construction contracting company.	1
Cl 2	Selected administration procedures obligatory in the construction project management	2
Cl 3	Selected parts of the feasibility study of a construction investment project	2
Cl 4	Engineering clauses in contracts for works in construction.	2
Cl 5	Planning of works with application of critical paths and the cost plan ("S" curve).	2
Cl 6	Calculation of Net Present Value and Internal Rate of Return for construction investment projects.	2
Cl 7	Calculation of forecasted final date and final cost of construction projects with use of Earned Value Method.	2
Cl 8	Crediting test.	2
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Regular lecture with multi-media presentation. Presentation of construction case studies. Presentation of annual report data of real construction companies.
N2.	Demonstration of some recognizable software packages for project management.
N3.	Contact hours for students.

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
	PEK_W01	final semester quiz
	PEK_W02	

	PEK_W03
	PEK_U01
	PEK_U02
	PEK_U03
	PEK_U04
	PEK_W01
	PEK_W01

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] A Guide to the Project Management Body of Knowledge, Fourth Edition. Project Management Institute, 2009.
[2] Clough R.H ., Sears G. A., Construction Project Management. JohnWiley 1991
[3] Code of Practice: Project Management for construction and development. Blackwell Publ. 2002
[4] Ferry D. J., Brandon P. S., Ferry J. D., Cost Planning of Buildings. Blackwelll Science, 1999.
[5] Fewings P., Construction Project Management – an integrated approach. Taylor&Francis, 2005.
[6] Harris F., McCaffer, Modern Construction Management. Blackwell Sci. Publ. 1989
[7] Lambeck R., Eschemuller J., Urban Construction Project Management. McGraw-Hill, 2008.
[8] Lester A., Project Management – Planning and Control (5th Edition). Elsevier, 2007.

SECONDARY LITERATURE:

[1] Fisk E. R., Construction project administration. Pearson 2006.
[2] Gould F. E., Managing the construction process. Pearson 2005
[3] Kerzner H., Project Management. Van Nostrand Rein. Comp., 1984
[4] Johnson R. E., The Economics of Building, JohnWiley, 1990
[5] Woodward J. F., Construction Project Management – Getting it right first time. Thomas Telford 1997.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Construction project management
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 *****
Knowledge				
PEK_W01	K2_W11, K2_W12, K2_W15, K2S_CEB_W21	C1, C2, C3, C4	Lec1,Lec2, Lec3	N1, N2, N3
PEK_W02	K2_W11, K2_W12, K2S_CEB_W21	C1, C2, C3, C4	Lec5 do Lec7	N1, N3
PEK_W03	K2_W11, K2_W12, K2_W13, K2_W14, K2S_CEB_W21	C1, C2, C3, C4	Lec2, Lec4	N1, N3
Skills				
PEK_U01	K2_U01, K2_U14, K2S_CEB_U23	C1, C2, C3, C4	Lec1 do Lec4 Cl2, Cl5	
PEK_U02	K2_U01, K2S_CEB _U23	C1, C2, C3, C4	Lec5 do Lec7 Cl1 do Cl7	
PEK_U03	K2_U08, K2_U13	C1, C2, C3, C4	Lec5, Cl5	N1, N2, N3
PEK_U04	K2_U14	C1, C2, C3, C4	Lec3 Cl1 do Cl7	
Social competence				
PEK_K01	K2_K01, K2_K02	C2	Lec1 do Lec3 Cl1 do Cl7	N1
PEK_K02	K2_K05	C3	Lec1 do Lec7 Cl1 do Cl7	N1, N2, N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Seminarium dyplomowe**
Name in Polish:	**Master (MSc) thesis seminar**
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:	**CEB009863**
Group of courses:	**~~YES /~~ NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					**30**
Number of hours of total student workload (CNPS)					**90**
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination~~-~~/ crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points					**3**
including number of ECTS points for practical (P) classes					**2,7**
including number of ECTS points for direct teacher-student contact (BK) classes					**1,1**

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic theoretical knowledge and skills in accordance with the requirements of the field of study *building* of the second cycle program, including specialty Civil Engineering.
2. Can shape, model, analyze, and measure components of complex buildings.
3. Knows the applicable standards, guidelines and regulations of construction, including extended for studying a specialty.
4. Has abilities and computational efficiency in the design of building structures, including the use of advanced computer-aided techniques for the calculation and plotting.

SUBJECT OBJECTIVES

C1. Synthesis of knowledge from the completed studies and practical experience.
C2. Creation of education skills to assess the suitability and usability of various tools and sources of information to solve engineering problems.
C3. Creation of education abilities of independent development and demonstration of technical issues in the construction industry, using multimedia techniques.
C4. Acquiring ability to develop a master thesis and a critical and comprehensive look at technological solutions.
C5. Learn how to prepare basic studies of a scientific or technical knowledge.

