PROGRAM OF STUDIES

FACULTY: FACULTY OF ELECTRONICS, PHOTONICS and MICROSYSTEMS

MAIN FIELD OF STUDIES: CONTROL ENGINEERING and ROBOTICS

BRANCH OF SCIENCE: ENGINEERING and TECHNOLOGY

DISCIPLINE: AUTOMATION, ELECTRONICS, ELECTRICAL ENGINEERING AND SPACE TECHNOLOGIES (D02)

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

LANGUAGE OF STUDY: Polish/English

Content:

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Resolution no. . . . of the Senate of Wroclaw University of Science and Technology

In effect since: 2022/2023

ASSUMED LEARNING OUTCOME

Faculty: FACULTY OF ELECTRONICS, PHOTONICS and MICROSYSTEMS

Main field of studies: Control Engineering and Robotics

Education level:: second-level studies

Profile: general academic

Location of the main-field-of study

Branch of science: **ENGINEERING and TECHNOLOGY**
Discipline: **AUTOMATION, ELECTRONICS, ELECTRICAL ENGINEERING AND SPACE TECHNOLOGIES**

Explanation of the markings:

P6U – universal first degree characteristics corresponding to education at the first-level studies - 6 PRK level*
P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level*
P6S – second degree characteristics corresponding to education at the first-level studies - 6 PRK level*
P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level*

W - category "knowledge"
U - category "skills"
K - category "social competences"

K(*faculty symbol*)_W1, K(*faculty symbol*)_W2, K(*faculty symbol*)_W3, . . .- main-field-of study learning outcomes related to the category "knowledge"
K(*faculty symbol*)_U1, K(*faculty symbol*)_U2, K(*faculty symbol*)_U3, . . .- main-field-of study learning outcomes related to the category "skills"
K(*faculty symbol*)_K1, K(*faculty symbol*)_K2, K(*faculty symbol*)_K3, . . .- main-field-of study learning outcomes related to the category "social competences"

S(*faculty symbol*)_W1, S(*faculty symbol*)_W2, S(*faculty symbol*)_W3, . . .- specialization learning outcomes related to the category "knowledge"
S(*faculty symbol*)_U1, S(*faculty symbol*)_U2, S(*faculty symbol*)_U3, . . .- specialization learning outcomes related to the category "skills"
S(*faculty symbol*)_K1, S(*faculty symbol*)_K2, S(*faculty symbol*)_K3, . . .- specialization learning outcomes related to the category "social competences"

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

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study **Control Engineering and Robotics** After completion of studies, the graduate:	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)				
K2AIR_W01	Has a broadened and deepened knowledge in selected sections of mathematics and physics necessary to understand issues in the the studied scientific discipline.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W02	Has knowledge in the creation or development of forms of individual Entrepreneurship in the area relevant to their field of study. field of study, has knowledge of industrial property protection and copyright law.	P7U_W	P7S_WK	P7S_WK_INŻ
K2AIR_W03	Is familiar with modern methods of optimal control theory.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W04	Is familiar with methods of modeling random environments, and parametric and non-parametric methods for static and dynamic systems.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W05	Has advanced knowledge of concepts and analytical methods used in control engineering and robotics, necessary to formulate models, description of properties and proposals of control algorithms.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W06	Has knowledge of various types of control algorithms for robotic systems, taking into account motion constraints, inaccuracy of the model, providing robustness and adaptability.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W07	Has knowledge of the discrete event systems (DES) formalism, including finite-state automata and selected classes of Petri nets, and its application in automation and robotics.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W08	Knows the main paradigms of knowledge representation, artificial intelligence and machine learning algorithms, and their applications in social robots.	P7U_W	P7S_WG	P7S_WG_INŻ

K2AIR_W09	Knows the tasks, methods and algorithms for plfor robot motion planning and has knowledge of modeling the robot's environment, enabling localization, map construction, and navigation.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W10	Has knowledge of the design issues of robotic embedded and distributed systems with the use of dedicated environments facilitating the systems implementation.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W11	Has knowledge of electronic components used in industrial automation systems and in power electronics.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W12	Knows the fundamental principles of optoelectronics in the field of generation, detection and processing of optical radiation as well as the construction of lasers used in industrial systems.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W13	Knows the algorithms used in data processing and in the control of automation devices. Knows the main principles of machine learning.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W14	Has knowledge of sensors and actuators present in automation systems.	P7U_W	P7S_WG	P7S_WG_INŻ
K2AIR_W15	Knows the methods of data transmission in industrial networks. Can characterize wired and wireless interfaces.	P7U_W	P7S_WG	P7S_WG_INŻ
SKILLS (U)				
K2AIR_U01	Has knowledge, skills and competences in the field of a foreign language in accordance with the requirements specified for the additional level B2 + CEFR and higher in the field of scientific and technical language related to the studied discipline and related issues.	P7U_U	P7S_UK	
K2AIR_U02	Can think critically and argue their position.	P7U_U	P7S_UK	
K2AIR_U03	Can formulate tasks and design as well as numerically examine systems of optimal decision making and control.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U04	Can use measurement data to build and test system models, conduct experimental research, and use dedicated software.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U05	Can define and analyze mathematical models of systems, use mathematical methods to design control algorithms, and is prepared to use specialist literature on the subject.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U06	Is able to design, implement and evaluate a control algorithm for a selected robotic system, taking into account the inaccuracy of the model, optionally ensuring robustness or adaptability.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U07	Can construct an event-driven model of an automation/robotics system, propose and implement algorithms for supervisory/distributed control.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U08	Can build a problem model, apply methods of problem solving using artificial intelligence techniques or machine learning methods, also in the field of social robots.	P7U_U	P7S_UW, P7S_UO	P7S_UW_INŻ, P7S_UO_INŻ
K2AIR_U09	Can design and analyze robot motion planning algorithms and model the robot's surroundings for the purpose of robot navigation and location in space.	P7U_U	P7S_UW, P7S_UO	P7S_UW_INŻ, P7S_UO_INŻ

K2AIR_U10	Can design and implement a complex distributed control system using robotic development environments and programming libraries as well as rapid prototyping strategy.	P7U_U	P7S_UW, P7S_UO	P7S_UW_INŻ, P7S_UO_INŻ
K2AIR_U11	Can design, fabricate, commission and test an electronic device. Is able to select measuring equipment according to the requirements of the system to be commissioned. Can independently interpret the obtained results.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U12	Is able to select optoelectronic components for applications in industrial automation. Is able to perform experiments in laser and fiber optic technology.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U13	Is able to use digital programmable circuits in digital and analog signal processing and control of automation devices. Is able to make use of machine learning principles in designed devices.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U14	Is able to design signal matching circuits between the programmable controller and sensors, and between the controller and actuators.	P7U_U	P7S_UW	P7S_UW_INŻ
K2AIR_U15	Is able to select the optimal type of communication interface for a specific application. Is able to configure the communication interfaces used.	P7U_U	P7S_UW	P7S_UW_INŻ

K2AIR_U16	Has up-to-date knowledge of development trends and the most important new achievements in the area of the studied scientific discipline. Is able to independently carry out a master's thesis containing research aspects, including:	P7U_U	P7S_UW, P7S_UU	P7S_UW_INŻ, P7S_UU_INŻ
	• is able to obtain information from literature, databases and other sources, integrate it, interpret and critically evaluate it,			
	• is able to plan and conduct experiments, including measurements and computer simulations, interpret the results obtained and draw conclusions,			
	• is able to use analytical, simulation and experimental methods to formulate and solve problems,			
	• is able to formulate and test hypotheses related to research problems,			
	• is able to integrate knowledge from different fields and disciplines and apply a systems approach, also taking into account non-technical aspects,			
	• is able to assess the usefulness and possibility of using new developments (techniques and technologies) in the represented discipline,			
	• is able to propose improvements/improvements to existing technical solutions,			
	• is able to interpret the obtained research results, draw appropriate conclusions and formulate recommendations,			
	• is able to edit a master's thesis according to formal requirements.			

SOCIAL COMPETENCES (K)				
K2AIR_K01	Is aware of the social consequences of research and development activities and the related responsibility for decisions. Understands the need to communicate information and opinions to the public regarding the achievements of technology and other aspects of the activities of a technical graduate. Understands the roles of mass media.	P7U_K	P7S_KR, P7S_KO	
K2AIR_K02	Appreciates the role of innovation in the economy. Is ready to think and act in an entrepreneurial way, start and run a small business.	P7U_K	P7S_KK, P7S_KO	

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study: **Control Engineering and Robotics**	Profile: **general academic**
Education level: **second-level studies**	Form of studies: **full-time studies**

1 General description

1.1 Number of semesters: **3**	1.2 Total number of ECTS points necessary to complete studies at a given level: **90**
1.3 Total number of hours: **1035**	1.4 Prerequisites (particularly for second-level studies): Candidates for master's studies in the field of Automation and Robotics may recruit after obtaining at least the title of a professional engineer in admitted fields of study. The detailed conditions and procedure of recruitment applicable for a given academic year are approved annually by the Senate of Wrocław University of Science and Technology and announced by an appropriate internal regulation.

