

# LEARNING OUTCOMES FOR THE FIELD OF STUDY

(Assumed educational effects)

**Faculty: Mechanical and Power Engineering**

**Field of study: Power Engineering (ENG)**

**Level of study: I (undergraduate)**

## The area of study

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

## 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

**1** – undergraduate studies,

**A** – general profile

Learning outcome for undergraduate studies in the field of study: ENG	DESCRIPTION OF THE MAIN LEARNING OUTCOMES  After completion of the undergraduate studies in the field of Power Engineering, the graduate:	Reference to learning outcomes for the area of technical sciences (T)
<b>KNOWLEDGE</b>		
K1ENG_W01	has general knowledge of complex numbers, polynomials, solution of systems of linear equations using matrix algebra, analytic geometry on the plane and in space, conic sections, necessary for understanding of engineering math and sciences	T1A_W01 T1A_W07
K1ENG_W02	has basic knowledge of the properties of functions (trigonometric, exponential, logarithmic, trigonometric and inverse thereof), single variable calculus, indefinite integrals, definite integrals and improper integrals, multivariable differential calculus, double and triple integrals, number series, power series, Fourier series and the basis of probability theory necessary for understanding of engineering math and sciences	T1A_W01 T1A_W07

K1ENG_W03	has basic knowledge of classical mechanics, wave motion and phenomenological thermodynamics, classical electrodynamics (electrostatics, electricity, magneto statics, electromagnetic induction, electromagnetic waves, optics), the special theory of relativity, selected topics of physics: quantum physics, physics of the solid, physics of the nucleus; astrophysics	T1A_W01
K1ENG_W04	has basic knowledge on the structure of matter, the periodic table, types of chemicals and chemical reactions	T1A_W01
K1ENG_W05	has basic knowledge of the theory and techniques of experimental measurement, characterization of properties of measuring instruments, presentation of the results of measurement as well as the method of calculation of its uncertainty and the interpretation of its results	T1A_W03
K1ENG_W06	have knowledge of data processing techniques, principles of operation of computers and computer networks, computer security, basic operating systems, known integrated packages of advanced tools and features and the basics of programming and formulating algorithms	T1A_W02 T1A_W07
K1ENG_W07	has knowledge of the geometric methods of recording the plane and spatial figures	T1A_W02
K1ENG_W08	acquires basic knowledge of the work, operation and construction of equipment and machinery from the field of thermal power engineering, nuclear power engineering and renewable sources of energy in heating, cooling and ventilation	T1A_W03
K1ENG_W09	has ordered knowledge of the different groups of materials used in thermal power engineering as well as their structure, composition and properties	T1A_W02
K1ENG_W10	has ordered and detailed knowledge of fluid mechanics among them the basic equations describing fluid flows over the entire range of criterion numbers, the basic measurements of the hydrodynamic parameters, description of flow phenomena using similarity criteria, perform basic calculations for hydraulic fluid flow in pipes, plumbing used for the design of power engineering systems	T1A_W03 T1A_W04
K1ENG_W11	has ordered and detailed knowledge of thermodynamics including on fundamental laws and principles of thermodynamics, thermodynamic description of the working mediums - ideal, semi-ideal and real, fundamental properties of matter, the phenomena occurring in combustion processes and the flow of gases, processes occurring in conventional heating systems and cooling equipments	T1A_W03 T1A_W04
K1ENG_W12	has ordered an expanded knowledge of the	T1A_W02

	technical problem-solving based on the laws of mechanics and perform stress analysis of structural elements in static and dynamic conditions of their work	
K1ENG_W13	knows and understands of the basic concepts and principles of the protection of industrial property and copyright law and the functioning of patent protection	T1A_W08 T1A_W10
K1ENG_W14	has ordered and theoretically founded knowledge in the field of industrial automation, knows and understands the principles of control systems and thermal power engineering systems	T1A_W03
K1ENG_W15	has a basic knowledge of electronics in the construction, characteristics and principles of operation of most electronic components, microprocessors and operating principles of simple electronic systems	T1A_W02
K1ENG_W16	has a basic and ordered knowledge of the electric and magnetic fields and methods of analysis of electrical circuits	T1A_W02
K1ENG_W17	have knowledge about construction materials and supplies used in the construction of thermal power engineering machineries	T1A_W02
K1ENG_W18	has ordered knowledge of the combustion mechanism and creation of gaseous pollutants; waste biomass co-firing with coal combustion and low carbon emission technologies	T1A_W03
K1ENG_W19	has a basic knowledge of the cycling of matter and energy in the ecosystem and of the dangers of the development of civilization and the possibility of its minimizing	T1A_W02
K1ENG_W20	has an elementary knowledge of the operation, construction and exploitation of basic electrical machinery and equipment	T1A_W02
K1ENG_W21	a ordered knowledge necessary to understand the process of heat transfer by convection, conduction, and radiation	T1A_W03 T1A_W04
K1ENG_W22	is well established and in-depth knowledge of the construction of assemblies and components selected power engineering machines and equipment	T1A_W03 T1A_W04 T1A_W06
K1ENG_W23	has knowledge of the technical capabilities (technology and equipment) standardized emission reduction of pollutants into the atmosphere	T1A_W03 T1A_W05
K1ENG_W24	knows and understands of the methods and techniques in the calculation of basic thermal processes in the power engineering sector and has knowledge of the calibration of measuring equipment and the way of use of the equipment characteristics	T1A_W03
K1ENG_W25	has a theoretical and practical knowledge on how to build boilers for power engineering industrial, put	T1A_W03 T1A_W04

	to recognize the individual elements of boilers and describe how they work	T1A_W05 T1A_W06
K1ENG_W26	has a basic knowledge of the construction and operation of thermal power stations; distinguishes and explains the working principles of the basic elements of power units	T1A_W03 T1A_W04 T1A_W05 T1A_W06
K1ENG_W27	has an established knowledge of balancing machines and equipment of thermal power engineering, knows and understands of methods of calculation efficiency of these devices, identify and name the major energy losses in these devices	T1A_W03
K1ENG_W28	has an elementary knowledge of the principles of operation of the electro-power system and its components; recognizes the risks associated with the operation of electrical equipment and indicates how to protect against them	T1A_W03
K1ENG_W29	know the legal basis for the production of electricity and heat in terms of environmental priorities	T1A_W02 T1A_W08
K1ENG_W30	has a basic knowledge necessary to understand the social, philosophical, economic and legal conditions of engineering	T1A_W08 T1A_W09 T1A_W11
	achieves results in the category KNOWLEDGE for one of the following specializations: <ul style="list-style-type: none"> <li>• Electric Power Engineering (EEN) - Appendix 1</li> <li>• Thermal Power Engineering (ENC) – Appendix 2</li> </ul>	
<b>SKILLS</b>		
K1ENG_U01	can obtain information from literature, databases and other sources, can integrate the information, make their interpretation, and to draw conclusions and formulate and justify opinions	T1A_U01
K1ENG_U02	can use an integrated suite of office applications such as Microsoft Office, acquires the ability to automate work with these applications, and create their own tools using algorithms and macros	T1A_U02
K1ENG_U03	has the ability to self-learning, able to work individually and in teams; know how to estimate the time needed for the commissioned tasks, can develop and implement a work schedule to ensure deadlines	T1A_U05
K1ENG_U04	can prepare the documentation on the implementation of engineering tasks and prepare the text that discusses the results of this task	T1A_U03
K1ENG_U05	able to prepare and present a short presentation concluding of the results of the engineering task	T1A_U04
K1ENG_U06	has language skills in the fields of science and scientific disciplines relevant to the Power Engineering in accordance with the requirements for level B2 of the European Framework of Reference for Languages	T1A_U06
K1ENG_U07	is able to properly and effectively apply knowledge	T1A_U09

