

ASSUMED LEARNING OUTCOMES

FACULTY: Electrical Engineering

MAIN FIELD OF STUDY: Industrial Control Engineering

EDUCATION LEVEL: first-level (licencjat/inżynier) studies / ~~second-level studies / magister uniform studies*~~

PROFILE: general academic / ~~practical*~~

Location of the main-field-of study:

Branch of science: Engineering and technology

Discipline / disciplines (for several disciplines, please indicate the major discipline)

automation, electronics and electrical engineering

Explanation of the markings:

P6U – universal first degree characteristics corresponding to education at the first-level studies - 6 PRK level *

P6S – second degree characteristics corresponding to education at the first-level studies - 6 PRK level *

W - category "knowledge"

U - category "skills"

K - category "social competences"

K1APR_W1, K1APR_W2, K1APR_W3, ...- main-field-of study learning outcomes related to the category "knowledge"

K1APR_U1, K1APR_U2, K1APR_U3,...- main-field-of study learning outcomes related to the category "skills"

K1APR_K1, K1APR_K2, K1APR_K3,...- main-field-of study learning outcomes related to the category "social competences"

Main field of study learning outcomes for the optional courses block: Automation of Machines, Vehicles and Apparatus:

K1APR_AMPU_W1, K1APR_AMPU_W2, K1APR_AMPU_W3, ...- efekty kierunkowe dot. kategorii „wiedza” –

K1APR_AMPU_U1, K1APR_AMPU_U2, K1APR_AMPU_U3, ...- efekty kierunkowe dot. kategorii „umiejętności”

_inż. – learning outcomes related to the engineer competences

Main field of study learning outcomes for the optional courses block: Automation and Control in Electrical Power Systems:

K1APR_ASE_W1, K1APR_ASE_W2, K1APR_ASE_W3, ...- efekty kierunkowe dot. kategorii „wiedza” –

K1APR_ASE_U1, K1APR_ASE_U2, K1APR_ASE_U3, ...- efekty kierunkowe dot. kategorii „umiejętności”

... _inż. – learning outcomes related to the engineer competences

* delete as applicable

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study Industrial Control Engineering	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K1APR_W1	has the basic knowledge in the field of complex numbers, polynomials, matrix algebra with applications to linear equation systems, analytical geometry in 2D and 3D and cone-type curves	P6U_W		
K1APR_W2	has the basic knowledge about function properties (trigonometric, exponential, logarithmic, cyclometric, and reverse) calculus elements – differentiation and integration of one variable function necessary for the understanding of mathematical aspects in engineering	P6U_W	P6S_WG	
K1APR_W3	has the basic knowledge in the field of definite integrals, improper integrals, calculus of multivariable functions, double and triple integrals, number series, power series necessary for the understanding of mathematical aspects in engineering sciences	P6U_W	P6S_WG	
K1APR_W4	has the basic knowledge in the field of ordinary differential equations, and linear differential equation systems (also the application of Lapace’s transform and basics of stability theory) necessary for the understanding of mathematical aspects in engineering sciences	P6U_W	P6S_WG	
K1APR_W5	has the basic knowledge in the field of basic mathematical probabilistic models (random variables, quantile, moments, independence), statistical analysis methods of stochastic phenomena (estimation, statistical	P6U_W	P6S_WG	