1.5 Upon completion of studies graduate obtains professional degree of:	*1.6 Graduate profile, employability:*
Master of Science (MSc)	Graduates have advanced knowledge and skills necessary to design, construct and implement automation and robotics systems using techniques and tools of applied computer science. Thanks to soft skills, they can perform managerial functions in industry and fulfill themselves in their own businesses. They can take up creative challenges in various fields of technology, both as a specialist in research centers and in scientific work.
	specialization: Robotics(in Polish) The specialist knowledge of Robotics graduates covers various methods of control (adaptive, robust, intelligent), or planning of movements and activities of a robot and their group. Their specialist skills relate to the design of robots, including electronic robotic systems, robot controllers, drive systems, environment perception systems, human-robot interfaces and algorithms for planning robot activities. Students have the opportunity to acquire practical skills, learn new tools and technologies by performing laboratory exercises and projects on many types of robots (manipulators, service robots) and programming platforms, both general-purpose and specifically robotic. Low- and high-level programming skills are an asset of graduates, as they are required when applying artificial intelligence techniques in the fusion of data from multiple sources and the processing of incomplete information. The domain of the roboticists is versatility that combines mechanics, electronics and computer science into a synergistic whole.
	specialization: Electronic Control Systems(in Polish) Graduates are able to apply the means of computer science for measurement acquisition, control of technological processes, design, commissioning, and maintenance of automation and industrial robotics systems with information exchange based on standard data transmission protocols. They are able to design, implement, test and operate analog, digital and mixed electronic systems using electronic, optoelectronic, sensor and microprocessor components. They have competences in the field of devices and systems controlling high-current and high-voltage signals. They can solve computational tasks using computer tools including DSP signal processors. Yhey can prepare, perform and analyze computer simulations and experiments, and create computer programs independently. Thanks to soft skills, they can perform managerial functions in industry and fulfill themselves in their own business. They can take up creative challenges in various fields of technology, both as specialists in research centers and in scientific work.

	specialization: Embedded Robotics(in English)
	The specialist knowledge of Embedded Robotics graduates includes methods of control, planning of robot motion and operations, as well as practical methods of building such systems, from the level of electronics to formal verification. Acquired skills include design, programming, and commissioning of microprocessor embedded systems, as well as of robots, robotic and robotized systems, robot controllers, drive systems, environmental perception systems, human-robot interfaces, and various types of electronic systems. Graduates are also prepared for creative engineering activities in the field of industrial and service robotics, as well as for scientific and research work, including third-level (doctoral) studies. Studying in English provides graduates with additional competence thanks to in-depth knowledge of terminology and literature, as well as an asset in the form of a master's thesis written in English.
1.7 Possibility of continuing studies:	*1.8 Indicate connection with University's mission and its development strategy:*
Eligibility to apply for admission to a doctorial school or non-degree postgraduate programmes	The study program is fully correlated with the university's mission and development strategy adopted by the Senate of Wroclaw University of Science and Technology on March 21, 2013 (Resolution No. 127/7/2012-2016) as amended (Resolution No. 227/11/2012-2016 and Resolution No. 759/34/2012-2016). In particular, the study program uses the sectoral models defined in Section 7 of the Development Plan of Wroclaw University of Science and Technology: Education Model and Study Model, in order to ensure high quality teaching.

2   Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 15, U (skills) = 16, K (competences) = 2, W + U + K = 33

2.2 For the main field of study assigned to more than one discipline - the number of learning outcomes assigned to the discipline:

not applicable

2.3 For the main field of study assigned to more than one discipline - percentage share of the number of ECTS points for each discipline:

not applicable

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) :

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80 ECTS: specialization Robotics

80 ECTS: specialization Electronic Control Systems

74 ECTS: specialization Embedded Robotics

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2.4b. For the practical profile of the main field of study - the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 1.2)

<div align="center">

not applicable

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2.5 Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market

According to the 2018 report "Opportunities and Challenges of the Polish Industry 4.0", in the near future we should expect an increased demand for employees specialized in the production and in the area of complex systems integrating robotics, automation, artificial intelligence and Internet of Things devices and sensors. These conclusions are confirmed in the 2019 report "Analysis of the demand for competencies in the economy and in the labor market" prepared for NCBiR (National Centre for Research and Development). It indicates staffing deficits among electronics, automation and robotics specialists in three regions of Poland, including the southwestern region, which includes the regions of Lower Silesia and Opole.

The program of this field of study responds to all the most important needs and requirements of employers regarding automation and robotics specialists as well as specialized IT and electronics engineers. The main employers are production and service companies, including companies specializing in software development for embedded systems. Due to the dynamic development of the market, there is and will be a great demand for specialists with the title of Master of Science in Control Engineering and Robotics, who have the competences necessary to design electronic system devices, use SCADA systems and robotic systems, implement and integrate industrial installations, design and implement functionalities in various technologies and programming languages, model technological processes and robots.

It should also be noted that the Control Engineering and Robotics study field is in line with the needs arising from changes in manufacturing (Industry 4.0+) and the use and design of devices and solutions from the Smart category. In Wroclaw and the Lower Silesia Region, there are many small, medium and large companies and manufacturing plants for which Control Engineering and Robotics graduates already form the backbone of the workforce, and the demand for highly qualified personnel continues to grow.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU code)

55.8 ECTS: specializationRobotics
53.1 ECTS: specialization Electronic Control Systems
56.0 ECTS: specialization Embedded Robotics

2.7. Total number of ECTS points, which student has to obtain from basic sciences classes

specialization	Robotics	Electronic Control Systems	Embedded Robotics
Number of ECTS points for obligatory subjects	2	2	5
Number of ECTS points for optional subjects	0	0	0
Total number of ECTS points	2	2	5

2.8. Total number of ECTS points, which student has to obtain from practical classes, including project and laboratory classes (enter total number of ECTS points for courses/group of courses denoted with code P)

specialization	Robotics	Electronic Control Systems	Embedded Robotics
Number of ECTS points for obligatory subjects	13	13	13
Number of ECTS points for optional subjects	36	34	38
Total number of ECTS points	49	47	51

2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of University-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code O):
10 ECTS points specializationRobotics
10 ECTS points specializationElectronic Control Systems
9 ECTS points specializationEmbedded Robotics

2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points)
60 ECTS points

3   Description of the process leading to learning outcomes acquisition:

Following the curriculum, students attend organized classes. According to the regulations of higher education at Wroclaw University of Science and Technology, the student is obliged to participate in the classes. Classes are conducted in the forms specified in the the study regulations, where both traditional teaching methods and tools are used. The possibilities of classes taught in the remote mode are offered as well, including through the university's e-learning platform. Outside the classroom hours, the tutors are available to

students during the consultation hours designated and announced on the Faculty's website. An important element of learning is the student's own work, consisting of preparing for classes (on the basis of materials provided by teachers and recommended literature), studying literature, preparing reports and reports, preparing for tests and exams.

To each learning effect PRK, relevant courses present in the curriculum are assigned. Passing these courses (this course) means achieving the desired effect. Courses are passed on the basis of the forms of control of acquiring the desired knowledge, skills and social competencies, defined in the course cards. Failure of a student to achieve the learning effects assigned to a course results in failure to pass the course and the need to repeat it. Completion of each semester of studies is conditional upon obtaining the number of ECTS points required by a specific study program, which is tantamount to achieving most of the learning effects envisaged in a given semester. Failed courses must be repeated by the student in the following semesters, thus achieving the remaining learning effects.

Successful completion of studies is possible after the student has achieved all the learning effects specified in the study program. The quality of teaching and the achievement of learning effects are controlled by the Committee for Assessment and Assurance of Education Quality. The scope of its activity includes procedures for creating and modifying educational programs, individualizing study programs, implementing the teaching process and graduation. Quality control of the educational process includes evaluation of the learning effects achieved by students. Control of the teaching quality is supported by peer observation of conducting classes with students and by surveys, carried out according to strictly defined faculty procedures.

4 List of education blocks:

4.1 List of obligatory blocks:

4.1.1 List of general education blocks

4.1.1.1. Liberal-managerial subjects block in Polish: ECTS points: 5

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/ group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W08W12-SM0001S	Social Communication					1	K2AIR_K01	15	60	2		1	T	Z	O		P(1)	KO
2	W08AIR-SM0010S	Entrepreneurship					1	K2AIR_K02	15	30	1		0.8	T	Z	O		P(1)	KO
3	W08AIR-SM0010W	Entrepreneurship	1					K2AIR_W02	15	60	2		1	T/Z	Z	O			KO
	Total		**1**	**0**	**0**	**0**	**2**		**45**	**150**	**5**	**0**	**2.8**						

4.1.1.2. Liberal-managerial subjects block in English: ECTS points: 5

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/ group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W08AIR-SM0030S	Entrepreneurship					1	K2AIR_K02	15	30	1		0.8	T	Z	O		P(1)	KO
2	W08AIR-SM0030W	Entrepreneurship	1					K2AIR_W02	15	60	2		1	T/Z	Z	O			KO
3	W08W12-SM0002S	Social Communication					1	K2AIR_K01	15	60	2		1	T	Z	O		P(1)	KO
	Total		**1**	**0**	**0**	**0**	**2**		**45**	**150**	**5**	**0**	**2.8**						

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
1	**0**	**0**	**0**	**2**	**45**	**150**	**5**	**0**	**2.8**

4.1.2 List of basic sciences blocks

4.1.2.1. Mathematics block in Polish   ECTS points: 1

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			Universitywide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W13AIR-SM1440W	Mathematics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
		Total	**1**	**0**	**0**	**0**	**0**		**15**	**30**	**1**	**0**	**0.5**						

4.1.2.2. Mathematics block in English   ECTS points: 4

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			Universitywide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0720C	Applied logic		1				K2AIR_U02	15	60	2		2	T	Z			P(2)	PD
2	W12AIR-SM0720W	Applied logic	2					K2AIR_W01	30	60	2		1.6	T/Z	Z				PD
		Total	**2**	**1**	**0**	**0**	**0**		**45**	**120**	**4**	**0**	**3.6**						