	of linear algebra and analytic geometry for qualitative and quantitative analysis of mathematical problems related engineering discipline of study	
K1ENG_U08	is able to properly and effectively apply the knowledge of differential and integral calculus of functions of one and several variables, numerical series, power series and Fourier series and probability for qualitative and quantitative analysis of mathematical problems related engineering discipline of study	T1A_U09
K1ENG_U09	can properly and effectively apply the principles and laws of physics to the qualitative and quantitative analysis of the physical problems from engineering area, able to plan and safely perform and analyze measurements and estimate the uncertainty of the these measured values	T1A_U09
K1ENG_U10	can properly and effectively apply the principles and laws of chemistry for qualitative and quantitative analysis of chemical problems from an engineering area; can plan and safely perform simple chemical experiments	T1A_U09
K1ENG_U11	can write and interpret correctly the result of the measurement, determine the value of the measurement uncertainty for the measurement of direct and indirect; can identify and calculate and disclose the amendment measurement errors, and assess opportunities to improve accuracy.	T1A_U09
K1ENG_U12	is able to plan an experiment, make simple measurements using direct and indirect methods; is able to present the results in numerical form, together with the uncertainties and graphically, and to analyze them and draw conclusions.	T1A_U08
K1ENG_U13	can correctly and unambiguously save plane and spatial figures on a plane; can perform on the technical documentation of the basic elements of machinery and equipment of thermal power engineering using CAx tools for 2D and 3D	T1A_U07 T1A_U15
K1ENG_U14	able to use the theoretical knowledge of fluid mechanics to determine the basic parameters of the hydrodynamic modeling of flow phenomena, solving simple and complex hydraulic systems, plotting the distribution of energy in hydraulic systems, determine the energy loss in hydraulic systems	T1A_U09
K1ENG_U15	can measure the basic flow and power engineering parameters in hydraulic systems; properly develop conclusions and graphically display characteristics	T1A_U08 T1A_U09
K1ENG_U16	Is able to apply the basic laws and principles of thermodynamics to solve the heat problems using ideal and real mediums; determine the basic parameters of the combustion processes, flow and	T1A_U09

	gas compression; determine the basic parameters of the classic and nuclear power stations, cogeneration and refrigeration equipment	
K1ENG_U17	can perform basic measurements of thermal parameters of solids, gaseous, liquid, together with an analysis	T1A_U08 T1A_U09
K1ENG_U18	uses the graphical and analytical methods of solving the basic construction components and performs stress analysis of machine elements under static and dynamic conditions	T1A_U09 T1A_U14 T1A_U15
K1ENG_U19	can use the known methods of control and mathematical apparatus to determine the characteristics of control systems and control units	T1A_U09 T1A_U10
K1ENG_U20	knows how to practically identify and analyze the characteristics of dynamic and static control units, as well as selected tool in the process of regulation and control of thermal power engineering	T1A_U08 T1A_U09
K1ENG_U21	uses the control and measuring equipment, is able to draw up the characteristics of selected electronic components and systems	T1A_U08
K1ENG_U22	is able to use theoretical knowledge to analyze simple DC circuits and alternating single and multiphase and simple analytical calculation of electrostatic and magnetic fields	T1A_U09
K1ENG_U23	can combine circuits of one- and multiphase and perform measurements of electrical circuits for AC and DC	T1A_U08
K1ENG_U24	is able to use theoretical knowledge to the selection of structural materials for equipment used in thermal power engineering, characterize operational problems of materials; to identify research and determine the basic parameters of structural materials	T1A_U08
K1ENG_U25	can calculate the theoretical values of characteristic necessary for combustion processes, design of heating fuel systems in industrial plants and emissions projections	T1A_U09
K1ENG_U26	can use measurement methods in combustion processes; evaluates, interprets and presents graphically the results of measurements	T1A_U08
K1ENG_U27	is able to perform basic measurements in the determination of the characteristics of typical electric motors and other electrical devices used in power engineering devices	T1A_U08
K1ENG_U28	can use theoretical knowledge to determine the heat flux and temperature distribution in the different elements of power engineering equipment; can provide heat exchangers calculations and assumptions for the design	T1A_U09 T1A_U14
K1ENG_U29	is able to use theoretical knowledge to design elements of power engineering equipment,	T1A_U13 T1A_U16

	including the matching of components and materials for the selected machine and perform load analysis of the selected (unit) power engineering machine	
K1ENG_U30	is able to solve basic issues related to construction and calculation of basic construction components of the machines	T1A_U15 T1A_U16
K1ENG_U31	can estimate the drift and emissions, calculate the reduction efficiency in single and multi-stage systems and set selected design parameters and operating equipment and processes in the field of exhaust gas cleaning technology	T1A_U08 T1A_U09
K1ENG_U32	is able to use theoretical knowledge in order to perform measurements of the basic parameters of the thermal-flow processes in power engineering; makes the choice of the optimal method of measurement, debugging methods and techniques of measurement and performance characteristics of the device including correction curves	T1A_U08 T1A_U09
K1ENG_U33	is able to perform design calculations of boiler	T1A_U16
K1ENG_U34	is able to describe and name the individual components of the power unit and analyze the work of the power unit together with the basic equipment	T1A_U11 T1A_U13
K1ENG_U35	is able to use theoretical knowledge in order to apply the measurement methods used to determine the balance of power engineering equipment, the calculation of losses in the thermal unit (machine); prepares graphical plot of energy balance of equipment, evaluates measurement uncertainty of characteristic values for power engineering equipment	T1A_U08 T1A_U09
K1ENG_U36	can calculate selected parameters of the power system, knows the method of calculating damages in the system and methods of protection against accidents and damages	T1A_U09
	achieves results in the category SKILLS for one of the following specializations: <ul style="list-style-type: none"> <li>• Electric Power Engineering (EEN) - Appendix 1</li> <li>• Thermal Power Engineering (ENC) - Appendix 2</li> </ul>	
<b>SOCIAL COMPETENCIES</b>		
K1ENG_K01	understands the need and knows the possibilities of lifelong learning (II and III stage of study, postgraduate courses) - raising professional, personal and social competences,	T1A_K01
K1ENG_K02	is aware of the importance and understanding of non-technical aspects and impacts of engineering, including its impact on the environment, as well as the associated responsibility for decisions	T1A_K02
K1ENG_K03	is aware of the necessity of individual and group activities that go beyond the activities of	T1A_K03

	engineering	
K1ENG_K04	has sense of responsibility for their own work and the willingness to comply with the rules work in a team and to take responsibility for collaborative tasks	T1A_K04
K1ENG_K05	is able to think and act in an entrepreneurial manner	T1A_K06
K1ENG_K06	is aware of the social role of technical college graduates, especially understands the need for the formulation and communication to the public - including through the mass media - information and advice on power engineering -related activities, shall endeavor to provide such information and opinions in a reliable and widely understood way	T1A_K05 T1A_K07