	hypothesis testing, variance analysis, linear regression) necessary for the understanding of probabilistic and statistical aspects in engineering sciences			
K1APR_W6	has the basic knowledge in the field of classical mechanics, wave propagation, and phenomenological thermodynamics	P6U_W	P6S_WG	
K1APR_W7	has the basic knowledge in the field of classical electrodynamics (electrostatics, electrical current, magneto statics, electromagnetic induction, electromagnetic waves, optics) selected topics of physics: quantum physics, solids physics, nuclei physics, and astrophysics	P6U_W		
K1APR_W8	has the knowledge in the field of structure of matter and electrical phenomena in it, which is necessary for solving simple material problems in the field of electrical engineering he knows the basic properties of materials used in electrical engineering and methods of its research	P6U_W	P6S_WG	
K1APR_W9	has the elementary knowledge in descriptive geometry in the field of 2D and 3D objects projections and technical drawing in CAD software he has the knowledge in composing and reading technical drawings of details and assembly drawings of electromechanical objects		P6S_WG	
K1APR_W10	has the knowledge in the field of mechanics and strength of materials he knows the rules for the reduction of a 2D or 3D force systems and the stability conditions he understands the basics elements of theory of stress and strain, fatigue and composed strength	P6U_W	P6S_WG	
K1APR_W11	knows the most important terms of informatics he knows the general principles of computers composition and operation, software, computer networks, especially internet understands the problems of computer system security he knows the basic rules for ergonomic work, health	P6U_W	P6S_WG P6S_WK	

	protection, countermeasures, and selected issues of legal aspects related to work with computers			
K1APR_W12	knows the principles of developing algorithms for solving an engineering task knows the rules of programming in C language	P6U_W	P6S_WG	
K1APR_W13	has the basic knowledge in the field of programming in the Matlab/Simulink environment he knows the rules for computation using matrix apparatus, numerical methods of differentiation and integration, analysis and synthesis of simple control systems and measured data processing in this environment	P6U_W	P6S_WG	
K1APR_W14	has the basic knowledge in the field of computer communication and information exchange in engineering he has the elementary knowledge about modelling of network events and knows how to build local computer networks	P6U_W	P6S_WG	P6S_WG_inż
K1APR_W15	has the basic knowledge in the field of modern data bases technologies he knows the rules for the design of relational data bases and its application for data monitoring and processing	P6U_W	P6S_WG	
K1APR_W16	knows the theoretical foundations of electrical engineering knows the physical quantities and fundamental laws characterizing electrical fields, magnetic fields, and DC current fields he knows the fundamentals of circuit theory	P6U_W	P6S_WG	
K1APR_W17	has the knowledge in the field of transients analysis in linear electrical circuits he knows the macroscopic approach to electromagnetic fields	P6U_W	P6S_WG	

K1APR_W18	has the elementary knowledge in the field of metrology and units he knows the metrological features of basic measurement devices, the rules of measurement devices design, the computational methods used for raw measured data analysis, the knowledge of up to date measurement techniques	P6U_W	P6S_WG	
K1APR_W19	has the elementary knowledge in the field of metrology and units he knows the metrological features of basic measurement devices, the rules of measurement devices design, the computational methods used for raw measured data analysis, the knowledge of up to date measurement techniques	P6U_W	P6S_WG	
K1APR_W20	has the elementary knowledge about operation of electronic elements, describes its functionality with a circuit model, differentiates and characterises simple analogue and discrete circuits he knows the rules for its cooperation and methods for its features analysis	P6U_W	P6S_WG	
K1APR_W21	has the elementary knowledge about the dynamical properties of sensors and measuring transformers he knows and understands the measurement methods of basic electrical quantities	P6U_W	P6S_WG	
K1APR_W22	has the basic knowledge about industrial measurements, knows the operating principals and construction of sensors, methods and systems used in measurement of non-electrical quantities		P6S_WG	P6S_WG_inż
K1APR_W23	has the knowledge about description of discrete and continuous automatic control systems, its properties he has the knowledge of control system analysis with respect to statics, dynamics, stability of linear and continuous systems he has the knowledge about correction of linear continuous and discrete control systems, state space variables, nonlinear control systems	P6U_W	P6S_WG	