4.1.2.3. Physics block in Polish   ECTS points: 1

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			Universitywide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W11W12-SM4901W	Physics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
		Total	**1**	**0**	**0**	**0**	**0**		**15**	**30**	**1**	**0**	**0.5**						

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.2.4. Physics block in English   ECTS points: 1

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
			Weekly number of hours						Number of hours		Number of ECTS points					Course/group of courses			
1	W11W12-SM0100W	Physics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
	Total		**1**	**0**	**0**	**0**	**0**		**15**	**30**	**1**	**0**	**0.5**						

Altogether for basic sciences blocks in Polish

lec	cl	lab	pr	sem	Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
Total number of hours									
2	**0**	**0**	**0**	**0**	**30**	**60**	**2**	**0**	**1.0**

Altogether   for basic sciences blocks in English

lec	cl	lab	pr	sem	Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
Total number of hours									
3	**1**	**0**	**0**	**0**	**60**	**150**	**5**	**0**	**4.1**

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.3 List of the main field of study blocks

4.1.3.1. List of the main field of study blocks in Polish   ECTS points: 23

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0003C	Theory and Methods of Optimization		1				K2AIR_U03	15	60	2	2	1.6	T	Z		DN	P(2)	K
2	W12AIR-SM0003W	Theory and Methods of Optimization	2					K2AIR_W03	30	90	3	3	2	T/Z	Z		DN		K
3	W12AIR-SM0001L	Modeling and identification			2			K2AIR_U04	30	60	2	2	1.6	T	Z		DN	P(2)	K
4	W12AIR-SM0001W	Modeling and identification	2					K2AIR_W04	30	90	3	3	2	T/Z	Z		DN		K
5	W12AIR-SM0007L	Control Theory			1			K2AIR_U06	15	60	2	2	1.5	T	Z		DN	P(2)	K
6	W12AIR-SM0007W	Control Theory	2					K2AIR_W06	30	60	2	2	1	T/Z	E(W)		DN		K
7	W12AIR-SM0007C	Control Theory		1				K2AIR_U05	15	60	2	2	1.5	T	Z		DN	P(2)	K
8	W12AIR-SM0006W	Intelligent virtualization of systems and process automation	1					K2AIR_W14, K2AIR_W15	15	60	2	2	1.2	T/Z	E(W)		DN		K
9	W12AIR-SM0006P	Intelligent virtualization of systems and process automation				2		K2AIR_U14, K2AIR_U15	30	60	2	2	1.6	T	Z		DN	P(2)	K
10	W12AIR-SM0005W	Artificial Neural Networks	1					K2AIR_W08	15	60	2	2	1.5	T/Z	Z		DN		K
11	W12AIR-SM0005P	Artificial Neural Networks				1		K2AIR_U08	15	30	1	1	0.8	T	Z		DN	P(1)	K
		Total	**8**	**2**	**3**	**3**	**0**		**240**	**690**	**23**	**23**	**16.3**						

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – T, remote – Z
[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.3.2. List of the main field of study blocks in English ECTS points: 20

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form² of course/group of courses	Way³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN⁵ classes	BU¹ classes			University-wide⁴	concern with scient. activity⁵	Practical⁶	Type⁷
1	W12AIR-SM0723C	Control Theory		1				K2AIR_U05	15	60	2	2	1.5	T	Z		DN	P(2)	K
2	W12AIR-SM0723L	Control Theory			1			K2AIR_U06	15	30	1	1	0.7	T	Z		DN	P(1)	K
3	W12AIR-SM0723W	Control Theory	2					K2AIR_W06	30	60	2	2	1	T/Z	E(W)		DN		K
4	W12AIR-SM0722P	Intelligent virtualization of systems and process automation				2		K2AIR_U14, K2AIR_U15	30	60	2	2	1.6	T	Z		DN	P(2)	K
5	W12AIR-SM0722W	Intelligent virtualization of systems and process automation	1					K2AIR_W14, K2AIR_W15	15	60	2	2	1.2	T/Z	E(W)		DN		K
6	W12AIR-SM0721W	Artificial Neural Networks	1					K2AIR_W08	15	60	2	2	1.5	T/Z	Z		DN		K
7	W12AIR-SM0721P	Artificial Neural Networks				1		K2AIR_U08	15	30	1	1	0.8	T	Z		DN	P(1)	K
8	W12AIR-SM0711L	Modeling and identification			2			K2AIR_U04	30	60	2	2	1.6	T	Z		DN	P(2)	K
9	W12AIR-SM0711W	Modeling and identification	2					K2AIR_W04	30	90	3	3	2	T/Z	Z		DN		K
10	W12AIR-SM0708C	Theory and Methods of Optimization		1				K2AIR_U03	15	30	1	1	0.8	T	Z		DN	P(1)	K
11	W12AIR-SM0708W	Theory and Methods of Optimization	1					K2AIR_W03	15	60	2	2	1.4	T/Z	Z		DN		K
		Total	**7**	**2**	**3**	**3**	**0**		**225**	**600**	**20**	**20**	**14.1**						

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether   for main field of study blocks in Polish

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
8	2	3	3	0	240	690	23	23	16.3

Altogether   for main field of study blocks in English

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
7	2	3	3	0	225	600	20	20	14.1

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.1. Foreign languages block   ECTS points: 3

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			Universitywide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1		Foreign language A1		3				K2AIR_U01	45	60	2		1.6	T	Z	O		P(2)	KO
2		Foreign language B2+		1				K2AIR_U01	15	30	1		0.8	T	Z	O		P(1)	KO
		Total	**0**	**4**	**0**	**0**	**0**		**60**	**90**	**3**	**0**	**2.4**						

Altogether   for foreign languages block:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
0	**4**	**0**	**0**	**0**	**60**	**90**	**3**	**0**	**2.4**

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.3.1. Block Robotics ECTS points: 57

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/ group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0107S	Specialization seminar					2	K2AIR_U02	30	60	2	2	1.6	T	Z		DN	P(1)	S
2	W12AIR-SM0104W	Algorithms for mobile robotics	1					K2AIR_W09	15	30	1	1	0.6	T/Z	Z		DN		S
3	W12AIR-SM0104L	Algorithms for mobile robotics			1			K2AIR_U09	15	60	2	2	2	T	Z		DN	P(2)	S
4	W12AIR-SM0104S	Algorithms for mobile robotics					1	K2AIR_U09	15	30	1	1	1	T	Z		DN	P(1)	S
5	W12AIR-SM0103W	Distributed Control Systems	1					K2AIR_W10	15	60	2	2	1.6	T/Z	Z		DN		S
6	W12AIR-SM0103L	Distributed Control Systems			2			K2AIR_U10	30	60	2	2	1.6	T	Z		DN	P(2)	S
7	W12AIR-SM0106W	Artificial Intelligence Methods	2					K2AIR_W08	30	60	2	2	1.2	T	E(W)		DN		S
8	W12AIR-SM0106P	Artificial Intelligence Methods				1		K2AIR_U08	15	60	2	2	1.6	T	Z		DN	P(2)	S
9	W12AIR-SM0114P	Discrete Event Systems				1		K2AIR_U07	15	30	1	1	0.7	T	Z		DN	P(1)	S
10	W12AIR-SM0114W	Discrete Event Systems	1					K2AIR_W07	15	60	2	2	1.2	T/Z	Z		DN		S
11	W12AIR-SM0113P	Advanced robotic systems				1		K2AIR_U10	15	30	1	1	0.8	T	Z		DN	P(1)	S
12	W12AIR-SM0113W	Advanced robotic systems	1					K2AIR_W10	15	30	1	1	0.6	T/Z	Z		DN		S
13	W12AIR-SM0100C	Robust and Adaptive Control		1				K2AIR_U05	15	30	1	1	0.8	T	Z		DN	P(1)	S
14	W12AIR-SM0100W	Robust and Adaptive Control	2					K2AIR_W06	30	60	2	2	1.2	T/Z	E(W)		DN		S
15	W12AIR-SM0100L	Robust and Adaptive Control			1			K2AIR_U06	15	60	2	2	1.6	T	Z		DN	P(2)	S
16	W12AIR-SM0105W	Systems of robot control	2					K2AIR_W10	30	60	2	2	1.2	T/Z	Z		DN		S
17	W12AIR-SM0105P	Systems of robot control				1		K2AIR_U06	15	60	2	2	1.6	T	Z		DN	P(2)	S
18	W12AIR-SM0102P	Specialization project				2		K2AIR_U08, K2AIR_U09, K2AIR_U10	30	60	2	2	1.6	T	Z		DN	P(2)	S
19	W12AIR-SM0010D	Master thesis				10		K2AIR_U16	150	450	15	15	2	T	Z		DN	P(10)	S
20	W12AIR-SM0112S	Diploma Seminar					2	K2AIR_U02	30	90	3	3	2.4	T	Z		DN	P(3)	S

No	Code	Course name	lec	cl	lab	pr	sem	Code	ZZU	CNPS									
21	W12AIR-SM0108W	Methods of scene representation	1					K2AIR_W08	15	60	2	2	2	T	Z		DN		S
22	W12AIR-SM0111W	Robot motion planning	2					K2AIR_W09	30	60	2	2	1.5	T/Z	Z		DN		S
23	W12AIR-SM0111S	Robot motion planning				1		K2AIR_U09	15	30	1	1	0.7	T	Z		DN	P(1)	S
24	W12AIR-SM0109L	Social Robots			1			K2AIR_U08	15	30	1	1	0.8	T	Z		DN	P(1)	S
25	W12AIR-SM0109W	Social Robots	1					K2AIR_W08	15	30	1	1	0.6	T/Z	Z		DN		S
26	W12AIR-SM0110W	Machine Learning	1					K2AIR_W13	15	30	1	1	1	T	Z		DN		S
27	W12AIR-SM0110L	Machine Learning			1			K2AIR_U13	15	30	1	1	0.8	T	Z		DN	P(1)	S
		Total	**15**	**1**	**6**	**16**	**6**		**660**	**1710**	**57**	**57**	**34.3**						