## LEARNING OUTCOMES FOR SPECIALIZATION

**Faculty: Mechanical and Power Engineering**

**Field of study: Power Engineering (ENG)**

**Level of study: I (undergraduate)**

**Specialization: ELECTRIC POWER ENGINEERING (EEN)**

Learning outcome for undergraduate studies in specialization: EEN	DESCRIPTION OF THE MAIN LEARNING OUTCOMES	Reference to learning outcomes for the area of technical sciences (T)
<b>KNOWLEDGE</b>		
S1EEN_W01	has knowledge of reactive power measurement single-phase and three-phase loads, active power measurement in high voltage networks, classical and transformer bridges (R, L, C), measuring transducers $c/a$ and $a/c$ , and remote DVR	T1A_W04
S1EEN_W02	has knowledge in the analysis of work flow machines, knows phenomena occurred in the flow machine parts	T1A_W03 T1A_W04 T1A_W06
S1EEN_W03	has ordered knowledge of the design and construction of pumps and pumping systems used in thermal power engineering units	T1A_W03 T1A_W04 T1A_W06
S1EEN_W04	has knowledge of the principles of operation of equipment for electricity generation, knows techniques for their implementation, possesses working knowledge of electricity generators in the power system, orients in operating of generators in accordance with applicable regulations and standards	T1A_W04
S1EEN_W05	has knowledge of the structure and operation of electrical equipment of low and high voltage (switches, transformers, chokes, and other short-circuit), learns rules for the selection of switchgear and protection devices used in networks and systems of low and high voltage	T1A_W04
S1EEN_W06	has a basic knowledge necessary for understanding of the unit operations in process engineering; knows instrument solutions used or their implementation	T1A_W03
S1EEN_W07	has a knowledge about the issues of static and dynamic electrical drives, the basic DC and AC propulsion, speed control method meets in these drives and methods used to design electric drives	T1A_W04 T1A_W05 T1A_W06

S1EEN_W08	has knowledge of the structure, functions and principles of power automation solutions	T1A_W04
S1EEN_W09	has knowledge of the new technologies related to low temperatures and used or prepared for use in the power engineering sector (eg oxy-fuel technology)	T1A_W04 T1A_W05
S1EEN_W10	has knowledge of the principles of design overhead and cable power lines and methods of network design and electrical power installations using modern computer technology, knows the methods of determining the demand for power and electricity supply in different areas (eg towns and settlements), and legal issues related to perform and operation of the network and power installations	T1A_W04
S1EEN_W11	has knowledge of the principles of functioning of the threat of electric current in equipment of low and high voltage, examines the effects of electric current on the human dimension meets fire protection methods and degrees of protection and electrical protection class of electric devices	T1A_W03
S1EEN_W12	has a basic knowledge of the construction and operation of nuclear power plants, in particular nuclear reactors, nuclear technology systems with different types of reactors and control rules of reactors, nuclear safety and nuclear fuel cycle	T1A_W03 T1A_W05 T1A_W06
<b>SKILLS</b>		
S1EEN_U01	is able to perform measurements of reactive power single-phase and three-phase loads, active power measurement in high voltage networks, can use a measuring bridges and electricity network analyzers	T1A_U08
S1EEN_U02	can design selected turbomachinery components used in thermal Power engineering	T1A_U16
S1EEN_U03	is able select the appropriate generator and auxiliary systems designed for specific solutions power stations and choose generators to work with renewable energy sources	T1A_U16
S1EEN_U04	is able use the learned models of unit operations of process engineering to calculate their position and interpret the results	T1A_U08
S1EEN_U05	is able to analyze the work of motor driven DC and AC (speed control methods, methods of acceleration and deceleration), is able to select the speed control systems, depending on the type of engine	T1A_U08
S1EEN_U06	can analyze selected automation systems and simulate phenomena in a simple power system for the automation	T1A_U08 T1A_U09
S1EEN_U07	is able be analyzed condensation systems and separation of gases and selected cryogenic systems up to helium temperatures, is able compute and select low-temperature insulation systems	T1A_U09
S1EEN_U08	able to identify the cycles indicated refrigeration, has ability to determine the characteristics of the equipment and refrigeration systems, is able to apply appropriate	T1A_U08 T1A_U09 T1A_U11

	rules for the safe use of cryogenic medium depending on the techniques of their acquisition and use of technology	
S1ENG_U09	is able design a basic electricity network systems and power receiving installations, as well as various types of lighting installations	T1A_U16
S1EEN_U10	is able in a practical way to perform electrical tests, performed diagnostics of shock protection effectiveness	T1A_U08 T1A_U11 T1A_U12
S1EEN_U11	has the ability to solve tasks from fundamentals of nuclear physics and theory of nuclear reactors	T1A_U09
S1EEN_U12	is able, based on their knowledge, to provide simulations (using computer software) of nuclear power plant work during normal operation and during accident	T1A_U08 T1A_U09

## LEARNING OUTCOMES FOR SPECIALIZATION

**Faculty: Mechanical and Power Engineering**

**Field of study: Power Engineering (ENG)**

**Level of study: I (undergraduate)**

**Specialization: THERMAL POWER ENGINEERING (ENC)**

Learning outcome for undergraduate studies in specialization: ENC	DESCRIPTION OF THE MAIN LEARNING OUTCOMES	Reference to learning outcomes for the area of technical sciences (T)
<b>KNOWLEDGE</b>		
SIENC_W01	has ordered knowledge of the design and construction of pumps and pump systems used in thermal power engineering units	T1A_W03 T1A_W04 T1A_W06
SIENC_W02	has knowledge in the analysis of flow machines' work, knows phenomena in the flow machine parts	T1A_W03 T1A_W04 T1A_W06
SIENC_W03	gains knowledge in relation to thermodynamic and technical basis for obtaining low temperatures, how to implement the refrigeration cycles and parameters that could affect on the achieved efficiency	T1A_W03 T1A_W04
SIENC_W04	has ordered and theoretically founded knowledge of the principles of operation of ventilation systems and air conditioning systems, and ways to balance the energy demand for cooling capacity building	T1A_W03
SIENC_W05	has knowledge of the deposits and methods of its use, storage, transportation and distribution of natural gas; meets the design procedure and the performance distribution network	T1A_W03
SIENC_W06	has knowledge of the thermodynamic principles of operation of heat pumps and solar collectors; knows the basic elements of heating and air conditioning systems based on heat pumps and solar collectors and the methodology for calculating the efficiency, effectiveness and evaluating the coefficients of heat and air-conditioning systems using heat pumps and solar collectors	T1A_W03
SIENC_W07	has knowledge of the processes and mechanisms of energy conversion and knows the basic unit in the corresponding systems, conventional and unconventional	T1A_W03
SIENC_W08	has practical and theoretical knowledge of energy management	T1A_W03 T1A_W07 T1A_W08
SIENC_W09	has knowledge of heat and electricity production in the boiler systems in the municipal sector	T1A_W04 T1A_W06