K1APR_W24	<p>has knowledge of the construction of low and high voltage electrical equipment used in distribution networks and industrial installations, their parameters and principles of selection of these devices and electrical installations for normal and disturbing operation conditions</p> <p>knows the main elements of power stations, construction solutions, connection systems and the possibilities of their practical applications</p>	P6U_W	P6S_WG	P6S_WG_inż
K1APR_W25	<p>he has the basic knowledge about the operation of electrical power system and substations</p> <p>knows the technologies of electrical power generation and transmission, knows the rules for constructing equivalent circuits of overhead lines, cables, transformers</p> <p>knows the analysis methods for power flow in transmission networks, symmetrical and non-symmetrical faults in electric power grids</p>		P6S_WG	P6S_WG_inż
K1APR_W26	<p>has basic knowledge in the field of construction and principles of operation of transformers, AC and DC electric machines</p> <p>understands the physical phenomena occurring in electrical machines and transformers</p> <p>knows equivalent circuits, vector graphs and equations describing machines and transformers in various operating conditions</p> <p>can explain the electromechanical characteristics of electric machines</p>		P6S_WG	P6S_WG_inż
K1APR_W27	<p>he has the knowledge of fundamental elements of a converter drive systems</p> <p>he knows its operating principles and its static characteristics</p> <p>he has the basic knowledge about description methods of a drive system and elementary methods of</p>		P6S_WG	P6S_WG_inż

	characteristic shaping of drive systems with DC and AC electric motors during the regulation and reduction of angular velocity			
K1APR_W28	<p>he has the knowledge about power electronics system, especially elementary knowledge of power electronics elements</p> <p>he understands the physical principals of power transformation in static converters</p> <p>he knows the methods for mathematical description of converter systems and methods of its control</p>		P6S_WG	P6S_WG_inż
K1APR_W29	<p>has a structured knowledge in the field of microprocessor systems architecture, addressing modes, number codes, types of memory, typical inner systems in microprocessors (AC converters, counters, interruptions)</p> <p>he has the knowledge allowing self-formulation of algorithms ant its implementation</p>	P6U_W	P6S_WG	
K1APR_W30	<p>has elementary knowledge of the architectures of PLC controllers, knows and understands PLC controllers operation and the operation of its modules</p> <p>he has a structured knowledge about basic methods and languages of PLC programming, formulation of control algorithms and its software and hardware implementation</p>	P6U_W	P6S_WG	P6S_WG_inż
K1APR_W31	has knowledge about synthesis methods for discrete control algorithms for various types of controllers	P6U_W	P6S_WG	
K1APR_W32	has structured knowledge in the field of digital signal processing including sampling theory, mathematical description, discrete systems analysis and design of signal processing systems		P6S_WG	P6S_WG_inż
K1APR_W33	he has the basic knowledge in the field of robotics theory, cybernetics, manipulators, understands the		P6S_WG	P6S_WG_inż

	design methodology of manipulator task control, kinematic structures of robots manipulators			
K1APR_W34	has the basic knowledge about construction and operation of electrical, hydraulic pneumatic drives used in industrial robots, manipulators and lathes, the drives structures in CNC lathes		P6S_WG	P6S_WG_inż
K1APR_W35	has the basic knowledge of numerical methods used in engineering practice	P6U_W	P6S_WG	P6S_WG_inż
K1APR_W36	has knowledge of protection systems against electric shock in low-voltage electrical equipment and installations and knows in detail the principles of safe handling of electrical devices in industrial installations, including legal regulations and scope of responsibility		P6S_WG P6S_WK	P6S_WG_inż
K1APR_W37	knows the basic methods of inference (induction, deduction, abductive reasoning) has the basic knowledge for the understanding of social and philosophical conditions for engineering activities		P6S_WK	
K1APR_W38	has the basic knowledge about management processes he knows the functions, rules and instruments of management and is able to identify basic managements problems		P6S_WK	P6S_WK_inż
K1APR_W39	has the basic knowledge for the understanding of the legal conditions of engineering activitieshe knows and understands the basic terms related to industrial property, and copy right knows the rules for the preparation of a patent description and the use of patent data bases		P6S_WK	
SKILLS (U)				
K1APR_U1	is able to apply properly and effectively the knowledge about linear algebra and descriptive geometry to quantitative and qualitative analysis of mathematical issues connected to the studied engineering branch	P6U_U	P6S_UW	