Altogether for Robotics block

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
15	**1**	**6**	**16**	**6**	**660**	**1710**	**57**	**57**	**34.3**

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.3.2. Block Electronic Control Systems   ECTS points: 57

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0207S	Specialization seminar					2	K2AIR_U02	30	60	2	2	1	T	Z		DN	P(1)	S
2	W12AIR-SM0206W	Operations research in control theory	1					K2AIR_W03	15	30	1	1	0.5	T/Z	Z		DN		S
3	W12AIR-SM0206L	Operations research in control theory			2			K2AIR_U03	30	60	2	2	1.6	T	Z		DN	P(2)	S
4	W12AIR-SM0205W	Industrial Automation Electronics	1					K2AIR_W11	15	60	2	2	0.6	T/Z	E(W)		DN		S
5	W12AIR-SM0205L	Industrial Automation Electronics			2			K2AIR_U11	30	60	2	2	1.1	T	Z		DN	P(2)	S
6	W12AIR-SM0205P	Industrial Automation Electronics				1		K2AIR_U11	15	60	2	2	1.6	T	Z		DN	P(2)	S
7	W12AIR-SM0204W	Industria networks	1					K2AIR_W15	15	60	2	2	2	T/Z	Z		DN		S
8	W12AIR-SM0204L	Industria networks			2			K2AIR_U15	30	60	2	2	1	T	Z		DN	P(1)	S
9	W12AIR-SM0203W	Machine learning	1					K2AIR_W13	15	60	2	2	1	T/Z	Z		DN		S
10	W12AIR-SM0203P	Machine learning				2		K2AIR_U13	30	60	2	2	1.5	T	Z		DN	P(2)	S
11	W12AIR-SM0202W	Optical Components and Systems	1					K2AIR_W12	15	60	2	2	1.5	T/Z	Z		DN		S
12	W12AIR-SM0202S	Optical Components and Systems					1	K2AIR_U12	15	30	1	1	1	T	Z		DN	P(1)	S
13	W12AIR-SM0202L	Optical Components and Systems			1			K2AIR_U12	15	30	1	1	1	T	Z		DN	P(1)	S
14	W12AIR-SM0201L	Programmable Controllers			2			K2AIR_U13	30	60	2	2	1	T	Z		DN	P(2)	S
15	W12AIR-SM0201W	Programmable Controllers	2					K2AIR_W13	30	90	3	3	2	T/Z	E(W)		DN		S
16	W12AIR-SM0200W	Sensors	1					K2AIR_W14	15	30	1	1	0.6	T/Z	Z		DN		S
17	W12AIR-SM0200L	Sensors			1			K2AIR_U14	15	30	1	1	1	T	Z		DN	P(1)	S
18	W12AIR-SM0010D	Master thesis				10		K2AIR_U16	150	450	15	15	2	T	Z		DN	P(10)	S
19	W12AIR-SM0211S	Diploma Seminar					2	K2AIR_U02	30	90	3	3	1.5	T	Z		DN	P(3)	S
20	W12AIR-SM0210L	Energy Electronics			1			K2AIR_U11	15	60	2	2	2	T	Z		DN	P(2)	S
21	W12AIR-SM0210W	Energy Electronics	2					K2AIR_W11	30	60	2	2	1	T/Z	Z		DN		S
22	W12AIR-SM0209L	Practical aspect of signal processing			2			K2AIR_U13	30	30	1	1	1	T	Z		DN	P(1)	S

№	Course code	Course name	lec	cl	lab	pr	sem	Prerequisites	ZZU	CNPS	ECTS								
23	W12AIR-SM0209W	Practical aspect of signal processing	1					K2AIR_W13	15	60	2	2	1.5	T/Z	Z		DN		S
24	W12AIR-SM0208W	Selected Topics in Robotics	2					K2AIR_W08, K2AIR_W09	30	60	2	2	1.6	T	Z		DN		S
		Total	**13**	**0**	**13**	**13**	**5**		**660**	**1710**	**57**	**57**	**30.6**						

Altogether for Electronic Control Systems block

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
13	**0**	**13**	**13**	**5**	**660**	**1710**	**57**	**57**	**30.6**

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.3.2. Block Embedded Robotics   ECTS points: 57

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0703W	Embedded Systems	2					K2AIR_W10	30	90	3	3	1.8	T/Z	Z		DN		S
2	W12AIR-SM0703L	Embedded Systems			2			K2AIR_U10	30	60	2	2	1.6	T	Z		DN	P(2)	S
3	W12AIR-SM0702W	Artificial Intelligence and Machine Learning	2					K2AIR_W08	30	60	2	2	2	T	Z		DN		S
4	W12AIR-SM0702P	Artificial Intelligence and Machine Learning				2		K2AIR_U08	30	90	3	3	2	T	Z		DN	P(3)	S
5	W12AIR-SM0706S	Specialization seminar					2	K2AIR_U02	30	60	2	2	1	T	Z		DN	P(2)	S
6	W12AIR-SM0713P	Intermediate project				2		K2AIR_U08, K2AIR_U09, K2AIR_U10	30	90	3		1.5	T	Z			P(3)	S
7	W12AIR-SM0726L	Mobile robotics			2			K2AIR_U09	30	90	2	2	2	T	Z		DN	P(2)	S
8	W12AIR-SM0726W	Mobile robotics	1					K2AIR_W09	15	30	2	2	1.2	T/Z	E(W)		DN		S
9	W12AIR-SM0707L	Sensors and Actuators			1			K2AIR_U14	15	60	2	2	2	T	Z		DN	P(2)	S
10	W12AIR-SM0707W	Sensors and Actuators	1					K2AIR_W14	15	30	1	1	1	T/Z	Z		DN		S
11	W12AIR-SM0709W	Control Theory for Embedded Systems	1					K2AIR_W10, K2AIR_W03	15	30	1	1	0.5	T/Z	Z		DN		S
12	W12AIR-SM0709L	Control Theory for Embedded Systems			1			K2AIR_U06	15	60	2	2	1.5	T	Z		DN	P(2)	S
13	W12AIR-SM0725W	Event-based Control	1					K2AIR_W07	15	60	2	2	1.2	T/Z	Z		DN		S
14	W12AIR-SM0725P	Event-based Control				1		K2AIR_U05	15	30	1	1	0.7	T	Z		DN	P(1)	S
15	W12AIR-SM0724L	Robotic Programming Environments			2			K2AIR_U10	30	60	2	2	2	T	Z		DN	P(2)	S
16	W12AIR-SM0724W	Robotic Programming Environments	1					K2AIR_W10	15	60	2	2	2	T/Z	E(W)		DN		S
17	W12AIR-SM0719D	Master thesis			10			K2AIR_U16	150	450	15	15	2	T	Z		DN	P(10)	S
18	W12AIR-SM0718S	Diploma Seminar					2	K2AIR_U02	30	90	3	3	1.5	T	Z		DN	P(3)	S
19	W12AIR-SM0715W	Social Robots	1					K2AIR_W08	15	30	1	1	0.5	T/Z	Z		DN		S
20	W12AIR-SM0715L	Social Robots			1			K2AIR_U08	15	30	1	1	0.7	T	Z		DN	P(1)	S
21	W12AIR-SM0714W	Task and Motion Planning	2					K2AIR_W09	30	60	2	2	1.5	T/Z	Z		DN		S

No	Code	Name	lec	cl	lab	pr	sem	Learning outcomes	ZZU hours	CNPS hours	ECTS		BU				DN		
22	W12AIR-SM0714S	Task and Motion Planning					1	K2AIR_U09	15	30	1	1	0.7	T	Z		DN	P(1)	S
23	W12AIR-SM0717W	Advanced Robot Control	1					K2AIR_W09, K2AIR_W10	15	30	1	1	0.5	T/Z	Z		DN		S
24	W12AIR-SM0717L	Advanced Robot Control			1			K2AIR_U06	15	30	1	1	1	T	Z		DN	P(1)	S
		Total	**13**	**0**	**10**	**15**	**5**		**645**	**1710**	**57**	**54**	**32.4**						

Altogether   for Embedded Robotics   block

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
13	**0**	**10**	**15**	**5**	**645**	**1710**	**57**	**54**	**32.4**

4.3 "Diploma dissertation" block

Type of diploma dissertation	magister inżynier	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
1	15 P(10)	**W12AIR-SM0010D (study in Polish)** **W12AIR-SM0719DP (study in English)**
Character of diploma dissertation		
research, research and development		
Number of BU[1] ECTS points	**2**	
Number of DN[5] ECTS points	**15**	

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[1] BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2] Traditional – T, remote – Z

[3] Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4] University-wide course /group of courses – O

[5] DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6] Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7] KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