C6. Developing skills of preparation, critical evaluation and presentation of experimental results and evaluation studies.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Has in-depth knowledge of issues related to the construction industry, in particular relating to diploma specialization.
PEK_W02	Has knowledge of the techniques and methods of guiding and participation in public discussion on the issue of the construction industry.
Relating to skills:	
PEK_U01	Has specific skills for solving problems in the construction industry, particularly in specialty Civil Engineering.
PEK_U02	Has the ability to collect and critically analyze, from a variety of sources, of information about the construction industry, in particular, of the realized diploma specialization.
PEK_U03	Is able to conduct properly design, implementation and make, using advanced multimedia technology, complex technical presentations in the area of construction, and in particularly of the specialty Civil Engineering.
PEK_U04	Has the ability, in accordance with scientific principles and using research techniques, to prepare and implement a preliminary work on a research leading to solutions of complex engineering problems that occur in the construction industry.
PEK_U05	Is able to prepare all the necessary information to present the essence of popular scientific or technical problems.
Relating to social competences:	
PEK_K01	Is able to work independently over the implementation of the forthcoming thesis.
PEK_K02	Has the ability to prepare and execute complex presentation and the ability to participate in discussions in a public forum on topics related to construction.
PEK_K03	Is aware of the social role of technical college graduate in defining and delivering to public the information and opinions on the achievements of technology and other aspects of engineering.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1		
…		
	Total hours	

Form of classes - class		**Number of hours**
Cl1		
…		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1	Introduction to the course, range of subject, course organization, the principles of evaluation. Methodology for the design and development of complex multimedia presentations using computer tools. Sources of information and how to collect them and analyze.	2
Sem2	Examples of the use of advanced software features in presentations related to the theme of the course - an analysis of the advantages and disadvantages of discussed presentations. Rules on technical presentation. Formulating questions and answers during the discussion in a public forum.	2
Sem3	Presentation of the principles of preparation and implementation of issues related to the conduct of basic research. Examples.	2
Sem4	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem5	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem6	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem7	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem8	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem9	Summary of the 1st series of presentations. Discussion.	2
Sem10	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem11	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem12	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem13	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem14	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem15	Summary of the results of the seminar and credition.	2
	Total hours	**30**

TEACHING TOOLS USED	
N1.	Multimedia presentations - own and collegues.
N2.	Discussion of problems among students.
N3.	Evaluating of presentations - with justification.
N4.	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 (seminar)	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_U03, PEK_U04, PEK_U05, PEK_K01, PEK_K02, PEK_K03	Multimedia presentations - series 1
F2 (seminar)	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_U03, PEK_U04, PEK_U05, PEK_K01, PEK_K02, PEK_K03	Multimedia presentations - series 2
F3 (technical discussion)	PEK_W01, PEK_U01, PEK_U02, PEK_K02	Activity and the value of the substantive vote in the discussions.
P = 0,35 x F1+0,35 x F2+0,2 x F3 +0,1 x obecność		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

Literature depending on theme in which student is preparing his diploma.

SECONDARY LITERATURE:

1. Żurek E.: Sztuka prezentacji czyli jak przemawiać obrazem (Płyta CD). Wyd. Poltex, 2008.
2. Grzybowski P., Sawicki K.: Pisanie prac i sztuka ich prezentacji. Wyd. Impuls, 2010.
3. Blein B.: Sztuka prezentacji i wystąpień publicznych. Wyd. RM, 2010.
4. Wiszniewski A.: Jak pisać skutecznie? Wyd. Videograf II, 2003..

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Master thesis seminar
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 *****
Knowledge				
PEK_W01	K2S_CEB_W16-K2S_CEB_W21	C1	Sem4-Sem8, Sem10-Sem14	N1, N2
PEK_W02	K2_W15, K2_U01	C2, C3, C4, C5	Sem4-Sem14	N1, N2, N3
Skills				
PEK_U01	K2S_CEB_U18-K2S_CEB_U23	C2 do C8	Sem4-Sem8, Sem10-Sem14	N1, N2, N3
PEK_U02	K2_U01, K2_K01	C2 do C8	Sem1 do Sem15	N1, N2, N3, N4
PEK_U03	K2_U01	C2 do C8	Sem1 do Sem15	N1, N2, N3, N4
PEK_U04	K2_U15, K2_U16, K2_U17	C2 do C8	Sem1 do Sem15	N1, N2, N3, N4
PEK_U05	K2_U01, K2_U02, K2_K06	C2 do C8	Sem1 do Sem15	N1, N2, N3, N4
Social competence				
PEK_K01	K2_K03	C2 do C8	Sem1 do Sem15	N1, N2, N3, N4
PEK_K02	K2_K06	C2 do C8	Sem1 do Sem15	N1, N2, N3, N4
PEK_K03	K2_U02, K2_K01, K2_K02, K2_K06	C2 do C8	Sem1 do Sem15	N1, N2, N3, N4

