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

	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.	
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