5 Ways of verifying assumed learning outcomes

Type of classes	Ways of verifying assumed learning outcomes
lecture	oral or written credit assessment, midterm and final test, written exam, oral answers, active participation in lectures, grade from the final written examination
class	average of the control papers grades, average of the homework grades, assessment of the class work, grade of the final test
laboratory	observation of the preparation for and performance in laboratory classes, reports on laboratory exercises, activity in laboratory classes, evaluation of the quality of the written laboratory exercise reports, evaluation of the activity and efficiency of the execution of the exercise based on observation of its course, evaluation of the degree of implementation of the laboratory exercises, tests on the e-learning platform, oral answer
project	assessment of the project task realization, written documentation of the project, presentation of the assumptions and final solution, presentation of the results of the project with a discussion and conclusions, evaluation of the project preparation, defense of the project, participation in problem discussions, evaluation of completed project tasks, evaluation of the written report on the project, evaluation of the presentation of the subsequent stages of project implementation, compliance with the schedule, team activity, creative attitude, evaluation of the quality of the completed documentation, evaluation of the components of the project and its final form, oral answer
seminar	seminar presentation, activity/participation in the discussion, evaluation of the preparation of the presentation, participation in problem discussions, activity in seminar classes, evaluation of the quality of multimedia presentations, evaluation of presentations, adherence to the schedule, evaluation of summary presentations and written elaboration, discussion
diploma dissertation	prepared diploma dissertation

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – T, remote – Z
[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

6 Range of diploma examination

7 Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular blocks

No.	Course	Name of course	Crediting by deadline of ... (number of semester)
1		Foreign language 1	2
2		Foreign language 2	2

8 Plan of studies (attachment no. 3)

Approved by faculty student government legislative body:

....
Date

....
name and surname, signature of student representative

....
Date

....
Dean's signature

PLAN OF STUDIES

FACULTY: FACULTY OF ELECTRONICS, PHOTONICS and MICROSYSTEMS

MAIN FIELD OF STUDIES: CONTROL ENGINEERING and ROBOTICS

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Robotics

LANGUAGE OF STUDY: Polish

In effect since: 2022/2023

Faculty of Electronics, Photonics and Microsystems
Education level: second-level studies
Main field of studies: Control Engineering and Robotics
Specialization: Robotics

ARR

In effect since 2022/23

Plan of studies structure in hourly layout

	I	II	III
26			
25			
24		Specialization project	
23	Artificial neural networks	W12AIR-SM0102P 00020	
22	W12AIR-SM0005 10010	Systems of robot control	Machine learning
21	Intell. systems' virtualization	W12AIR-SM0105 20010	W12AIR-SM0110 10100
20	and process automatization		Social Robots
19	W12AIR-SM0006 10020 **E**	Robust and Adaptive	W12AIR-SM0109 10100
18	Control Theory	Control	Robot motion planning
17			
16	W12AIR-SM0007 21100 **E**	W12AIR-SM0100 21100 **E**	W12AIR-SM0111 20001
15		Advanced robotic systems	*Msr W12AIR-SM0108W 10000
14	Modeling and Identification	W12AIR-SM0113 10010	Entreprenuership
13		Event-based Control	W08AIR-SM0010 10001
12	W12AIR-SM0001 20200	W12AIR-SM0114 10010	Master thesis
11		Artificial Intelligence	
10	Theory and Methods	Methods	W12AIR-SM0010D 10h
9	of Optimization	W12AIR-SM0106 20010 **E**	
8	W12AIR-SM0003 21000		
7	Soc Comm W08W12-SM0001S 00001	Distributed Control	
6	Physics W11W12-SM4901W 10000	Systems	
5	Math. W13AIR-SM1440W 10000	W12AIR-SM0103 10200	
4	Foreign language B2+ 01000	Algorithms for	
3	Foreign language (or Polish) A1	mobile robotics	
2		W12AIR-SM0104 10101	
1	03000	Specialization seminar	Diploma Seminar
		W12AIR-SM0107S 00002	W12AIR-SM0112S 00002

*Methods of scene representation

Chairman of the Specialization Program Committee

....

Prof. D.Sc., Eng. Ignacy Dulęba

Chairwoman of the Main field of studies Program Committee

....

D.Sc., Eng. Alicja Mazur, Assoc. Prof.

Dean

....

Prof. D.Sc., Eng. Rafał Walczak

Faculty of Electronics, Photonics and Microsystems
Education level: second-level studies
Main field of studies: Control Engineering and Robotics
Specialization: Robotics

ARR

Obowiązuje od :
In effect since 2022/23

Plan of studies structure in ECTS point layout

	I	II	III
30	Artificial neural networks **3**	Specialization project **2**	Machine learning **2**
29			
28		Systems of robot control **4**	Social Robots **2**
27	Intell. systems' virtualization and process automatization **4**		
26			Robot motion planning **3**
25			
24		Robust and Adaptive Control **5**	
23	Control Theory **6**		Methods of scene representation **2**
22			
21			Entreprenuership **3**
20			
19		Advanced robotic systems **2**	
18			Master thesis **15**
17	Modeling and Identification **5**	Event-based Control **3**	
16			
15			
14		Artificial Intelligence Methods **4**	
13			
12	Theory and Methods of Optimization **5**		
11			
10		Distributed Control Systems **4**	
9			
8			
7	Social Communication **2**		
6		Algorithms for mobile robotics **4**	
5	Physics **1**		
4	Mathematics **1**		
3	Foreign language B2+ **1**		Diploma Seminar **3**
2	Foreign language (or Polish) A1 **2**	Specialization seminar **2**	
1			

Chairman of the Specialization Program Committee

Chairwoman of the Main field of studies Program Committee

Dean

....

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Prof. D.Sc., Eng. Ignacy Dulęba

D.Sc., Eng. Alicja Mazur, Assoc. Prof.

Prof. D.Sc., Eng. Rafał Walczak

1 Set of obligatory and optional courses and groups of courses in semestral arrangement

Semester 1

Obligatory courses / groups of courses   **Number of ECTS points: 27**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W13AIR-SM1440W	Mathematics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
2	W11W12-SM4901W	Physics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
3	W08W12-SM0001S	Social Communication					1	K2AIR_K01	15	60	2		1	T	Z	O		P(1)	KO
4	W12AIR-SM0003W	Theory and Methods of Optimization	2					K2AIR_W03	30	90	3	3	2	T/Z	Z		DN		K
5	W12AIR-SM0003C	Theory and Methods of Optimization		1				K2AIR_U03	15	60	2	2	1.6	T	Z		DN	P(2)	K
6	W12AIR-SM0001L	Modeling and identification			2			K2AIR_U04	30	60	2	2	1.6	T	Z		DN	P(2)	K
7	W12AIR-SM0001W	Modeling and identification	2					K2AIR_W04	30	90	3	3	2	T/Z	Z		DN		K
8	W12AIR-SM0007C	Control Theory		1				K2AIR_U05	15	60	2	2	1.5	T	Z		DN	P(2)	K
9	W12AIR-SM0007W	Control Theory	2					K2AIR_W06	30	60	2	2	1	T/Z	E(W)		DN		K
10	W12AIR-SM0007L	Control Theory			1			K2AIR_U06	15	60	2	2	1.5	T	Z		DN	P(2)	K
11	W12AIR-SM0006W	Intelligent virtualization of systems and process automation	1					K2AIR_W14, K2AIR_W15	15	60	2	2	1.2	T/Z	E(W)		DN		K
12	W12AIR-SM0006P	Intelligent virtualization of systems and process automation				2		K2AIR_U14, K2AIR_U15	30	60	2	2	1.6	T	Z		DN	P(2)	K
13	W12AIR-SM0005W	Artificial Neural Networks	1					K2AIR_W08	15	60	2	2	1.5	T/Z	Z		DN		K
14	W12AIR-SM0005P	Artificial Neural Networks				1		K2AIR_U08	15	30	1	1	0.8	T	Z		DN	P(1)	K
		Total	**10**	**2**	**3**	**3**	**1**		**285**	**810**	**27**	**23**	**18.3**						

Optional courses / groups of courses (4 hours in semester, 3 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/ group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1		Foreign language A1		3				K2AIR_U01	45	60	2		1.6	T	Z	O		P(2)	KO
2		Foreign language B2+		1				K2AIR_U01	15	30	1		0.8	T	Z	O		P(1)	KO
		Total	**0**	**4**	**0**	**0**	**0**		**60**	**90**	**3**	**0**	**2.4**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
10	**6**	**3**	**3**	**1**	**345**	**900**	**30**	**23**	**20,7**

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – T, remote – Z
[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 2

