Attachement no. 1 to Programme of Education
(for studies beginning in the year 2015/2016)

LEARNING OUTCOMES FOR THE FIELD OF STUDY

(Assumed educational effects)

Faculty: Mechanical and Power Engineering
Field of study: POWER ENGINEERING (ENG)
Specialization: Renewable Sources of Energy (OZE)
Level of study: II (post-graduate)

The area of study:

Field of study Power Engineering belongs to the domain of technical sciences and is related to such majors as *Mechanical Engineering and Machine Building, Environmental Engineering, Electrical Engineering, Process Engineering and Chemical Technology*.

An applicant for the admission to the Master's degree in Power Engineering must have undergraduate degree and possess competencies to continue education at post-graduate level in this field of study. The candidate should have in particular the following abilities:

- knowledge of physics and mathematics that enables understanding of the fundamentals of physical phenomena used in the power engineering sector and to formulate and solve simple design tasks in the field of power engineering,
- knowledge and skills in the field of mechanics, electronics, electrical engineering, materials science, metrology, fluid mechanics, thermodynamics and the basics of machine design, enabling the measurement, analysis and design of simple components and power systems,
- ability to use, to formulate and solve engineering tasks, experimental and design methods,
- knowledge and skills in methodology and design techniques, enabling the formulation of a simple engineering problem and develop the solution using appropriate information tools,
- skills of interpretation, presentation and documentation of the experiment results, and the presentation and documentation of the project tasks.

Explanation of symbols:

K – learning outcomes for the field of study
S – learning outcomes for specialization
W – category of knowledge
U – category of skill
K (after the underscore) – category of social competencies
T – the area of study in the field of technical sciences
2 – post-graduate studies,
A – general profile

Learning outcome for	**DESCRIPTION OF THE MAIN LEARNING OUTCOMES**	**Reference to learning**

post-graduate studies in the field of study: ENG specialization: OZE	**After completion of the post-graduate studies in the field of *Power Engineering* in specialization *Renewable Sources of Energy* the graduate:**	**outcomes for the area of technical sciences (T)**
	KNOWLEDGE	
K2ENG_W01	has ordered knowledge of probabilistics useful to formulate and solve power engineering problems	T2A_W01
K2ENG_W02	has ordered knowledge of numerical methods suitable to solve simple engineering problems	T2A_W01
K2ENG_W03	has ordered knowledge of quantum physics needed to understand the processes used in the power engineering and cryogenics	T2A_W01 T2A_W03
K2ENG_W04	has knowledge of the development trends and the most important achievements of the latest technologies used in the power industry, the development trends and problems in their implementation	T2A_W05 T2A_W08
K2ENG_W05	knows the basic tools for the formulation of mathematical models describing the properties of power systems, their identification and optimization	T2A_W07
K2ENG_W06	has knowledge necessary to understand the social, economic, legal and other non-technical considerations engineering activities, including the management and conduct of business, including in the area of individual entrepreneurship	T2A_W08 T2A_W09 T2A_W11
K2ENG_W07	knows methods of planning of energy systems at the local and regional scale; knows diagnostic systems and network control systems; knows the technical and economic issues associated with the production and distribution of electricity	T2A_W03 T2A_W09
S2OZE_W01	has ordered and theoretically founded detailed knowledge related to matters relating to physical phenomena and processes used in the renewable energy sector as well as the most important new developments and trends in the field of renewable energy sources	T2A_W01 T2A_W03 T2A_W04 T2A_W05
S2OZE_W02	has ordered and detailed knowledge of production technology, methods of preparation, purification of hydrogen for professional power engineering	T2A_W02 T2A_W06 T2A_W07
S2OZE_W03	has detailed knowledge of issues related to hydropower plants, hydropower plant construction, also has the knowledge necessary to understand the ecological conditions of engineering	T2A_W02 T2A_W07 T2A_W08
S2OZE_W04	has an in-depth, ordered knowledge of the legal requirements and methodology for periodic measuring and monitoring pollutant emissions	T2A_W04 T2A_W08
S2OZE_W05	has theoretically founded a detailed knowledge of the systems implementing thermodynamic cycle (for heating) and methods of use of waste and low-parameters heat sources	T2A_W02 T2A_W04