K1APR_U2	is able to apply properly and effectively the knowledge about calculus (one dimensional functions) to quantitative and qualitative analysis of mathematical issues connected to the studied engineering branch	P6U_U	P6S_UW	
K1APR_U3	is able to apply properly and effectively the knowledge about calculus (multidimensional functions, number and power series) to quantitative and qualitative analysis of mathematical issues connected to the studied engineering branch	P6U_U	P6S_UW	
K1APR_U4	is able to apply properly and effectively the knowledge of physical laws to quantitative and qualitative analysis of physical issues connected to the studied engineering branch	P6U_U	P6S_UW	
K1APR_U5	is able to plan and safely conduct measurements, elaborate results, estimate measurement errors	P6U_U	P6S_UW	
K1APR_U6	is able to safely conduct measurements of selected properties of materials used in electrical engineering and formulate conclusions	P6U_U	P6S_UW	
K1APR_U7	is able to make technical drawings as a sketch or a CAD file he is able to make and read technical documentation, especially assembly and working drawings of electro-mechanical appliances, in European projections and isometric projections with the help of views, cross-sections and examples including dimensions, tolerances and normalized connection elements		P6S_UW	
K1APR_U8	is able to solve simple technical problems with the use of classical mechanics and perform material strength analysis of machines parts	P6U_U	P6S_UW	
K1APR_U9	is able to use basic computers and software, compose and edit texts on the basic level, establish spread sheets, and make engineering analysis with it, make computer presentations, use computer networks	P6U_U	P6S_UW	P6S_UW_inż

K1APR_U10	knows how to develop algorithms for solving an engineering task and write programs in C language	P6U_U	P6S_UW	
K1APR_U11	is able to formulae an algorithm, use Matlab and Simulink language to write programs to conduct computations utilizing matrix notation, numerical differentiation and integration, synthesis of control systems and signal processing		P6S_UW	P6S_UW_inż
K1APR_U12	is able to derive information from literature and other sources about establishing communication connections is able to use imbedded in operating systems of computers, utilise the processes and resources of servers via web		P6S_UW	P6S_UW_inż
K1APR_U13	is able to derive information from literature and other sources about design of relational data bases, to program a data base in MS ACCESS with included interactive interfaces	P6U_U	P6S_UW	P6S_UW_inż
K1APR_U14	is able to use various methods of circuit theory for the computation of currents in restive circuits is able to compute basic quantities of electric and magnetic fields	P6U_U	P6S_UW	
K1APR_U15	is able to apply mathematical apparatus to the analysis of linear circuits with sinusoidal sources	P6U_U	P6S_UW	
K1APR_U16	is able to apply mathematical apparatus to the analysis of transients in linear circuits	P6U_U	P6S_UW	
K1APR_U17	is able to conduct the measurements of basic electrical quantities using analogue devices, digital meters and oscilloscope, sketch characteristics of nonlinear elements, write down results as numbers, tables and graphics, interpret and conclude results	P6U_U	P6S_UW	P6S_UW_inż

K1APR_U18	<p>is able to analyse the operation of simple electronic systems – analogue and digital – based on its structure and properties of used elements</p> <p>he is able to investigate the properties of this systems</p> <p>he is able to present the effects of theoretical and investigative work</p> <p>make a comparison in a numerical and graphical manner, and summarise accordingly</p>		P6S_UW	P6S_UW_inż
K1APR_U19	<p>is able to make the measurement of static and dynamical characteristics of sensors and measurement transformers</p> <p>he is able to present results in an numerical and graphical form, interpret them and formulate conclusion</p>		P6S_UW	P6S_UW_inż
K1APR_U20	<p>is able to use known measurement methods</p> <p>connect, power and test designed measurement system</p> <p>analyse results</p> <p>interpret measurement results, conclude</p>		P6S_UW	P6S_UW_inż
K1APR_U21	<p>is able to solve alone tasks regarding analogue and discrete control systems</p> <p>he is able to use mathematical apparatus to analyse control systems in time and frequency domain</p> <p>he is able to design, operate and test simple control systems for analogue discrete and nonlinear systems</p> <p>is able to elaborate results, make conclusions</p>		P6S_UW	P6S_UW_inż
K1APR_U22	<p>is able to connect, launch, test measurement unit, conduct measurement of machines and generators characteristics (DC and AC), and figure out its parameters</p> <p>he is able to storage and elaborate results in a numerical and graphical form, interpret them and conclude</p>		P6S_UW	P6S_UW_inż
K1APR_U23	<p>he is able to connect, launch and test designed drive system, make measurements of static and dynamic characteristics of drive systems with DC and AC machines</p> <p>he is able to storage and elaborate results in a numerical and graphical form, interpret them and conclude</p>		P6S_UW	P6S_UW_inż