SIENC_W10	has a basic knowledge of the construction, operation and control of operating parameters and automation of heat networks; puts to explain the principle of operation of heat networks	T1A_W03
SIENC_W11	has knowledge of performing energy audits of residential buildings	T1A_W03 T1A_W08
<b>SKILLS</b>		
SIENC_U01	is able select a pump into the system, determine the characteristics of the pump system	T1A_U09 T1A_U14
SIENC_U02	is able determine the thermodynamic parameters of one-dimensional flow in the elements of the flow equipment used in power engineering	T1A_U09 T1A_U10
SIENC_U03	can design selected turbomachinery components used in thermal power engineering	T1A_U16
SIENC_U04	is able to identify the basic operating parameters and construction of cryogenic and refrigeration equipment; experimentally determines characteristics of refrigeration equipment and systems; interprets indications of control – measuring apparatus	T1A_U08
SIENC_U05	is able to use computational methods for simulation and optimization of gas networks	T1A_U09
SIENC_U06	is able to examine and interpret the results of liquid solar collector; calculates the actual efficiency of the heat pump based on the results of the tests of thermodynamic system	T1A_U08
SIENC_U07	is able to design a heat pump system with a solar collector as the lower heat source to achieve the desired heating parameters	T1A_U16
SIENC_U08	is able to determine the characteristics of the devices for the energy conversion of non-conventional energy systems; is able to assess the usefulness of non-conventional energy devices for energy conversion	T1A_U08
SIENC_U09	has ability to analyze basic and complex energy conversion systems; has the ability of economic efficiency of thermal processes	T1A_U08 T1A_U12
SIENC_U10	is able to do balancing calculating the low-power boilers; selects components of equipment for low-power systems; calculates energy losses for the exhaust gas flow	T1A_U09
SIENC_U11	knows how to make a calculation of the heat demand for the purposes of domestic hot water, heating and ventilation, can determine the value of seasonal heating demand	T1A_U09
SIENC_U12	is able to do calculating of individual parts of the energy audit of the selected object	T1A_U09 T1A_U12

**MATRIX OF CORRELATION BETWEEN EDUCATIONAL OUTCOMES/ EFFECTS IN THE FIELD OF TECHNICAL SCIENCES  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY**

**1<sup>st</sup> level, main field of study *Power Engineering* (ENG), general academic profile**

**Legend:** EEN - Electric Power Engineering , ENC –Thermal Power Engineering

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 1 <sup>st</sup> level, main field of study ENG		
		Main field of study effects	Specialization effects	
			EEN	ENC
<b>KNOWLEDGE</b>				
<b>T1A_W01</b>	has knowledge of mathematics, physics and chemistry and other areas related to the studied discipline necessary to formulate and solve simple tasks in the field of the studied discipline	K1ENG_W01 K1ENG_W02 K1ENG_W03 K1ENG_W04		
<b>T1A_W02</b>	has fundamental knowledge in the field of study related to the studied discipline	K1ENG_W06 K1ENG_W07 K1ENG_W09 K1ENG_W12 K1ENG_W15 K1ENG_W16 K1ENG_W17 K1ENG_W19 K1ENG_W20 K1ENG_W29		
<b>T1A_W03</b>	has organized, general knowledge and theoretical grounding including key issues related to the studied discipline	K1ENG_W05 K1ENG_W08 K1ENG_W10 K1ENG_W11 K1ENG_W14	S1EEN_W02 S1EEN_W03 S1EEN_W06 S1EEN_W11 S1EEN_W12	S1ENC_W01 S1ENC_W02 S1ENC_W03 S1ENC_W04 S1ENC_W05

		K1ENG_W18 K1ENG_W21 K1ENG_W22 K1ENG_W23 K1ENG_W24 K1ENG_W25 K1ENG_W26 K1ENG_W27 K1ENG_W28		S1ENC_W06 S1ENC_W07 S1ENC_W08 S1ENC_W10 S1ENC_W11
<b>T1A_W04</b>	has detailed knowledge connected with the chosen issues in the field of the studied discipline	K1ENG_W10 K1ENG_W11 K1ENG_W21 K1ENG_W22 K1ENG_W25 K1ENG_W26	S1EEN_W01 S1EEN_W02 S1EEN_W03 S1EEN_W04 S1EEN_W05 S1EEN_W07 S1EEN_W08 S1EEN_W09 S1EEN_W10	S1ENC_W01 S1ENC_W02 S1ENC_W03 S1ENC_W09
<b>T1A_W05</b>	has fundamental knowledge of trends in development in scientific disciplines and fields of study related to the studied discipline	K1ENG_W23 K1ENG_W25 K1ENG_W26	S1EEN_W07 S1EEN_W09 S1EEN_W12	
<b>T1A_W06</b>	has fundamental knowledge of the lifecycle of devices, objects and technical systems	K1ENG_W22 K1ENG_W25 K1ENG_W26	S1EEN_W02 S1EEN_W03 S1EEN_W07 S1EEN_W12	S1ENC_W01 S1ENC_W02 S1ENC_W09
<b>T1A_W07</b>	knows fundamental methods, techniques, tools and materials used for solving simple engineering tasks in the field of the studied discipline	K1ENG_W01 K1ENG_W02 K1ENG_W06		S1ENC_W08
<b>T1A_W08</b>	has fundamental knowledge necessary to understand social, economical ,legal and other non-technical factors of engineering activities	K1ENG_W13 K1ENG_W29 K1ENG_W30		S1ENC_W08 S1ENC_W11
<b>T1A_W09</b>	has fundamental knowledge of management, including quality management and running a business	K1ENG_W30		

<b>T1A_W10</b>	knows and understands basic concepts and rules related to industrial property protection and copyright laws; is able to use patent information resources	K1ENG_W13		
<b>T1A_W11</b>	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	K1ENG_W30		
<b>SKILLS</b>				
<b>1) general skills ( not related to the area of engineering education)</b>				
<b>T1A_U01</b>	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 it and draw conclusions, formulate and justify opinions	K1ENG_U01		
<b>T1A_U02</b>	is able to communicate in their professional environment and other environments using various techniques	K1ENG_U02		
<b>T1A_U03</b>	is able to prepare a well documented study of problems in the field of studied discipline both in Polish and a foreign language regarded as a basic one in the scientific disciplines and fields of study related to the studied discipline	K1ENG_U04		
<b>T1A_U04</b>	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	K1ENG_U05		
<b>T1A_U05</b>	has ability to self-learning	K1ENG_U03		
<b>T1A_U06</b>	has language skills in scientific disciplines and fields of study related to the studied discipline according to CEFR requirements for B2 level	K1ENG_U06		
<b>2 ) fundamental engineering skills</b>				
<b>T1A_U07</b>	is able to use information and communication technologies necessary to perform tasks typical of engineering activities	K1ENG_U13		
<b>T1A_U08</b>	is able to plan and run experiments including measurements and computer simulations, interpret results and draw conclusions	K1ENG_U12 K1ENG_U15 K1ENG_U17 K1ENG_U20 K1ENG_U21 K1ENG_U23 K1ENG_U24 K1ENG_U26 K1ENG_U27 K1ENG_U31	S1EEN_U01 S1EEN_U04 S1EEN_U05 S1EEN_U06 S1EEN_U08 S1EEN_U10 S1EEN_U12	S1ENC_U04 S1ENC_U06 S1ENC_U08 S1ENC_U09