S2OZE_W06	has theoretically founded detailed knowledge of issues related to wind energy	T2A_W04 T2A_W06 T2A_W07
S2OZE_W07	has ordered knowledge of geothermal energy	T2A_W03
S2OZE_W08	has theoretically founded detailed knowledge in the field of energy production from biomass	T2A_W03 T2A_W04
S2OZE_W09	has an expanded knowledge of solar energy conversion into heat and solar systems.	T2A_W02
SKILLS		
K2ENG_U01	can obtain information from the literature and other sources; can suggest improvements to existing solutions; can design energy systems	T2A_U01 T2A_U16 T2A_U19
K2ENG_U02	is able to communicate using a variety of techniques in a professional environment in the range of field study; can predict the directions of self-study in connection with realization of the thesis	T2A_U02 T2A_U04
K2ENG_U03	is able to obtain information from various sources, can make a preliminary economic analysis, is able to prepare a study on the results of their own research	T2A_U03 T2A_U05
K2ENG_U04	has language skills in the fields of science and scientific disciplines relevant to the Power Engineering in accordance with the requirements for level B2+ and possibly for level C1+ of the European Framework of Reference for Languages	T2A_U06
K2ENG_U05	is able to - in formulating and solving engineering tasks - integrate knowledge of power engineering and probability	T2A_U09 T2A_U10
K2ENG_U06	is able to - in formulating and solving engineering tasks - integrate knowledge of power engineering and numerical methods	T2A_U08 T2A_U10
K2ENG_U07	is able to plan and carry out computer modeling of energy installations	T2A_U08 T2A_U09 T2A_U11 T2A_U17 T2A_U18
K2ENG_U08	is able to plan energy systems on a local scale, and to identify diagnostic systems and network control systems, and the technical and economic issues associated with the production and distribution of electricity	T2A_U10 T2A_U13 T2A_U15
K2ENG_U09	has language skills in the fields of science and scientific disciplines relevant to the *Power Engineering* in accordance with the requirements for level A1 or A2 or B1 of the European Framework of Reference for Languages	T2A_U02
S2OZE_U01	is able to prepare (also in the group) a computational design dossier of simple energy system based on renewable energy sources, taking into account the preliminary economic analysis; can do a critical evaluation, draws conclusions and formulates and fully justify opinions	T2A_U01 T2A_U12 T2A_U14

S2OZE_U02	is able to prepare and give a presentation on a topic related to energy from renewable sources and lead a discussion regarding the above presentation, as well as to assess the discussion	T2A_U01 T2A_U04 T2A_U05
S2OZE_U03	is able to plan and carry out experiments related to the production of hydrogen and to interpret the results and draw conclusions	T2A_U08
S2OZE_U04	is able to specify the required parameters for various types of hydropower stations	T2A_U01 T2A_U07 T2A_U09 T2A_U15
S2OZE_U05	can formulate design specifications of components of the hydropower station system	T2A_U01 T2A_U07 T2A_U09 T2A_U15
S2OZE_U06	can formulate measuring specifications of components of systems for measurement and monitoring of pollution	T2A_U17 T2A_U18
S2OZE_U07	is able to design systems performing thermodynamic cycle (for heating) and using the waste and low-parameters heat sources; provides the thermodynamic, energy, technical and economic analysis for local technical conditions	T2A_U08 T2A_U09
S2OZE_U08	can formulate design specifications of components of wind power system	T2A_U01 T2A_U07 T2A_U09 T2A_U15
S2OZE_U09	can formulate design specifications of components of geothermal power plant	T2A_U01 T2A_U07 T2A_U09 T2A_U15
S2OZE_U10	is able to identify and formulate specifications of complex engineering tasks related to the use of biomass in power engineering	T2A_U07 T2A_U15 T2A_U17
S2OZE_U11	is able to prepare and present an oral presentation on the use of biomass for power engineering	T2A_U04
S2OZE_U12	can formulate design specifications of a system using solar radiation for heating	T2A_U19
SOCIAL COMPETENCIES		
K2ENG_K01	understands the need to improve professional, personal and social skills; identifies and resolves dilemmas associated with his profession	T2A_K01 T2A_K05
K2ENG_K02	is aware of the importance of non-technical aspects and impacts of social engineering and the role of university graduates	T2A_K02