Optional courses / groups of courses (24 hours in semester, 30 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0107S	Specialization seminar					2	K2AIR_U02	30	60	2	2	1.6	T	Z		DN	P(1)	S
2	W12AIR-SM0104S	Algorithms for mobile robotics					1	K2AIR_U09	15	30	1	1	1	T	Z		DN	P(1)	S
3	W12AIR-SM0104W	Algorithms for mobile robotics	1					K2AIR_W09	15	30	1	1	0.6	T/Z	Z		DN		S
4	W12AIR-SM0104L	Algorithms for mobile robotics			1			K2AIR_U09	15	60	2	2	2	T	Z		DN	P(2)	S
5	W12AIR-SM0103W	Distributed Control Systems	1					K2AIR_W10	15	60	2	2	1.6	T/Z	Z		DN		S
6	W12AIR-SM0103L	Distributed Control Systems			2			K2AIR_U10	30	60	2	2	1.6	T	Z		DN	P(2)	S
7	W12AIR-SM0106P	Artificial Intelligence Methods				1		K2AIR_U08	15	60	2	2	1.6	T	Z		DN	P(2)	S
8	W12AIR-SM0106W	Artificial Intelligence Methods	2					K2AIR_W08	30	60	2	2	1.2	T	E(W)		DN		S
9	W12AIR-SM0114W	Discrete Event Systems	1					K2AIR_W07	15	60	2	2	1.2	T/Z	Z		DN		S
10	W12AIR-SM0114P	Discrete Event Systems				1		K2AIR_U07	15	30	1	1	0.7	T	Z		DN	P(1)	S
11	W12AIR-SM0113W	Advanced robotic systems	1					K2AIR_W10	15	30	1	1	0.6	T/Z	Z		DN		S
12	W12AIR-SM0113P	Advanced robotic systems				1		K2AIR_U10	15	30	1	1	0.8	T	Z		DN	P(1)	S
13	W12AIR-SM0100L	Robust and Adaptive Control			1			K2AIR_U06	15	60	2	2	1.6	T	Z		DN	P(2)	S
14	W12AIR-SM0100C	Robust and Adaptive Control		1				K2AIR_U05	15	30	1	1	0.8	T	Z		DN	P(1)	S
15	W12AIR-SM0100W	Robust and Adaptive Control	2					K2AIR_W06	30	60	2	2	1.2	T/Z	E(W)		DN		S
16	W12AIR-SM0105W	Systems of robot control	2					K2AIR_W10	30	60	2	2	1.2	T/Z	Z		DN		S
17	W12AIR-SM0105P	Systems of robot control				1		K2AIR_U06	15	60	2	2	1.6	T	Z		DN	P(2)	S
18	W12AIR-SM0102P	Specialization project				2		K2AIR_U08, K2AIR_U09, K2AIR_U10	30	60	2	2	1.6	T	Z		DN	P(2)	S
		Total	10	1	4	6	3		360	900	30	30	22.5						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
10	1	4	6	3	360	900	30	30	22.5

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 3

Obligatory courses / groups of courses   **Number of ECTS points: 3**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of cre-di-ting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W08AIR-SM0010W	Entrepreneurship	1					K2AIR_W02	15	60	2		1	T/Z	Z	O			KO
2	W08AIR-SM0010S	Entrepreneurship					1	K2AIR_K02	15	30	1		0.8	T	Z	O		P(1)	KO
		Total	**1**	**0**	**0**	**0**	**1**		**30**	**90**	**3**	**0**	**1.8**						

Optional courses / groups of courses   **(20 hours in semester, 27 ECTS points)**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of cre-di-ting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0010D	Master thesis				10		K2AIR_U16	150	450	15	15	2	T	Z		DN	P(10)	S
2	W12AIR-SM0112S	Diploma Seminar					2	K2AIR_U02	30	90	3	3	2.4	T	Z		DN	P(3)	S
3	W12AIR-SM0108W	Methods of scene representation	1					K2AIR_W08	15	60	2	2	2	T	Z		DN		S
4	W12AIR-SM0111W	Robot motion planning	2					K2AIR_W09	30	60	2	2	1.5	T/Z	Z		DN		S
5	W12AIR-SM0111S	Robot motion planning					1	K2AIR_U09	15	30	1	1	0.7	T	Z		DN	P(1)	S
6	W12AIR-SM0109W	Social Robots	1					K2AIR_W08	15	30	1	1	0.6	T/Z	Z		DN		S
7	W12AIR-SM0109L	Social Robots			1			K2AIR_U08	15	30	1	1	0.8	T	Z		DN	P(1)	S
8	W12AIR-SM0110L	Machine Learning			1			K2AIR_U13	15	30	1	1	0.8	T	Z		DN	P(1)	S
9	W12AIR-SM0110W	Machine Learning	1					K2AIR_W13	15	30	1	1	1	T	Z		DN		S
		Total	**5**	**0**	**2**	**10**	**3**		**300**	**810**	**27**	**27**	**11.8**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
6	0	2	10	4	330	900	30	27	13.6

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2   Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
W12AIR-SM0006	Intelligent virtualization of systems and process automation	1
W12AIR-SM0007	Control Theory	1
W12AIR-SM0100	Robust and Adaptive Control	2
W12AIR-SM0106	Artificial Intelligence Methods	2

3   Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester
1	8
2	8

Opinion of student government legislative body:

....
    Date

....
Name and surname, signature of student representative

....
    Date

....
Dean's signature

PLAN OF STUDIES

FACULTY: FACULTY OF ELECTRONICS, PHOTONICS and MICROSYSTEMS

MAIN FIELD OF STUDIES: CONTROL ENGINEERING and ROBOTICS

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Electronic Control Systems

LANGUAGE OF STUDY: Polish

In effect since: 2022/2023

Faculty of Electronics, Photonics and Microsystems
Education level: second-level studies
Main field of studies: Control Engineering and Robotics
Specialization: Electronic Control Systems

AEU

In effect since 2022/23

Plan of studies structure in hourly layout

	I	II	III
26			
25			
24		Sensors W12AIR-SM0200 10100	
23	Artificial neural networks W12AIR-SM0005 10010		Selected Topics in Robotics W12AIR-SM0208W 20000
22		Programmable Controllers	
21	Intell. systems' virtualization and process automatization W12AIR-SM0006 10020 **E**	W12AIR-SM0201 20200 **E**	Practical aspect of signal processing W12AIR-SM0209 10200
20			
19			
18	Control Theory	Optical Components and Systems	
17	W12AIR-SM0007 21100 **E**	W12AIR-SM0202 10101	Energy Electronics W12AIR-SM0210 20100
16			
15		Machine learning	
14	Modeling and Identification	W12AIR-SM0203 10020	Entrepreneurship W08AIR-SM0010 10001
13	W12AIR-SM0001 20200		
12		Industria networks	Master thesis
11		W12AIR-SM0204 10200	
10	Theory and Methods of Optimization W12AIR-SM0003 21000		W12AIR-SM0010D 10h
9		Industrial Automation Electronics	
8			
7	Soc Comm W08W12-SM0001S 00001	W12AIR-SM0205 10210 **E**	
6	Physics W11W12-SM4901W 10000		
5	Math. W13AIR-SM1440W 10000	Operations research in control theory W12AIR-SM0206 10200	
4	Foreign language B2+ 01000		
3	Foreign language (or Polish) A1		
2	03000	Specialization seminar W12AIR-SM0207S 00002	Diploma Seminar W12AIR-SM0211S 00002
1			

Chairman of the Specialization Program Committee

Chairwoman of the Main field of studies Program Committee

Dean

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Prof. D.Sc., Eng. Krzysztof Opieliński

D.Sc., Eng. Alicja Mazur, Assoc. Prof.

Prof. D.Sc., Eng. Rafał Walczak

Faculty of Electronics, Photonics and Microsystems
Education level: second-level studies
Main field of studies: Control Engineering and Robotics
Specialization: Electronic Control Systems

AEU

Obowiązuje od :
In effect since 2022/23

Plan of studies structure in ECTS point layout

	I	II	III
30	Artificial neural networks **3**	Sensors **2**	Selected Topics in Robotics **2**
29			
28		Programmable Controllers **5**	Practical aspect of signal processing **3**
27	Intell. systems' virtualization and process automatization **4**		
26			
25			Energy Electronics **4**
24			
23	Control Theory **6**	Optical Components and Systems **4**	
22			
21			Entrepreneurship **3**
20			
19		Machine learning **4**	
18			Master thesis **15**
17	Modeling and Identification **5**		
16			
15		Industria networks **4**	
14			
13			
12	Theory and Methods of Optimization **5**	Industrial Automation Electronics **6**	
11			
10			
9			
8			
7	Social Communication **2**		
6			
5	Physics **1**	Operations research in control theory **3**	
4	Mathematics **1**		
3	Foreign language B2+ **1**		Diploma Seminar **3**
2	Foreign language (or Polish) A1 **2**	Specialization seminar **2**	
1			

Chairman of the Specialization Program Committee

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Prof. D.Sc., Eng. Krzysztof Opieliński

Chairwoman of the Main field of studies Program Committee

....

D.Sc., Eng. Alicja Mazur, Assoc. Prof.

Dean

....

Prof. D.Sc., Eng. Rafał Walczak

1 Set of obligatory and optional courses and groups of courses in semestral arrangement

Semester 1

Obligatory courses / groups of courses   **Number of ECTS points: 27**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W13AIR-SM1440W	Mathematics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
2	W11W12-SM4901W	Physics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
3	W08W12-SM0001S	Social Communication					1	K2AIR_K01	15	60	2		1	T	Z	O		P(1)	KO
4	W12AIR-SM0003W	Theory and Methods of Optimization	2					K2AIR_W03	30	90	3	3	2	T/Z	Z		DN		K
5	W12AIR-SM0003C	Theory and Methods of Optimization		1				K2AIR_U03	15	60	2	2	1.6	T	Z		DN	P(2)	K
6	W12AIR-SM0001L	Modeling and identification			2			K2AIR_U04	30	60	2	2	1.6	T	Z		DN	P(2)	K
7	W12AIR-SM0001W	Modeling and identification	2					K2AIR_W04	30	90	3	3	2	T/Z	Z		DN		K
8	W12AIR-SM0007C	Control Theory		1				K2AIR_U05	15	60	2	2	1.5	T	Z		DN	P(2)	K
9	W12AIR-SM0007W	Control Theory	2					K2AIR_W06	30	60	2	2	1	T/Z	E(W)		DN		K
10	W12AIR-SM0007L	Control Theory			1			K2AIR_U06	15	60	2	2	1.5	T	Z		DN	P(2)	K
11	W12AIR-SM0006W	Intelligent virtualization of systems and process automation	1					K2AIR_W14, K2AIR_W15	15	60	2	2	1.2	T/Z	E(W)		DN		K
12	W12AIR-SM0006P	Intelligent virtualization of systems and process automation				2		K2AIR_U14, K2AIR_U15	30	60	2	2	1.6	T	Z		DN	P(2)	K
13	W12AIR-SM0005W	Artificial Neural Networks	1					K2AIR_W08	15	60	2	2	1.5	T/Z	Z		DN		K
14	W12AIR-SM0005P	Artificial Neural Networks				1		K2AIR_U08	15	30	1	1	0.8	T	Z		DN	P(1)	K
		Total	**10**	**2**	**3**	**3**	**1**		**285**	**810**	**27**	**23**	**18.3**						