	he is able to design a simple drive system			
K1APR_U24	is able to connect simple power electronic circuits, measure the voltage and current characteristics of rectifiers (one, two, three and six pulse), DC current controllers, AC current controllers (one and three phases), resonance and frequency modulation, additionally make the frequency analysis of these characteristics he is able to storage and elaborate results in a numerical and graphical form, interpret them and conclude		P6S_UW	P6S_UW_inż
K1APR_U25	is able to use software dedicated to program microprocessors is able to formulate an algorithm and write program realising a control task with intern and externs systems of a microprocessor		P6S_UW	P6S_UW_inż
K1APR_U26	is able to select a type of PLC controller and its equipment according to design, connect system elements, monitor the PLC controller on site he is able to program PLC controller in an appropriate language is able to launch and test PLC control programs		P6S_UW	P6S_UW_inż
K1APR_U27	is able to design FIR and IIR filters alone, design and select the values of parameters of PID and fuzzy control systems, design control systems utilising state observers		P6S_UW	P6S_UW_inż
K1APR_U28	is able to use mathematical apparatus for the description and analysis of discrete signal processing in programming environments, to program and implement signal processing algorithms on a DSP		P6S_UW	P6S_UW_inż
K1APR_U29	is able to plan the trajectory of robots movements, program robots actions, analyse complicated movements of robots		P6S_UW	P6S_UW_inż
K1APR_U30	is able to program and launch selected types of industrial robots (SCADA-, arm-, Cartesian- type), CNC lathes is able to program and launch selected servo drives with		P6S_UW	P6S_UW_inż

	DC and AC machines			
K1APR_U31	is able to apply numerical methods apparatus in engineering practice	P6U_U	P6S_UW	P6S_UW_inż
K1APR_U32	is able to check the electric installation and make by himself the necessary operational and launch measurements of low voltage installation		P6S_UW	P6S_UW_inż
K1APR_U33	accordingly to the chosen level of the studied language: has the knowledge, skills and competence which comply with the requirements for level B2 ESOKJ; acquires, comprehends and interprets specialized texts; in speech and writing uses linguistic means specific for academic language and the working environment of an engineer or has the knowledge, skills and competence which comply with the requirements for level C1 ESOKJ; comprehends and formulates statements concerning topics related to the studied discipline and profession using measures appropriate to the situation; reads, interprets, evaluates and creates specialised texts; makes use of the language skills in interpersonal relations and communication in international academic and professional environment		P6S_UK P6S_UU	
K1APR_U34	has the necessary abilities to work in industrial environment and knows the safety rules with regard to his working place		P6S_UW P6S_UK P6S_UO	P6S_UW_inż
K1APR_U35	has the ability to prepare and present oral presentations in the field of scientific disciplin relevant to the studied faculty with the use of audio-visual tools and implementing the knowledge concerning psychological aspects of communication with other people	P6U_U	P6S_UW P6S_UK	