		T2A_K07
K2ENG_K03	is able to work in a group and assume different roles	T2A_K03
K2ENG_K04	can properly identify priorities for implementation of self-defined or appointed tasks	T2A_K04
K2ENG_K05	is able to think and act in entrepreneurial manner	T2A_K06
K2ENG_K06	is aware of the necessity of individual and group activities that go beyond the activities of engineering	T2A_K02 T2A_K03

MATRIX OF CORRELATION BETWEEN EDUCATIONAL OUTCOMES/ EFFECTS IN THE FIELD OF TECHNICAL SCIENCES AND EDUCATIONAL EFFECTS
for 2nd level, main field of study *POWER ENGINEERING* in specialization RENEWABLE SOURCES OF ENERGY
general academic profile

Symbol of the educational outcome in the field of technical sciences	Description of the educational outcomes/ effects in the field of technical sciences	Reference to educational outcomes for 2nd level main field of study	
		main field of study *Power Engineering*	specialization *Renewable Sources of Energy*
KNOWLEDGE			
T2A_W01	has expanded and broadened knowledge of mathematics, physics and chemistry and other areas related to the studied discipline necessary to formulate and solve complex tasks in the field of the studied discipline	K2ENG_W01 K2ENG_W02 K2ENG_W03	S2OZE_W01
T2A_W02	has detailed knowledge in the field of study related to the studied discipline		S2OZE_W02 S2OZE_W03 S2OZE_W05 S2OZE_W09
T2A_W03	has organized, general knowledge and theoretical grounding including key issues related to the studied discipline	K2ENG_W03 K2ENG_W07	S2OZE_W01 S2OZE_W07 S2OZE_W08
T2A_W04	has detailed knowledge and theoretical grounding connected with the chosen issues in the field of the studied discipline		S2OZE_W01 S2OZE_W04 S2OZE_W05 S2OZE_W06 S2OZE_W08
T2A_W05	has knowledge of trends in development and the most crucial and newest achievements in scientific disciplines and fields of study related to the studied discipline and other related scientific disciplines	K2ENG_W04	S2OZE_W01
T2A_W06	has fundamental knowledge of the lifecycle of devices, objects and technical systems		S2OZE_W02 S2OZE_W06
T2A_W07	knows fundamental methods, techniques, tools and materials used for solving simple engineering tasks in the field of the studied discipline	K2ENG_W05	S2OZE_W02 S2OZE_W03 S2OZE_W06

T2A_W08	has fundamental knowledge necessary to understand social, economical ,legal and other non-technical factors of engineering activities as well as taking them into consideration in engineering practice	K2ENG_W04 K2ENG_W06	S2OZE_W03 S2OZE_W04
T2A_W09	has fundamental knowledge of management, including quality management and running a business	K2ENG_W06 K2ENG_W07	
T2A_W10	knows and understands basic concepts and rules related to industrial property protection and copyright laws and knows the necessity of these laws and rules in managing intellectual property resources; is able to use patent information resources		
T2A_W11	knows general rules related to establishing and developing individual entrepreneurial activity, using knowledge of scientific disciplines and fields of study related to the studied discipline	K2ENG_W06	
SKILLS			
T2A_U01	is able to obtain information from literature, databases and other properly selected sources, either in English or another foreign language regarded as a language for international communication in the studied discipline ; is able to integrate obtained information, interpret and critically evaluate it, draw conclusions, formulate and justify opinions in full	K2ENG_U01	S2OZE_U01 S2OZE_U02 S2OZE_U04 S2OZE_U05 S2OZE_U08 S2OZE_U09
T2A_U02	is able to communicate in their professional environment and other environments using various techniques, either in English or another foreign language regarded as a language for international communication in the studied discipline	K2ENG_U02 K2ENG_U09	
T2A_U03	is able to prepare a scientific study in Polish language and also a short scientific report, with the results of own research, in a foreign language regarded as a basic one in the scientific disciplines and fields of study related to the studied discipline	K2ENG_U03	
T2A_U04	is able to prepare and give an oral presentation concerning detailed issues in the field of the studied discipline both in Polish and a foreign language	K2ENG_U02	S2OZE_U02 S2OZE_U11
T2A_U05	is able to establish directions of further education and follow the process of self-learning	K2ENG_U03	S2OZE_U02
T2A_U06	has language skills in scientific disciplines and fields of study related to the studied discipline according to CEFR requirements for B2+ level	K2ENG_U04	
T2A_U07	is able to use information and communication technologies necessary to perform tasks typical of engineering activities		S2OZE_U04 S2OZE_U05 S2OZE_U08 S2OZE_U09 S2OZE_U10
T2A_U08	is able to plan and run experiments including measurements and computer simulations, interpret results and draw conclusions	K2ENG_U06 K2ENG_U07	S2OZE_U03 S2OZE_U07