		K1ENG_U32 K1ENG_U35		
<b>T1A_U09</b>	is able to use analytical, simulation and experimental methods to formulate and solve engineering tasks	K1ENG_U07 K1ENG_U08 K1ENG_U09 K1ENG_U10 K1ENG_U11 K1ENG_U14 K1ENG_U15 K1ENG_U16 K1ENG_U17 K1ENG_U18 K1ENG_U19 K1ENG_U20 K1ENG_U22 K1ENG_U25 K1ENG_U28 K1ENG_U31 K1ENG_U32 K1ENG_U35 K1ENG_U36	S1EEN_U06 S1EEN_U07 S1EEN_U08 S1EEN_U11 S1EEN_U12	S1ENC_U01 S1ENC_U02 S1ENC_U05 S1ENC_U10 S1ENC_U11 S1ENC_U12
<b>T1A_U10</b>	is able -while formulating and solving engineering tasks-to notice their system and non technical aspects	K1ENG_U19		S1ENC_U02
<b>T1A_U11</b>	is prepared to work in industry environment and knows safety rules in the workplace	K1ENG_U34	S1EEN_U08 S1EEN_U10	
<b>T1A_U12</b>	is able to carry out primary economic analysis of undertaken engineering activities		S1EEN_U10	S1ENC_U09 S1ENC_U12
<b>3) skills directly connected with solving engineering tasks</b>				
<b>T1A_U13</b>	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	K1ENG_U29 K1ENG_U34		
<b>T1A_U14</b>	is able to identify and formulate specifications of simple, practical engineering tasks specific for the studied discipline	K1ENG_U18 K1ENG_U28		S1ENC_U01

<b>T1A_U15</b>	is able to assess the usefulness of routine methods and tools for solving a simple, practical engineering task specific for the studied discipline and choose and apply a proper method and tools	K1ENG_U13 K1ENG_U18 K1ENG_U30		
<b>T1A_U16</b>	is able – according to a given specification- to desing and complete a simple device, object, system or process specific for the studied discipline, using appropriate methods, techniques and tools	K1ENG_U29 K1ENG_U30 K1ENG_U33	S1EEN_U02 S1EEN_U03 S1EEN_U09	S1ENC_U03 S1ENC_U07
<b>SOCIAL COMPETENCES</b>				
<b>T1A_K01</b>	understands the necessity of a lifetime learning process; is able to inspire and organize the process of learning for others	K1ENG_K01		
<b>T1A_K02</b>	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	K1ENG_K02		
<b>T1A_K03</b>	is able to cooperate and work in a group, taking up different roles	K1ENG_K03		
<b>T1A_K04</b>	is able to set clear priorities leading to the realization tasks set by himself or others	K1ENG_K04		
<b>T1A_K05</b>	identifies correctly and solves dilemmas connected with the profession	K1ENG_K06		
<b>T1A_K06</b>	is able to think and act in an entrepreneurial way	K1ENG_K05		
<b>T1A_K07</b>	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	K1ENG_K06		

# LEARNING OUTCOMES FOR THE FIELD OF STUDY

(Assumed educational effects)

**Faculty: Mechanical and Power Engineering**

**Field of study: Power Engineering (ENG)**

**Level of study: I (undergraduate)**

## The area of study

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

## 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

**1** – undergraduate studies,

**A** – general profile

Learning outcome for undergraduate studies in the field of study: ENG	DESCRIPTION OF THE MAIN LEARNING OUTCOMES  After completion of the undergraduate studies in the field of Power Engineering, the graduate:	Reference to learning outcomes for the area of technical sciences (T)
<b>KNOWLEDGE</b>		
K1ENG_W01	has general knowledge of complex numbers, polynomials, solution of systems of linear equations using matrix algebra, analytic geometry on the plane and in space, conic sections, necessary for understanding of engineering math and sciences	T1A_W01 T1A_W07
K1ENG_W02	has basic knowledge of the properties of functions (trigonometric, exponential, logarithmic, trigonometric and inverse thereof), single variable calculus, indefinite integrals, definite integrals and improper integrals, multivariable differential calculus, double and triple integrals, number series, power series, Fourier series and the basis of probability theory necessary for understanding of engineering math and sciences	T1A_W01 T1A_W07

K1ENG_W03	has basic knowledge of classical mechanics, wave motion and phenomenological thermodynamics, classical electrodynamics (electrostatics, electricity, magneto statics, electromagnetic induction, electromagnetic waves, optics), the special theory of relativity, selected topics of physics: quantum physics, physics of the solid, physics of the nucleus; astrophysics	T1A_W01
K1ENG_W04	has basic knowledge on the structure of matter, the periodic table, types of chemicals and chemical reactions	T1A_W01
K1ENG_W05	has basic knowledge of the theory and techniques of experimental measurement, characterization of properties of measuring instruments, presentation of the results of measurement as well as the method of calculation of its uncertainty and the interpretation of its results	T1A_W03
K1ENG_W06	have knowledge of data processing techniques, principles of operation of computers and computer networks, computer security, basic operating systems, known integrated packages of advanced tools and features and the basics of programming and formulating algorithms	T1A_W02 T1A_W07
K1ENG_W07	has knowledge of the geometric methods of recording the plane and spatial figures	T1A_W02
K1ENG_W08	acquires basic knowledge of the work, operation and construction of equipment and machinery from the field of thermal power engineering, nuclear power engineering and renewable sources of energy in heating, cooling and ventilation	T1A_W03
K1ENG_W09	has ordered knowledge of the different groups of materials used in thermal power engineering as well as their structure, composition and properties	T1A_W02
K1ENG_W10	has ordered and detailed knowledge of fluid mechanics among them the basic equations describing fluid flows over the entire range of criterion numbers, the basic measurements of the hydrodynamic parameters, description of flow phenomena using similarity criteria, perform basic calculations for hydraulic fluid flow in pipes, plumbing used for the design of power engineering systems	T1A_W03 T1A_W04
K1ENG_W11	has ordered and detailed knowledge of thermodynamics including on fundamental laws and principles of thermodynamics, thermodynamic description of the working mediums - ideal, semi-ideal and real, fundamental properties of matter, the phenomena occurring in combustion processes and the flow of gases, processes occurring in conventional heating systems and cooling equipments	T1A_W03 T1A_W04
K1ENG_W12	has ordered an expanded knowledge of the	T1A_W02

	technical problem-solving based on the laws of mechanics and perform stress analysis of structural elements in static and dynamic conditions of their work	
K1ENG_W13	knows and understands of the basic concepts and principles of the protection of industrial property and copyright law and the functioning of patent protection	T1A_W08 T1A_W10
K1ENG_W14	has ordered and theoretically founded knowledge in the field of industrial automation, knows and understands the principles of control systems and thermal power engineering systems	T1A_W03
K1ENG_W15	has a basic knowledge of electronics in the construction, characteristics and principles of operation of most electronic components, microprocessors and operating principles of simple electronic systems	T1A_W02
K1ENG_W16	has a basic and ordered knowledge of the electric and magnetic fields and methods of analysis of electrical circuits	T1A_W02
K1ENG_W17	have knowledge about construction materials and supplies used in the construction of thermal power engineering machineries	T1A_W02
K1ENG_W18	has ordered knowledge of the combustion mechanism and creation of gaseous pollutants; waste biomass co-firing with coal combustion and low carbon emission technologies	T1A_W03
K1ENG_W19	has a basic knowledge of the cycling of matter and energy in the ecosystem and of the dangers of the development of civilization and the possibility of its minimizing	T1A_W02
K1ENG_W20	has an elementary knowledge of the operation, construction and exploitation of basic electrical machinery and equipment	T1A_W02
K1ENG_W21	a ordered knowledge necessary to understand the process of heat transfer by convection, conduction, and radiation	T1A_W03 T1A_W04
K1ENG_W22	is well established and in-depth knowledge of the construction of assemblies and components selected power engineering machines and equipment	T1A_W03 T1A_W04 T1A_W06
K1ENG_W23	has knowledge of the technical capabilities (technology and equipment) standardized emission reduction of pollutants into the atmosphere	T1A_W03 T1A_W05
K1ENG_W24	knows and understands of the methods and techniques in the calculation of basic thermal processes in the power engineering sector and has knowledge of the calibration of measuring equipment and the way of use of the equipment characteristics	T1A_W03
K1ENG_W25	has a theoretical and practical knowledge on how to build boilers for power engineering industrial, put	T1A_W03 T1A_W04