SOCIAL COMPETENCES (K)				
K1APR_K1	understands the urgency and knows the possibilities for further education (2nd level studies, third level studies, studies for graduates, courses), rising the social, professional, and personal skills		P6S_KK	
K1APR_K2	is aware about the importance and non-technical aspects of an control engineer activities, i.e. influence on environment, therefore takes responsible actions	P6U_K	P6S_KO	
K1APR_K3	is aware about the responsibility for own work and is able to obey the rules of team work and take responsibility of collectively taken actions	P6U_K	P6S_KR	
K1APR_K4	is able to think and act in an enterprising manner		P6S_KO	
K1APR_K5	exhibits care about entrusted tasks	P6U_K	P6S_KR	
K1APR_K6	correctly identifies and solves dilemmas related to profession		P6S_KK	
K1APR_K7	has the awareness of the social role of an technical university alumnus especially understands the need of formulating and publishing, i.e. via mass media, information and opinions about technical achievements and other aspects of engineering, he makes efforts to provide such information and opinions in a generally understandable way	P6U_K	P6S_KO P6S_KR	
K1APR_K8	is aware of the indispensability of individual and collective activities beyond engineering profession	P6U_K		
K1APR_K9	is able to cooperate and work in a team, taking different roles in it and can think critically and support his/her own view, so he/she can select priorities properly and choose appropriate measures to achieve the tasks defined by himself/herself or other people	P6U_K		
K1APR_K10	understands legal aspects and the results of engineering activities	P6U_K		

*delete as applicable

Attachment no. 1

Optional courses block: Automation of Machines, Vehicles and Apparatus

Optional courses block learning outcomes	Description of learning outcomes for the optional courses block Automation of Machines, Vehicles and Apparatus	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K1APR_AMPU_W1	has a structured knowledge about basic information regarding monitoring and diagnostic methods of industrial processes and electrical machines and drives, an also abut software and hardware solutions	P6U_W	P6S_WG	P6S_WG_inż
K1APR_AMPU_W2	has knowledge on the structure of measurement systems, linear measuring transducers, A / C converters, methods of reducing interference from external sources has knowledge of the use of the LabView programming environment for the design of intelligent measuring and control systems used in industrial automation	P6U_W	P6S_WG	P6S_WG_inż
K1APR_AMPU_W3	has the knowledge in the field of industrial control system design. He knows the connections topology and operating principal of popular industrial communication networks, the structure and programing techniques in SCADA systems	P6U_W	P6S_WG	P6S_WG_inż
K1APR_AMPU_W4	has knowledge in the field of the construction and operation of industrial working machines and selected production technologies has knowledge of used converter systems and industrial drive control algorithms	P6U_W	P6S_WG	P6S_WG_inż

	has knowledge in the field of construction, operation and applications of various machines, electrical micromachines and electromechanical actuators for industrial automation			
K1APR_AMPW5	has knowledge about control methods of converter-fed electric drives in closed-loop structures knows the basic control systems of AC and DC motors, their properties, advantages and disadvantages	P6U_W	P6S_WG	P6S_WG_inż
K1APR_AMPW6	has basic knowledge of neural networks, fuzzy logic systems, genetic and evolutionary algorithms knows the basic structures of neural networks and methods of their learning, the principles of fuzzy structures and intelligent optimization algorithms	P6U_W	P6S_WG	P6S_WG_inż
K1APR_AMPW7	has the basic knowledge about the application of dispersed automation systems application, and devices selection for the realisation of defined tasks	P6U_W	P6S_WG	P6S_WG_inż
SKILLS (U)				
K1APR_AMPU1	is able to apply basic method of fault detection in electrical machines and drives using automated measurement and detection systems, spectrum analysers he is able to analyse and assess fault symptoms		P6S_UW	P6S_UW_inż
K1APR_AMPU2	he is able to assess the metrological properties of linear and nonlinear measurement converters he is able to make the measurement transformers characteristic linear and apply advanced procedures for calibration and measurement error estimation he is able to design measurement systems utilising autonomous devices, data acquisition cards he is able to use collected measurement data and analyse them using virtual devices and LabView software		P6S_UW	P6S_UW_inż
K1APR_AMPU3	he is able to elaborate a design of an industrial process automation system. Especially, he is able to		P6S_UW	P6S_UW_inż

