FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Elektrownie wodne**
Name in English:	**Water Power Plants**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Renewable Energy Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR032332**
Group of courses:	**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:	crediting with grade				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
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40				0.70

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. Has knowledge for the selection of electrical low voltage installation and equipment in normal and fault conditions
2. He can read the design intent
3. He can able to make use of regulations and norms
4. He can use basic computer hardware and software
5. He can work in group and understand the needs of recurrent self education.

SUBJECT OBJECTIVES

C1. To make student acquaintance with rules of design, built and exploitation of hydro power station
C2. To make student acquaintance with basic rules of hydro power station control.
C3. To make student acquaintance with legal and economy analysis required for the design of small hydro power station.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 He has knowledge of the classification and construction of hydroelectric power plants.
PEK_W02 He has knowledge about the principles for the design and operation of hydroelectric power plants.

relating to skills:

PEK_U01 Is able to pre-design basic elements of small of hydro power stations.
PEK_U02 Is able to law and economy analysis in the process of small hydro power stations design.
PEK_U03 Is able to prepare report concerning design, building and exploitation of hydro power stations.

relating to social competences:

PEK_K01 Has cognisance of responsibility for his work and is ready to compliance of the team work rules.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction to subject, programme, requirements and way of testing. Introduction: general definition, classification of hydro power stations, European drivers of SHP development, state of the hydro-energy in Europe and Poland.	2
Lec 2	Water and energy potential: analysis of water resources and production: hydrological parameters river basin, electrical power and energy, flow duration curves.	2
Lec 3	Types and characteristics of the SHP: hydraulic structures, hydro-technical equipment,	2
Lec 4	Types and characteristics of the SHP: basic turbine types of, turbine technology and parameters.	2
Lec 5	Types and energy parameters of the turbines: Pelton, Banki-Michell, Kaplan,	2
Lec 6	Types and energy parameters of the turbines: Francis, Kinetic turbines; electrical diagrams	2
Lec 7	Automation and control of hydro power: Introduction to hydro power control, control of hydro power in electro-energy system.	2
Lec 8	Control of turbines.	2
Lec 9	Voltage control of in hydro power stations	2
Lec 10	Protection, tests, exploitations remarks.	2
Lec 11	Project analysis of hydro power stations: analysis of hydrological potential of the site, turbine choice, selection of generator, automation and protection.	2
Lec 12	Project analysis of small hydro power stations: Economy and Financing.	2
Lec 13	Water Law, Environment, Research &Development	2
Lec 14	Practical examples, good practice cases.	2
Lec 15	Summary of lectures and classification	2
	Total hours:	**30**

Form of classes - seminar		**Number of hours:**
Sem 1	Discussion of problematic aspects of seminar, the way if realisation, the way of programme, requirements and way of classification.	1
Sem 2	Dispensing of assumptions of SHP projects using software provided by attending person – team work.	2
Sem 3	Reports from the scope: Analysis of water potential, hydrological parameters of rivers and basins, electrical power and energy, flow duration curves.	2
Sem 4	Reports from the scope: Types and characteristics of the SHP: hydraulic structures, hydro-technical equipment, basic turbine types of, turbine technology and parameters	2
Sem 5	Reports from the scope: Automation and control of hydro power: introduction to hydro power control, control of hydro power in electro-energy system, control of turbines, voltage control of in hydro power stations, protection, tests, exploitations remarks.	2
Sem 6	Reports from the scope: Project analysis of small hydro power stations (SHP): analysis of hydrological potential of the site, turbine choice, selection of generator, automation and protection; economy and financing, feasibility study	2
Sem 7	Reports from the scope: Water Law, Environment, Research &Development, practical examples, good practice cases.	2
Sem 8	Summary of seminar and classification.	2
	Total hours:	**15**

TEACHING TOOLS USED
N1. Lecture using audio video techniques, multimedia presentations, foliograms.
N2. Seminar – preparing and giving a speech reports.
N3. Knowledge checking in written and unwritten form
N4. Preparing of the initial SHP project in teams.

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(W)	PEK_W01 PEK_W02	Written test or checking messages in the oral form
P(W)	P=F1	
F1(S)	PEK_U01 PEK_U02 PEK_K01	Evaluation of the pre-project of-SHP- teamwork
F2(S)	PEK_U03 PEK_K01	Evaluation of the paper, developed and delivered by each student
P(S)	P=0.5 F1 + 0.5 F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Stawski P., Herlender K., Bobrowicz W., Water Power Plants, Wrocław University of Technology, Wrocław 2011.

SECONDARY LITERATURE:

[1] Bobrowicz W., Small Hydro Power – Investor Guide Leonardo Energy, Utilisation Guide Section 8 – Distributed Generation, Autumn 2006.
[2] Harvey A., Micro-hydro power, 2004.
[3] Shannon R., Water Wheel Engineering. 1997.
[4] Allan. Undershot, Water Wheel. 2008.
[5] Damazy Laudyn, Maciej Pawlik, Franciszek Strzelczyk: Elektrownie, WNT, Warszawa 2007.
[6] Kremens Z., Sobierajski M.: Analiza systemów elektroenergetycznych, WNT, Warszawa 1996.
[7] Jackowski K.: Elektrownie wodne, WNT, Warszawa 1971.
[8] Kacejko P.: Generacja rozproszona w systemie energetycznym. Wyd. PL, Lublin 2004.
[9] Marian Hoffman, Małe elektrownie wodne – poradnik, Wydawnictwo Nabba, Warszawa 1992 r.

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR032332 - Water Power Plants
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Renewable Energy Systems**

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
PEK_W01	S2RES_W04	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec15	N.1
PEK_W02	S2RES_W04	C.1 C.3	Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_U01	S2RES_U04	C.1 C.2 C.3	Sem2 Sem3 Sem4 Sem5 Sem6	N.3 N.4
PEK_U02	S2RES_U04	C.1 C.2 C.3	Sem7	N.3 N.4
PEK_U03	S2RES_U04	C.1 C.2 C.3	Sem3 Sem4 Sem5 Sem6 Sem7	N.2
PEK_K01	S2RES_K02	C.1 C.2 C.3	Sem1 Sem2 Sem3 Sem4 Sem5 Sem6 Sem7 Sem8	N.2 N.3 N.4