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Praca dyplomowa**
Name in Polish:	**Master (MSc) thesis**
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:	**CEB099963**
Group of courses:	**~~YES /~~ NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)				**540**	
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points				**18**	
including number of ECTS points for practical (P) classes				**18,0**	
including number of ECTS points for direct teacher-student contact (BK) classes				**0,3**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has an advanced theoretical knowledge and skills in accordance with the requirements of the field of study *building* of the second cycle of the program, including Civil Engineering specialty.
2. Can shape, model, analyze, and measure complex structural components of buildings.
3. Knows the applicable standards, guidelines and regulations for the design of buildings, including the extended in the range of building structures.
4. Has the ability and computational efficiency in design, including computer-aided calculation and plotting.
5. Has the ability to independently acquire, use, and analysis of scientific and technical information.

SUBJECT OBJECTIVES

C1. Synthesis of knowledge of the whole the second cycle studies and practical experience, especially in the chosen diploma specialty.
C2. Getting knowledge of the planning and realization of a variety, complex technical, scientific and technical research.
C3. Strengthening the knowledge of the principles of programming, modeling and solving complex engineering design tasks.
C4. Learning students how to select and use advanced computational tools, including

computer programs.
C5. Strengthening skills of development the results and drawing conclusions.
C6. Strengthening the ability to use and critical analysis of scientific and technical information.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Has a well-established and extended knowledge of the issues of the construction industry, particularly in the area of diploma specialization.
PEK_W02	Has a theoretically grounded knowledge of programming, modeling and solving complex design engineering tasks.
PEK_W03	Knows the rules for the application of advanced techniques and computer programs supporting the design and research processes.
Relating to skills:	
PEK_U01	Has detailed, developed skills in solving problems in the construction industry, in particular of the studying specialty.
PEK_U02	Has the ability to collect and critically analyze, from a variety of sources, of information in the field of construction, especially of the studying specialty.
PEK_U03	Can select the methods and tools to solve complex engineering tasks and basic research problems.
PEK_U04	Has the ability to document the work or research projects done by himself and their presentation.
PEK_U05	Is able to establish directions of further education and follow the process of self learning.
Relating to social competences:	
PEK_K01	Is able to set priorities for implementation of specified by himself or the others tasks or research projects and is responsible for his decisions.
PEK_K02	Has an internal belief in the need for the continuous self-development, including related to his profession.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1		
…		
	Total hours	

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Studies of literature and other sources of information.
N2.	Preparation and execution of calculations and / or experimental and / or case study analysis.
N3.	Analysis of the comparisons results, summary, formulation of conclusions, editorial preparation of the thesis.
N4.	Participation in consultations related to the thesis, summarizing discussions.

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
P1, P2, P3, P4	PEK_W01, PEK_W02, PEK_W03, PEK_U01, PEK_U02, PEK_U03, PEK_U04, PEK_U05, PEK_K01, PEK_K02	Rating the thesis by the supervisor and reviewer. Thesis defense. Diploma exam.
P1 – evaluation of the thesis by the supervisor and reviewer P2 – defense of the thesis P3 – evaluation of diploma exam		

PRIMARY AND SECONDARY LITERATURE
Literature depending on specialty in which the diploma is realized. Literature related to the thesis topic chosen independently by student and under the direction of the supervisor.
SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
Thesis supervisor.
MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
Thesis reviewer

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Master thesis
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 *****
Knowledge				
PEK_W01	K2_W07, K2S_CEB_W16-K2S_CEB_W22	C1, C2, C3, C4		N1, N2
PEK_W02	K2_W02-K2_W05, K2S_CEB_W16-K2S_CEB_W22	C1, C2, C3, C4		N1, N2
PEK_W03	K2_W09, K2S_CEB_W16-K2S_CEB_W22	C1, C2, C3, C4		N1, N2
Skills				
PEK_U01	K2S_CEB_U18-K2S_CEB_U23	C4-C6		N1, N2, N3, N4
PEK_U02	K2_U01, K2_U08	C4-C6		N1, N2, N3, N4
PEK_U03	K2_U06-K2_U09, K2_U15, K2_U16	C4-C6		N1, N2, N3, N4
PEK_U04	K2_U17	C4-C6		N1, N2, N3, N4
PEK_U05	K2_U03	C1, C6		N1, N2, N3, N4
Social competence				
PEK_K01	K2_K02, K2_K04	C1, C6		N1, N4
PEK_K02	K2_K01, K2_K04	C1, C6		N1, N4

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above