	<p>select appropriate PLC controller, settle the communication requirements</p> <p>connect various automation devices using standard communication networks</p> <p>he is able to design and launch an automation program for an industrial process, design and launch application for the visualization of an industrial process by the means of operator panels and SCADA software</p> <p>is able to make a documentation of an automation system</p>			
K1APR_AMP_U4	<p>can present (in the form of a presentation at the seminar) the selected industrial drive system and discuss their operation, advantages and disadvantages and requirements for measuring and control equipment based on information from the literature</p>	P6U_U	P6S_UW P6S_UK	P6S_UW_inż
K1APR_AMP_U5	<p>is able to realise experimental research of selected structures used for control of DC and AC machines</p> <p>he is able to elaborate and interpret research results</p>	P6U_U	P6S_UW	P6S_UW_inż
K1APR_AMP_U6	<p>is able to realise learning process for selected structures of neural networks utilising the back propagation method and a specific simulator</p> <p>he is able to design the structure of a classical fuzzy logic system, define the rules set, apply the basic sharpening rules</p> <p>he is able to apply various selection, crossing and mutation rules to the designed genetic algorithm</p>		P6S_UW	P6S_UW_inż
K1APR_AMP_U7	<p>is able to analyse and dispersed automation system</p> <p>is able to design an dispersed automation system</p> <p>is able to select the elements and software needed for the realisation of the system</p> <p>is able to implement and operate an dispersed automation system</p>		P6S_UW	P6S_UW_inż

K1APR_AMP_U8	<p>is able to configure and test in a simulation study the selected industrial drive system based on information from literature, catalogs, databases and other sources (specialized software)</p> <p>is able to analyze and justify opinions on the selection of industrial solutions for electric drive systems of selected working machines</p>		P6S_UW	P6S_UW_inż
K1APR_AMP_U9	<p>is able to prepare a presentation including diploma work results, justify in a discussion the realisation process and reached results</p>	P6U_U	P6S_UW P6S_UK P6S_UO	P6S_UW_inż
K1APR_AMP_U10	<p>is able to make an diploma project from the block of elective subjects Automation of Machines, Vehicles and Apparatus and prepare and adequate documentation, including:</p> <ul style="list-style-type: none"> • is able to get information from literature, data bases and other sources, • is able to use analytical, simulation and experimental methods for the formulation and solution of tasks, • is able to assess the usability and practical potential of new technical solutions and technologies, • is able to identify and specify tasks, also non typical tasks • is able to make a design and then build a device, object, system or process according to given specification 	P6U_U	P6S_UW P6S_UK P6S_UO	P6S_UW_inż

*delete as applicable

Optional courses block Automation and Control in Electrical Power Systems

Optional courses block learning outcomes	Description of learning outcomes for the optional courses block Automation and Control in Electrical Power Systems	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K1APR_ASE_W1	knows the structures of digital automation, rules for construction and design of digital open automation systems knows the basic classical and intelligent automation algorithms	P6U_W	P6S_WG	
K1APR_ASE_W2	has a structured and theoretically founded knowledge material used in optoelectronics, optical phenomena used in photo-sensors in optical fibres, methods of digital modulation and analogue modulation, and configuration and specification of optical transmission	P6U_W	P6S_WG	
K1APR_ASE_W3	has a structured knowledge of methods and technics used for the protection of power system elements knows the role of various types of protective system automation – preventive, eliminatory, restitutive - in the power system knows the operational principles of measurement transformers with one or multiple inputs, knows the protection of generators, transformers, power lines and high voltage machines	P6U_W	P6S_WG	P6S_WG_inż