Optional courses / groups of courses （4 hours in semester, 3 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			Universitywide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1		Foreign language A1		3				K2AIR_U01	45	60	2		1.6	T	Z	O		P(2)	KO
2		Foreign language B2+		1				K2AIR_U01	15	30	1		0.8	T	Z	O		P(1)	KO
		Total	**0**	**4**	**0**	**0**	**0**		**60**	**90**	**3**	**0**	**2.4**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
10	**6**	**3**	**3**	**1**	**345**	**900**	**30**	**23**	**20,7**

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 2

Optional courses / groups of courses (24 hours in semester, 30 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0207S	Specialization seminar					2	K2AIR_U02	30	60	2	2	1	T	Z		DN	P(1)	S
2	W12AIR-SM0206W	Operations research in control theory	1					K2AIR_W03	15	30	1	1	0.5	T/Z	Z		DN		S
3	W12AIR-SM0206L	Operations research in control theory			2			K2AIR_U03	30	60	2	2	1.6	T	Z		DN	P(2)	S
4	W12AIR-SM0205L	Industrial Automation Electronics			2			K2AIR_U11	30	60	2	2	1.1	T	Z		DN	P(2)	S
5	W12AIR-SM0205P	Industrial Automation Electronics				1		K2AIR_U11	15	60	2	2	1.6	T	Z		DN	P(2)	S
6	W12AIR-SM0205W	Industrial Automation Electronics	1					K2AIR_W11	15	60	2	2	0.6	T/Z	E(W)		DN		S
7	W12AIR-SM0204W	Industria networks	1					K2AIR_W15	15	60	2	2	2	T/Z	Z		DN		S
8	W12AIR-SM0204L	Industria networks			2			K2AIR_U15	30	60	2	2	1	T	Z		DN	P(1)	S
9	W12AIR-SM0203W	Machine learning	1					K2AIR_W13	15	60	2	2	1	T/Z	Z		DN		S
10	W12AIR-SM0203P	Machine learning				2		K2AIR_U13	30	60	2	2	1.5	T	Z		DN	P(2)	S
11	W12AIR-SM0202L	Optical Components and Systems			1			K2AIR_U12	15	30	1	1	1	T	Z		DN	P(1)	S
12	W12AIR-SM0202S	Optical Components and Systems					1	K2AIR_U12	15	30	1	1	1	T	Z		DN	P(1)	S
13	W12AIR-SM0202W	Optical Components and Systems	1					K2AIR_W12	15	60	2	2	1.5	T/Z	Z		DN		S
14	W12AIR-SM0201L	Programmable Controllers			2			K2AIR_U13	30	60	2	2	1	T	Z		DN	P(2)	S
15	W12AIR-SM0201W	Programmable Controllers	2					K2AIR_W13	30	90	3	3	2	T/Z	E(W)		DN		S
16	W12AIR-SM0200W	Sensors	1					K2AIR_W14	15	30	1	1	0.6	T/Z	Z		DN		S
17	W12AIR-SM0200L	Sensors			1			K2AIR_U14	15	30	1	1	1	T	Z		DN	P(1)	S
	Total		**8**	**0**	**10**	**3**	**3**		**360**	**900**	**30**	**30**	**20**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
8	**0**	**10**	**3**	**3**	**360**	**900**	**30**	**30**	**20**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 3

Obligatory courses / groups of courses   **Number of ECTS points: 3**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W08AIR-SM0010W	Entrepreneurship	1					K2AIR_W02	15	60	2		1	T/Z	Z	O			KO
2	W08AIR-SM0010S	Entrepreneurship					1	K2AIR_K02	15	30	1		0.8	T	Z	O		P(1)	KO
		Total	**1**	**0**	**0**	**0**	**1**		**30**	**90**	**3**	**0**	**1.8**						

Optional courses / groups of courses   **(20 hours in semester, 27 ECTS points)**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0010D	Master thesis				10		K2AIR_U16	150	450	15	15	2	T	Z		DN	P(10)	S
2	W12AIR-SM0211S	Diploma Seminar					2	K2AIR_U02	30	90	3	3	1.5	T	Z		DN	P(3)	S
3	W12AIR-SM0210L	Energy Electronics			1			K2AIR_U11	15	60	2	2	2	T	Z		DN	P(2)	S
4	W12AIR-SM0210W	Energy Electronics	2					K2AIR_W11	30	60	2	2	1	T/Z	Z		DN		S
5	W12AIR-SM0209L	Practical aspect of signal processing			2			K2AIR_U13	30	30	1	1	1	T	Z		DN	P(1)	S
6	W12AIR-SM0209W	Practical aspect of signal processing	1					K2AIR_W13	15	60	2	2	1.5	T/Z	Z		DN		S
7	W12AIR-SM0208W	Selected Topics in Robotics	2					K2AIR_W08, K2AIR_W09	30	60	2	2	1.6	T	Z		DN		S
		Total	**5**	**0**	**3**	**10**	**2**		**300**	**810**	**27**	**27**	**10.6**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
6	**0**	**2**	**10**	**4**	**330**	**900**	**30**	**27**	**12.4**

2 Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
W12AIR-SM0006	Intelligent virtualization of systems and process automation	1
W12AIR-SM0007	Control Theory	1
W12AIR-SM0201	Programmable Controllers	2
W12AIR-SM0205	Industrial Automation Electronics	2

3 Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester
1	8
2	8

Opinion of student government legislative body:

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Date

....
Name and surname, signature of student representative

....
Date

....
Dean's signature

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – T, remote – Z
[3]Exam – E, crediting – Z. For the group of courses – after the letter E or Z - (in brackets) the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – P. For the group of courses – (in brackets) the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

PLAN OF STUDIES

FACULTY: FACULTY OF ELECTRONICS, PHOTONICS and MICROSYSTEMS

MAIN FIELD OF STUDIES: CONTROL ENGINEERING and ROBOTICS

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Embedded Robotics

LANGUAGE OF STUDY: English

In effect since: 2022/2023

Faculty of Electronics, Photonics and Microsystems
Education level: second-level studies
Main field of studies: Control Engineering and Robotics
Specialization: Embedded Robotics

AER

In effect since 2022/23

Plan of studies structure in hourly layout

	I	II	III
26			
25	Artificial Intelligence and Machine Learning W12AIR-SM0702 20020		
24			
23			
22		Robotic programming environments W12AIR-SM0724 10200 **E**	Advanced robot control W12AIR-SM0717 10100
21	Embedded Systems W12AIR-SM0703 20200		
20			Task and motion planning W12AIR-SM0714 20001
19		Event-based control W12AIR-SM0725 10010	
18			
17	Applied Logic W12AIR-SM0720 21000	*Contr. theory for Emb. Syst. W12AIR-SM0709 10100	Social robots W12AIR-SM0715 10100
16			
15		Sensors and actuators W12AIR-SM0707 10100	Master thesis W12AIR-SM0719D 10h
14	Artificial neural networks W12AIR-SM0721 10010		
13		Mobile robotics W12AIR-SM0726 10200 **E**	
12	Intell. systems' virtualization and process automatization W12AIR-SM0722 10020 **E**		
11			
10		Intermediate project W12AIR-SM0713P 00020	
9	Control Theory W12AIR-SM0723 21100 **E**		
8		**Th. and Meth. of Optimiz. W12AIR-SM0708 11000	
7			
6		Modeling and Identification W12AIR-SM0711 20200	
5	Physics W11W12-SM0100W 10000		Diploma seminar W12AIR-SM0718S 00002
4	Foreign language B2+ 01000		
3	Foreign language (or Polish) A1 03000		Soc Comm W08W12-SM0002S 00001
2		Specialization seminar W12AIR-SM0706S 00002	Entreprenuership W08AIR-SM0030 10001
1			

*Control theory for Embedded Systems

**Theory and Methods of Optimization

Chairwoman of the Specialization Program Committee

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D.Sc., Eng. Elżbieta Roszkowska, Assoc. Prof.

Chairwoman of the Main field of studies Program Committee

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D.Sc., Eng. Alicja Mazur, Assoc. Prof.

Dean

....

Prof. D.Sc., Eng. Rafał Walczak

Faculty of Electronics, Photonics and Microsystems
Education level: second-level studies
Main field of studies: Control Engineering and Robotics
Specialization: Embedded Robotics

AER

Obowiązuje od :
In effect since 2022/23

Plan of studies structure in ECTS point layout

	I	II	III
30	Artificial Intelligence and Machine Learning **5**	Robotic programming environments **4**	Advanced robot control **2**
29			
28			Task and motion planning **3**
27			
26		Event-based control **3**	
25	Embedded Systems **5**		Social robots **2**
24			
23		Control theory for Embedded Systems **3**	Master thesis **15**
22			
21			
20	Applied Logic **4**	Sensors and actuators **3**	
19			
18			
17		Mobile robotics **4**	
16	Artificial neural networks **3**		
15			
14			
13	Intell. systems' virtualization and process automatization **4**	Intermediate project **3**	
12			
11			
10		Theory and Methods of Optimization **3**	
9	Control Theory **5**		
8			Diploma seminar **3**
7		Modeling and Identification **5**	
6			
5			Social Communication **2**
4	Physics **1**		
3	Foreign language B2+ **1**		Entreprenuership **3**
2	Foreign language (or Polish) A1 **2**	Specialization seminar **2**	
1			

Chairwoman of the Specialization Program Committee

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D.Sc., Eng. Elżbieta Roszkowska, Assoc. Prof.