T2A_U09	is able to use analytical, simulation and experimental methods to formulate and solve engineering tasks as well as simple research problems	K2ENG_U05 K2ENG_U07	S2OZE_U04 S2OZE_U05 S2OZE_U07 S2OZE_U08 S2OZE_U09
T2A_U10	is able - while formulating and solving engineering tasks- to integrate knowledge of scientific disciplines and fields of studies appropriate for the specialization and apply the system approach which also takes into account non- technical aspects	K2ENG_U05 K2ENG_U06 K2ENG_U08	
T2A_U11	is able to formulate and test hypotheses connected with engineering problems and simple research problems	K2ENG_U07	
T2A_U12	is able to assess the usefulness and possibilities of new achievements (technological and technical) in the field of the studied discipline		S2OZE_U01
T2A_U13	is prepared to work in an industry environment and knows safety rules in the workplace	K2ENG_U08	
T2A_U14	is able to carry out primary economic analysis of undertaken engineering activities		S2OZE_U01
T2A_U15	is able to carry out critical analysis of functioning and also assess – particularly in reference to the studied discipline- existing technical solutions, in particular devices, objects, systems, processes, and services	K2ENG_U08	S2OZE_U04 S2OZE_U05 S2OZE_U08 S2OZE_U09 S2OZE_U10
T2A_U16	is able to plan improvements in existing technical solutions	K2ENG_U01	
T2A_U17	is able to identify and formulate specifications of complex engineering tasks specific for the studied discipline including untypical tasks considering their non-technical aspects	K2ENG_U07	S2OZE_U06 S2OZE_U10
T2A_U18	is able to assess the usefulness of methods and tools for solving an engineering task specific for the studied discipline, and notice limitations of these methods and tools; is able – by applying conceptually new methods- to solve complex engineering tasks specific for the studied discipline, including untypical tasks and tasks with a research component	K2ENG_U07	S2OZE_U06
T2A_U19	is able – according to a given specification which considers non –technical aspects- to design a complex device, object, system or process specific for the studied discipline and complete this project – at least partially- using appropriate methods, techniques and tools, adapting already existing tools or by creating new tools	K2ENG_U01	S2OZE_U12
SOCIAL COMPETENCIES			
T2A_K01	understands the necessity of a lifetime learning process; is able to inspire and organize the process of learning for others	K2ENG_K01	

T2A_K02	realizes the significance and understands non-technical aspects and consequences of engineering activity and especially its influence on the natural environment and the related responsibility for decisions	K2ENG_K02 K2ENG_K06	
T2A_K03	is able to cooperate and work in a group, taking up different roles	K2ENG_K03 K2ENG_K06	
T2A_K04	is able to set clear priorities leading to the realization tasks set by himself or others	K2ENG_K04	
T2A_K05	identifies correctly and solves dilemmas connected with the profession	K2ENG_K01	
T2A_K06	is able to think and act in an entrepreneurial way	K2ENG_K05	
T2A_K07	realizes the social role of technical university graduates and especially understands the need to formulate information and share it with society, e.g. through mass media, in relation to achievements in environmental engineering and other aspects of engineering activity; makes attempts at sharing such information and opinions in an understandable way	K2ENG_K02	