	to recognize the individual elements of boilers and describe how they work	T1A_W05 T1A_W06
K1ENG_W26	has a basic knowledge of the construction and operation of thermal power stations; distinguishes and explains the working principles of the basic elements of power units	T1A_W03 T1A_W04 T1A_W05 T1A_W06
K1ENG_W27	has an established knowledge of balancing machines and equipment of thermal power engineering, knows and understands of methods of calculation efficiency of these devices, identify and name the major energy losses in these devices	T1A_W03
K1ENG_W28	has an elementary knowledge of the principles of operation of the electro-power system and its components; recognizes the risks associated with the operation of electrical equipment and indicates how to protect against them	T1A_W03
K1ENG_W29	know the legal basis for the production of electricity and heat in terms of environmental priorities	T1A_W02 T1A_W08
K1ENG_W30	has knowledge in the analysis of work flow machines, knows phenomena occurred in the flow machine parts	T1A_W03 T1A_W04 T1A_W06
K1ENG_W31	has a basic knowledge necessary to understand the social, philosophical, economic and legal conditions of engineering	T1A_W08 T1A_W09 T1A_W11
	achieves results in the category KNOWLEDGE for one of the following specializations: <ul style="list-style-type: none"> <li>• Electric Power Engineering (EEN) - Appendix 1</li> <li>• Thermal Power Engineering (ENC) – Appendix 2</li> </ul>	
<b>SKILLS</b>		
K1ENG_U01	can obtain information from literature, databases and other sources, can integrate the information, make their interpretation, and to draw conclusions and formulate and justify opinions	T1A_U01
K1ENG_U02	can use an integrated suite of office applications such as Microsoft Office, acquires the ability to automate work with these applications, and create their own tools using algorithms and macros	T1A_U02
K1ENG_U03	has the ability to self-learning, able to work individually and in teams; know how to estimate the time needed for the commissioned tasks, can develop and implement a work schedule to ensure deadlines	T1A_U05
K1ENG_U04	can prepare the documentation on the implementation of engineering tasks and prepare the text that discusses the results of this task	T1A_U03
K1ENG_U05	able to prepare and present a short presentation concluding of the results of the engineering task	T1A_U04
K1ENG_U06	has language skills in the fields of science and scientific disciplines relevant to the Power Engineering in accordance with the requirements	T1A_U06

	for level B2 of the European Framework of Reference for Languages	
K1ENG_U07	is able to properly and effectively apply knowledge of linear algebra and analytic geometry for qualitative and quantitative analysis of mathematical problems related engineering discipline of study	T1A_U09
K1ENG_U08	is able to properly and effectively apply the knowledge of differential and integral calculus of functions of one and several variables, numerical series, power series and Fourier series and probability for qualitative and quantitative analysis of mathematical problems related engineering discipline of study	T1A_U09
K1ENG_U09	can properly and effectively apply the principles and laws of physics to the qualitative and quantitative analysis of the physical problems from engineering area, able to plan and safely perform and analyze measurements and estimate the uncertainty of the these measured values	T1A_U09
K1ENG_U10	can properly and effectively apply the principles and laws of chemistry for qualitative and quantitative analysis of chemical problems from an engineering area; can plan and safely perform simple chemical experiments	T1A_U09
K1ENG_U11	can write and interpret correctly the result of the measurement, determine the value of the measurement uncertainty for the measurement of direct and indirect; can identify and calculate and disclose the amendment measurement errors, and assess opportunities to improve accuracy.	T1A_U09
K1ENG_U12	is able to plan an experiment, make simple measurements using direct and indirect methods; is able to present the results in numerical form, together with the uncertainties and graphically, and to analyze them and draw conclusions.	T1A_U08
K1ENG_U13	can correctly and unambiguously save plane and spatial figures on a plane; can perform on the technical documentation of the basic elements of machinery and equipment of thermal power engineering using CAx tools for 2D and 3D	T1A_U07 T1A_U15
K1ENG_U14	able to use the theoretical knowledge of fluid mechanics to determine the basic parameters of the hydrodynamic modeling of flow phenomena, solving simple and complex hydraulic systems, plotting the distribution of energy in hydraulic systems, determine the energy loss in hydraulic systems	T1A_U09
K1ENG_U15	can measure the basic flow and power engineering parameters in hydraulic systems; properly develop conclusions and graphically display characteristics	T1A_U08 T1A_U09
K1ENG_U16	Is able to apply the basic laws and principles of	T1A_U09

	thermodynamics to solve the heat problems using ideal and real mediums; determine the basic parameters of the combustion processes, flow and gas compression; determine the basic parameters of the classic and nuclear power stations, cogeneration and refrigeration equipment	
K1ENG_U17	can perform basic measurements of thermal parameters of solids, gaseous, liquid, together with an analysis	T1A_U08 T1A_U09
K1ENG_U18	uses the graphical and analytical methods of solving the basic construction components and performs stress analysis of machine elements under static and dynamic conditions	T1A_U09 T1A_U14 T1A_U15
K1ENG_U19	can use the known methods of control and mathematical apparatus to determine the characteristics of control systems and control units	T1A_U09 T1A_U10
K1ENG_U20	knows how to practically identify and analyze the characteristics of dynamic and static control units, as well as selected tool in the process of regulation and control of thermal power engineering	T1A_U08 T1A_U09
K1ENG_U21	uses the control and measuring equipment, is able to draw up the characteristics of selected electronic components and systems	T1A_U08
K1ENG_U22	is able to use theoretical knowledge to analyze simple DC circuits and alternating single and multiphase and simple analytical calculation of electrostatic and magnetic fields	T1A_U09
K1ENG_U23	can combine circuits of one- and multiphase and perform measurements of electrical circuits for AC and DC	T1A_U08
K1ENG_U24	is able to use theoretical knowledge to the selection of structural materials for equipment used in thermal power engineering, characterize operational problems of materials; to identify research and determine the basic parameters of structural materials	T1A_U08
K1ENG_U25	can calculate the theoretical values of characteristic necessary for combustion processes, design of heating fuel systems in industrial plants and emissions projections	T1A_U09
K1ENG_U26	can use measurement methods in combustion processes; evaluates, interprets and presents graphically the results of measurements	T1A_U08
K1ENG_U27	is able to perform basic measurements in the determination of the characteristics of typical electric motors and other electrical devices used in power engineering devices	T1A_U08
K1ENG_U28	can use theoretical knowledge to determine the heat flux and temperature distribution in the different elements of power engineering equipment; can provide heat exchangers	T1A_U09 T1A_U14