K1APR_ASE_W4	has the knowledge of basic logic elements (gates, flip-flops, adders, comparators, counters, registers, etc.), has the elementary knowledge about logical combinatory systems and logical sequential systems (synchronous and asynchronous) and about the analysis and synthesis of logical systems	P6U_W	P6S_WG	
K1APR_ASE_W5	has a structured and theoretically founded knowledge about: transmission and distribution grid, the advantages of smart meters, methods of system peak load reduction, demand management methods in use and their efficiency, safety issues of smart meters technology	P6U_W	P6S_WG	P6S_WG_inž
K1APR_ASE_W6	has knowledge in the field of dispersed measurements in a power system, control and protection rules and techniques using dispersed measurement		P6S_WG	P6S_WG_inž
K1APR_ASE_W7	has the knowledge about the theoretical basics of decision making processes and fundamental approaches to rational and effective decision making with regard to automation and control systems		P6S_WG P6S_WK	
K1APR_ASE_W8	has a structured knowledge about the basics of control and automation techniques in power systems, especially the knowledge necessary for - understanding and description of the role of control systems of turbines, generators, transformers and capacitor banks - understanding and description of the structure and role of the frequency and active power control in a power system - understanding and description of the structure and role of the voltage and reactive power control in a power system		P6S_WG	P6S_WG_inž
K1APR_ASE_W9	has a grounded knowledge about power electronics and the application of static converters in power systems		P6S_WG	P6S_WG_inž

	<p>knows the negative influence of converters on the network powering industrial loads and according compensation methods</p> <p>knows the threat resulting from converter operation</p>			
SKILLS (U)				
K1APR_ASE_U1	<p>is able to use hardware standards, typical operation systems and software tools for the design of control algorithms</p> <p>he is able to use on-line tools for the simulation, data analysis and process state visualisation available in a CACSD (Computer Aided Control System Design) package</p> <p>he has the skills to edit and test controllers prototypes and to generate codes from CACSD environment</p>		P6S_UW	P6S_UW_inż
K1APR_ASE_U2	<p>is able to utilise, select and operate optic fibres networks, also analyse problems correlated to dispersion and attenuation, make an analysis based on the measurement of basic optic fibres parameters</p>		P6S_UW	P6S_UW_inż
K1APR_ASE_U3	<p>is able to operate and coordinate measurements transducers with one or multiple inputs, as well as power system protection installed in a power system, protecting its basic elements (generators, transformers, high voltage machines, transmission industrial, and distribution networks)</p>		P6S_UW	P6S_UW_inż
K1APR_ASE_U4	<p>he is able to make and test by himself (in simulation programs and using models) single combinatory and sequential logical systems (synchronous and asynchronous)</p>		P6S_UW	P6S_UW_inż

K1APR_ASE_U5	is able to react accordingly to price stimuli resulting from electric power tariff he is able to analyse existing realities, and undertake effective action to reduce electricity consumption and utilise it more effectively		P6S_UW	P6S_UW_inż
K1APR_ASE_U6	is able to make an analysis to verify the necessity of dispersed measurement, select appropriate measurement devices and assess their applicability for control purposes in the power system		P6S_UW	P6S_UW_inż
K1APR_ASE_U7	is able to select an appropriate method and detailed decision making algorithm for a particular decision problem, for technical and everyday problems as well he is able to use deterministic and statistical methods, for the analysis of data and elaboration of a decision		P6S_UW	P6S_UW_inż
K1APR_ASE_U8	is able to use known phenomena to assess the performance of static converters in typical power system (industrial) applications		P6S_UW	P6S_UW_inż
K1APR_ASE_U9	is able to connect, operate and tune elementary types of control and automation systems used in electrical power systems		P6S_UW	P6S_UW_inż
K1APR_ASE_U10	is able to prepare a presentation including diploma work results, justify in a discussion the realisation process and reached results	P6U_U	P6S_UW P6S_UK P6S_UO	P6S_UW_inż
K1APR_ASE_U11	is able to make an diploma project from the block of elective subjects Automation and Control in Electrical Power Systems and prepare and adequate documentation, including: <ul style="list-style-type: none"> - is able to get information from literature, data bases and other sources, - is able to use analytical, simulation and experimental methods for the formulation and solution of tasks, 	P6U_U	P6S_UW P6S_UK P6S_UO	P6S_UW_inż

	<ul style="list-style-type: none">- is able to assess the usability and practical potential of new technical solutions and technologies,- is able to identify and specify tasks, also non typical tasks- is able to make a design and then build a device, object, system or process according to given specification			
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*delete as applicable