	calculations and assumptions for the design	
K1ENG_U29	is able to use theoretical knowledge to design elements of power engineering equipment, including the matching of components and materials for the selected machine and perform load analysis of the selected (unit) power engineering machine	T1A_U13 T1A_U16
K1ENG_U30	is able to solve basic issues related to construction and calculation of basic construction components of the machines	T1A_U15 T1A_U16
K1ENG_U31	can estimate the drift and emissions, calculate the reduction efficiency in single and multi-stage systems and set selected design parameters and operating equipment and processes in the field of exhaust gas cleaning technology	T1A_U08 T1A_U09
K1ENG_U32	is able to use theoretical knowledge in order to perform measurements of the basic parameters of the thermal-flow processes in power engineering; makes the choice of the optimal method of measurement, debugging methods and techniques of measurement and performance characteristics of the device including correction curves	T1A_U08 T1A_U09
K1ENG_U33	is able to perform design calculations of boiler	T1A_U16
K1ENG_U34	is able to describe and name the individual components of the power unit and analyze the work of the power unit together with the basic equipment	T1A_U11 T1A_U13
K1ENG_U35	is able to use theoretical knowledge in order to apply the measurement methods used to determine the balance of power engineering equipment, the calculation of losses in the thermal unit (machine); prepares graphical plot of energy balance of equipment, evaluates measurement uncertainty of characteristic values for power engineering equipment	T1A_U08 T1A_U09
K1ENG_U36	can calculate selected parameters of the power system, knows the method of calculating damages in the system and methods of protection against accidents and damages	T1A_U09
K1ENG_U37	can design selected turbomachinery components used in thermal Power engineering	T1A_U16
	achieves results in the category SKILLS for one of the following specializations: <ul style="list-style-type: none"> <li>• Electric Power Engineering (EEN) - Appendix 1</li> <li>• Thermal Power Engineering (ENC) - Appendix 2</li> </ul>	
<b>SOCIAL COMPETENCIES</b>		
K1ENG_K01	understands the need and knows the possibilities of lifelong learning (II and III stage of study, postgraduate courses) - raising professional, personal and social competences,	T1A_K01
K1ENG_K02	is aware of the importance and understanding of	T1A_K02

	non-technical aspects and impacts of engineering, including its impact on the environment, as well as the associated responsibility for decisions	
K1ENG_K03	is aware of the necessity of individual and group activities that go beyond the activities of engineering	T1A_K03
K1ENG_K04	has sense of responsibility for their own work and the willingness to comply with the rules work in a team and to take responsibility for collaborative tasks	T1A_K04
K1ENG_K05	is able to think and act in an entrepreneurial manner	T1A_K06
K1ENG_K06	is aware of the social role of technical college graduates, especially understands the need for the formulation and communication to the public - including through the mass media - information and advice on power engineering -related activities, shall endeavor to provide such information and opinions in a reliable and widely understood way	T1A_K05 T1A_K07

## LEARNING OUTCOMES FOR SPECIALIZATION

**Faculty: Mechanical and Power Engineering**

**Field of study: Power Engineering (ENG)**

**Level of study: I (undergraduate)**

**Specialization: THERMAL POWER ENGINEERING (ENC)**

Learning outcome for undergraduate studies in specialization: ENC	DESCRIPTION OF THE MAIN LEARNING OUTCOMES	Reference to learning outcomes for the area of technical sciences (T)
<b>KNOWLEDGE</b>		
SIENC_W01	has ordered knowledge of the design and construction of pumps and pump systems used in thermal power engineering units	T1A_W03 T1A_W04 T1A_W06
SIENC_W02	has a basic knowledge of the construction and operation of nuclear power plants, in particular nuclear reactors, nuclear technology systems with different types of reactors and control rules of reactors, nuclear safety and nuclear fuel cycle	T1A_W03 T1A_W05 T1A_W06
SIENC_W03	gains knowledge in relation to thermodynamic and technical basis for obtaining low temperatures, how to implement the refrigeration cycles and parameters that could affect on the achieved efficiency	T1A_W03 T1A_W04
SIENC_W04	has ordered and theoretically founded knowledge of the principles of operation of ventilation systems and air conditioning systems, and ways to balance the energy demand for cooling capacity building	T1A_W04
SIENC_W05	has knowledge of the deposits and methods of its use, storage, transportation and distribution of natural gas; meets the design procedure and the performance distribution network	T1A_W03
SIENC_W06	has knowledge of the thermodynamic principles of operation of heat pumps and solar collectors; knows the basic elements of heating and air conditioning systems based on heat pumps and solar collectors and the methodology for calculating the efficiency, effectiveness and evaluating the coefficients of heat and air-conditioning systems using heat pumps and solar collectors	T1A_W03
SIENC_W07	has knowledge of the processes and mechanisms of energy conversion and knows the basic unit in the corresponding systems, conventional and unconventional	T1A_W03
SIENC_W08	has practical and theoretical knowledge of energy management	T1A_W03 T1A_W07 T1A_W08
SIENC_W09	has knowledge of heat and electricity production in the	T1A_W04

	boiler systems in the municipal sector	T1A_W06
SIENC_W10	has a basic knowledge of the construction, operation and control of operating parameters and automation of heat networks; puts to explain the principle of operation of heat networks	T1A_W03
SIENC_W11	has knowledge of performing energy audits of residential buildings	T1A_W03 T1A_W08
<b>SKILLS</b>		
SIENC_U01	is able select a pump into the system, determine the characteristics of the pump system	T1A_U09 T1A_U14
SIENC_U02	is able, based on their knowledge, to provide simulations (using computer software) of nuclear power plant work during normal operation and during accident	T1A_U08 T1A_U09
SIENC_U03	is able to do calculating of individual parts of the energy audit of the selected object	T1A_U09 T1A_U12
SIENC_U04	is able to identify the basic operating parameters and construction of cryogenic and refrigeration equipment; experimentally determines characteristics of refrigeration equipment and systems; interprets indications of control – measuring apparatus	T1A_U08
SIENC_U05	is able to use computational methods for simulation and optimization of gas networks	T1A_U09
SIENC_U06	is able to examine and interpret the results of liquid solar collector; calculates the actual efficiency of the heat pump based on the results of the tests of thermodynamic system	T1A_U08
SIENC_U07	is able to design a heat pump system with a solar collector as the lower heat source to achieve the desired heating parameters	T1A_U16
SIENC_U08	is able to determine the characteristics of the devices for the energy conversion of non-conventional energy systems; is able to assess the usefulness of non-conventional energy devices for energy conversion	T1A_U08
SIENC_U09	has ability to analyze basic and complex energy conversion systems; has the ability of economic efficiency of thermal processes	T1A_U08 T1A_U12
SIENC_U10	is able to do balancing calculating the low-power boilers; selects components of equipment for low-power systems; calculates energy losses for the exhaust gas flow	T1A_U09
SIENC_U11	knows how to make a calculation of the heat demand for the purposes of domestic hot water, heating and ventilation, can determine the value of seasonal heating demand	T1A_U09

**MATRIX OF CORRELATION BETWEEN EDUCATIONAL OUTCOMES/ EFFECTS IN THE FIELD OF TECHNICAL SCIENCES AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY**

**1<sup>st</sup> level, main field of study *Power Engineering* (ENG), general academic profile**

**Legend:** EEN - Electric Power Engineering , ENC –Thermal Power Engineering

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 1 <sup>st</sup> level, main field of study ENG		
		Main field of study effects	Specialization effects	
			EEN	ENC
<b>KNOWLEDGE</b>				
<b>T1A_W01</b>	has knowledge of mathematics, physics and chemistry and other areas related to the studied discipline necessary to formulate and solve simple tasks in the field of the studied discipline	K1ENG_W01 K1ENG_W02 K1ENG_W03 K1ENG_W04		
<b>T1A_W02</b>	has fundamental knowledge in the field of study related to the studied discipline	K1ENG_W06 K1ENG_W07 K1ENG_W09 K1ENG_W12 K1ENG_W15 K1ENG_W16 K1ENG_W17 K1ENG_W19 K1ENG_W20 K1ENG_W29		
<b>T1A_W03</b>	has organized, general knowledge and theoretical grounding including key issues related to the studied discipline	K1ENG_W05 K1ENG_W08 K1ENG_W10 K1ENG_W11 K1ENG_W14	S1EEN_W02 S1EEN_W03 S1EEN_W06 S1EEN_W11	S1ENC_W01 S1ENC_W02 S1ENC_W03 S1ENC_W05 S1ENC_W06

		K1ENG_W18 K1ENG_W21 K1ENG_W22 K1ENG_W23 K1ENG_W24 K1ENG_W25 K1ENG_W26 K1ENG_W27 K1ENG_W28 K1ENG_W30		S1ENC_W07 S1ENC_W08 S1ENC_W10 S1ENC_W11
<b>T1A_W04</b>	has detailed knowledge connected with the chosen issues in the field of the studied discipline	K1ENG_W10 K1ENG_W11 K1ENG_W21 K1ENG_W22 K1ENG_W25 K1ENG_W26 K1ENG_W30	S1EEN_W01 S1EEN_W03 S1EEN_W04 S1EEN_W05 S1EEN_W07 S1EEN_W08 S1EEN_W09 S1EEN_W10	S1ENC_W01 S1ENC_W03 S1ENC_W04 S1ENC_W09
<b>T1A_W05</b>	has fundamental knowledge of trends in development in scientific disciplines and fields of study related to the studied discipline	K1ENG_W23 K1ENG_W25 K1ENG_W26	S1EEN_W02 S1EEN_W07 S1EEN_W09 S1EEN_W12	S1ENC_W02
<b>T1A_W06</b>	has fundamental knowledge of the lifecycle of devices, objects and technical systems	K1ENG_W22 K1ENG_W25 K1ENG_W26 K1ENG_W30	S1EEN_W02 S1EEN_W03 S1EEN_W07	S1ENC_W01 S1ENC_W02 S1ENC_W09
<b>T1A_W07</b>	knows fundamental methods, techniques, tools and materials used for solving simple engineering tasks in the field of the studied discipline	K1ENG_W01 K1ENG_W02 K1ENG_W06		S1ENC_W08
<b>T1A_W08</b>	has fundamental knowledge necessary to understand social, economical ,legal and other non-technical factors of engineering activities	K1ENG_W13 K1ENG_W29 K1ENG_W31		S1ENC_W08 S1ENC_W11
<b>T1A_W09</b>	has fundamental knowledge of management, including quality management and	K1ENG_W31		

	running a business			
<b>T1A_W10</b>	knows and understands basic concepts and rules related to industrial property protection and copyright laws; is able to use patent information resources	K1ENG_W13		
<b>T1A_W11</b>	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	K1ENG_W31		
<b>SKILLS</b>				
<b>1) general skills ( not related to the area of engineering education)</b>				
<b>T1A_U01</b>	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 it and draw conclusions, formulate and justify opinions	K1ENG_U01		
<b>T1A_U02</b>	is able to communicate in their professional environment and other environments using various techniques	K1ENG_U02		
<b>T1A_U03</b>	is able to prepare a well documented study of problems in the field of studied discipline both in Polish and a foreign language regarded as a basic one in the scientific disciplines and fields of study related to the studied discipline	K1ENG_U04		
<b>T1A_U04</b>	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	K1ENG_U05		
<b>T1A_U05</b>	has ability to self-learning	K1ENG_U03		
<b>T1A_U06</b>	has language skills in scientific disciplines and fields of study related to the studied discipline according to CEFR requirements for B2 level	K1ENG_U06		
<b>2 ) fundamental engineering skills</b>				
<b>T1A_U07</b>	is able to use information and communication technologies necessary to perform tasks typical of engineering activities	K1ENG_U13		
<b>T1A_U08</b>	is able to plan and run experiments including measurements and computer simulations, interpret results and draw conclusions	K1ENG_U12 K1ENG_U15 K1ENG_U17 K1ENG_U20 K1ENG_U21 K1ENG_U23 K1ENG_U24 K1ENG_U26 K1ENG_U27	S1EEN_U01 S1EEN_U02 S1EEN_U04 S1EEN_U05 S1EEN_U06 S1EEN_U08 S1EEN_U10	S1ENC_U02 S1ENC_U04 S1ENC_U06 S1ENC_U08 S1ENC_U09

		K1ENG_U31 K1ENG_U32 K1ENG_U35		
<b>T1A_U09</b>	is able to use analytical, simulation and experimental methods to formulate and solve engineering tasks	K1ENG_U07 K1ENG_U08 K1ENG_U09 K1ENG_U10 K1ENG_U11 K1ENG_U14 K1ENG_U15 K1ENG_U16 K1ENG_U17 K1ENG_U18 K1ENG_U19 K1ENG_U20 K1ENG_U22 K1ENG_U25 K1ENG_U28 K1ENG_U31 K1ENG_U32 K1ENG_U35 K1ENG_U36	S1EEN_U02 S1EEN_U06 S1EEN_U07 S1EEN_U08 S1EEN_U11	S1ENC_U01 S1ENC_U02 S1ENC_U03 S1ENC_U05 S1ENC_U10 S1ENC_U11
<b>T1A_U10</b>	is able -while formulating and solving engineering tasks-to notice their system and non technical aspects	K1ENG_U19		
<b>T1A_U11</b>	is prepared to work in industry environment and knows safety rules in the workplace	K1ENG_U34	S1EEN_U08 S1EEN_U10	
<b>T1A_U12</b>	is able to carry out primary economic analysis of undertaken engineering activities		S1EEN_U10	S1ENC_U03 S1ENC_U09
<b>3) skills directly connected with solving engineering tasks</b>				
<b>T1A_U13</b>	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	K1ENG_U29 K1ENG_U34		
<b>T1A_U14</b>	is able to identify and formulate specifications of simple, practical engineering tasks	K1ENG_U18		



	specific for the studied discipline	K1ENG_U28		
<b>T1A_U15</b>	is able to assess the usefulness of routine methods and tools for solving a simple, practical engineering task specific for the studied discipline and choose and apply a proper method and tools	K1ENG_U13 K1ENG_U18 K1ENG_U30		
<b>T1A_U16</b>	is able – according to a given specification- to desing and complete a simple device, object, system or process specific for the studied discipline, using appropriate methods, techniques and tools	K1ENG_U29 K1ENG_U30 K1ENG_U33 K1ENG_U37	S1EEN_U02 S1EEN_U03 S1EEN_U09	S1EEN_U03 S1EEN_U09
<b>SOCIAL COMPETENCES</b>				
<b>T1A_K01</b>	understands the necessity of a lifetime learning process; is able to inspire and organize the process of learning for others	K1ENG_K01		
<b>T1A_K02</b>	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	K1ENG_K02		
<b>T1A_K03</b>	is able to cooperate and work in a group, taking up different roles	K1ENG_K03		
<b>T1A_K04</b>	is able to set clear priorities leading to the realization tasks set by himself or others	K1ENG_K04		
<b>T1A_K05</b>	identifies correctly and solves dilemmas connected with the profession	K1ENG_K06		
<b>T1A_K06</b>	is able to think and act in an entrepreneurial way	K1ENG_K05		
<b>T1A_K07</b>	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	K1ENG_K06		