Chairwoman of the Main field of studies Program Committee

....

D.Sc., Eng. Alicja Mazur, Assoc. Prof.

Dean

....

Prof. D.Sc., Eng. Rafał Walczak

1 Set of obligatory and optional courses and groups of courses in semestral arrangement

Semester 1

Obligatory courses / groups of courses   **Number of ECTS points: 17**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/ group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W11W12-SM0100W	Physics	1					K2AIR_W01	15	30	1		0.5	T	Z	O			PD
2	W12AIR-SM0723L	Control Theory			1			K2AIR_U06	15	30	1	1	0.7	T	Z		DN	P(1)	K
3	W12AIR-SM0723C	Control Theory		1				K2AIR_U05	15	60	2	2	1.5	T	Z		DN	P(2)	K
4	W12AIR-SM0723W	Control Theory	2					K2AIR_W06	30	60	2	2	1	T/Z	E(W)		DN		K
5	W12AIR-SM0722W	Intelligent virtualization of systems and process automation	1					K2AIR_W14, K2AIR_W15	15	60	2	2	1.2	T/Z	E(W)		DN		K
6	W12AIR-SM0722P	Intelligent virtualization of systems and process automation				2		K2AIR_U14, K2AIR_U15	30	60	2	2	1.6	T	Z		DN	P(2)	K
7	W12AIR-SM0721W	Artificial Neural Networks	1					K2AIR_W08	15	60	2	2	1.5	T/Z	Z		DN		K
8	W12AIR-SM0721P	Artificial Neural Networks				1		K2AIR_U08	15	30	1	1	0.8	T	Z		DN	P(1)	K
9	W12AIR-SM0720C	Applied logic		1				K2AIR_U02	15	60	2		2	T	Z			P(2)	PD
10	W12AIR-SM0720W	Applied logic	2					K2AIR_W01	30	60	2		1.6	T/Z	Z				PD
	Total		**7**	**2**	**1**	**3**	**0**		**195**	**510**	**17**	**12**	**12.4**						

Optional courses / groups of courses (12 hours in semester, 13 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/ group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1		Foreign or Polish language A1		3				K2AIR_U01	45	60	2		1.6	T	Z	O		P(2)	KO
2		Foreign language B2+		1				K2AIR_U01	15	30	1		0.8	T	Z	O		P(1)	KO
3	W12AIR-SM0703W	Embedded Systems	2					K2AIR_W10	30	90	3	3	1.8	T/Z	Z		DN		S
4	W12AIR-SM0703L	Embedded Systems			2			K2AIR_U10	30	60	2	2	1.6	T	Z		DN	P(2)	S
5	W12AIR-SM0702P	Artificial Intelligence and Machine Learning				2		K2AIR_U08	30	90	3	3	2	T	Z		DN	P(3)	S
6	W12AIR-SM0702W	Artificial Intelligence and Machine Learning	2					K2AIR_W08	30	60	2	2	2	T	Z		DN		S
		Total	**4**	**4**	**2**	**2**	**0**		**180**	**390**	**13**	**10**	**9.8**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
11	**6**	**3**	**5**	**0**	**375**	**900**	**30**	**22**	**22.2**

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[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z

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[4]University-wide course /group of courses – O

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Semester 2

Obligatory courses / groups of courses **Number of ECTS points: 8**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of cre-di-ting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] clas-ses	BU[1] clas-ses			Univer-sity-wide[4]	concern with scient. activity[5]	Practi-cal[6]	Type[7]
1	W12AIR-SM0711W	Modeling and identification	2					K2AIR_W04	30	90	3	3	2	T/Z	Z		DN		K
2	W12AIR-SM0711L	Modeling and identification			2			K2AIR_U04	30	60	2	2	1.6	T	Z		DN	P(2)	K
3	W12AIR-SM0708W	Theory and Methods of Optimization	1					K2AIR_W03	15	60	2	2	1.4	T/Z	Z		DN		K
4	W12AIR-SM0708C	Theory and Methods of Optimization		1				K2AIR_U03	15	30	1	1	0.8	T	Z		DN	P(1)	K
		Total	**3**	**1**	**2**	**0**	**0**		**90**	**240**	**8**	**8**	**5.8**						

Optional courses / groups of courses (16 hours in semester, 22 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN[5] classes	BU[1] classes	Form[2] of course/group of courses	Way[3] of crediting	University-wide[4]	concern with scient. activity[5]	Practical[6]	Type[7]
1	W12AIR-SM0706S	Specialization seminar					2	K2AIR_U02	30	60	2	2	1	T	Z		DN	P(2)	S
2	W12AIR-SM0713P	Intermediate project				2		K2AIR_U08, K2AIR_U09, K2AIR_U10	30	90	3		1.5	T	Z			P(3)	S
3	W12AIR-SM0726W	Mobile robotics	1					K2AIR_W09	15	30	2	2	1.2	T/Z	E(W)		DN		S
4	W12AIR-SM0726L	Mobile robotics			2			K2AIR_U09	30	90	2	2	2	T	Z		DN	P(2)	S
5	W12AIR-SM0707W	Sensors and Actuators	1					K2AIR_W14	15	30	1	1	1	T/Z	Z		DN		S
6	W12AIR-SM0707L	Sensors and Actuators			1			K2AIR_U14	15	60	2	2	2	T	Z		DN	P(2)	S
7	W12AIR-SM0709L	Control Theory for Embedded Systems			1			K2AIR_U06	15	60	2	2	1.5	T	Z		DN	P(2)	S
8	W12AIR-SM0709W	Control Theory for Embedded Systems	1					K2AIR_W10, K2AIR_W03	15	30	1	1	0.5	T/Z	Z		DN		S
9	W12AIR-SM0725P	Event-based Control				1		K2AIR_U05	15	30	1	1	0.7	T	Z		DN	P(1)	S
10	W12AIR-SM0725W	Event-based Control	1					K2AIR_W07	15	60	2	2	1.2	T/Z	Z		DN		S
11	W12AIR-SM0724W	Robotic Programming Environments	1					K2AIR_W10	15	60	2	2	2	T/Z	E(W)		DN		S
12	W12AIR-SM0724L	Robotic Programming Environments			2			K2AIR_U10	30	60	2	2	2	T	Z		DN	P(2)	S
	Total		**5**	**0**	**6**	**3**	**2**		**240**	**660**	**22**	**19**	**16.6**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
8	**1**	**8**	**3**	**2**	**330**	**900**	**30**	**27**	**22.4**

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Semester 3

Obligatory courses / groups of courses **Number of ECTS points: 5**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN⁵ classes	BU¹ classes	Form² of course/group of courses	Way³ of crediting	University-wide⁴	concern with scient. activity⁵	Practical⁶	Type⁷
1	W08AIR-SM0030S	Entrepreneurship					1	K2AIR_K02	15	30	1		0.8	T	Z	O		P(1)	KO
2	W08AIR-SM0030W	Entrepreneurship	1					K2AIR_W02	15	60	2		1	T/Z	Z	O			KO
3	W08W12-SM0002S	Social Communication					1	K2AIR_K01	15	60	2		1	T	Z	O		P(1)	KO
	Total		**1**	**0**	**0**	**0**	**2**		**45**	**150**	**5**	**0**	**2.8**						

Optional courses / groups of courses **(20 hours in semester, 25 ECTS points)**

No.	Course/group of courses code	Name of course/group of courses (group of courses – GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	Total	DN⁵ classes	BU¹ classes	Form² of course/group of courses	Way³ of crediting	University-wide⁴	concern with scient. activity⁵	Practical⁶	Type⁷
1	W12AIR-SM0719D	Master thesis				10		K2AIR_U16	150	450	15	15	2	T	Z		DN	P(10)	S
2	W12AIR-SM0718S	Diploma Seminar					2	K2AIR_U02	30	90	3	3	1.5	T	Z		DN	P(3)	S
3	W12AIR-SM0715L	Social Robots			1			K2AIR_U08	15	30	1	1	0.7	T	Z		DN	P(1)	S
4	W12AIR-SM0715W	Social Robots	1					K2AIR_W08	15	30	1	1	0.5	T/Z	Z		DN		S
5	W12AIR-SM0714S	Task and Motion Planning					1	K2AIR_U09	15	30	1	1	0.7	T	Z		DN	P(1)	S
6	W12AIR-SM0714W	Task and Motion Planning	2					K2AIR_W09	30	60	2	2	1.5	T/Z	Z		DN		S
7	W12AIR-SM0717W	Advanced Robot Control	1					K2AIR_W09, K2AIR_W10	15	30	1	1	0.5	T/Z	Z		DN		S
8	W12AIR-SM0717L	Advanced Robot Control			1			K2AIR_U06	15	30	1	1	1	T	Z		DN	P(1)	S
	Total		**4**	**0**	**2**	**10**	**3**		**285**	**750**	**25**	**25**	**8.4**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
5	**0**	**2**	**10**	**5**	**330**	**900**	**30**	**25**	**11.2**

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2   Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
W12AIR-SM0722	Intelligent virtualization of systems and process automation	1
W12AIR-SM0723	Control Theory	1
W12AIR-SM0726W	Mobile robotics	2
W12AIR-SM0724W	Robotic Programming Environments	2

3   Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester
1	8
2	8

Opinion of student government legislative body:

....
Date

....
Name and surname, signature of student representative

....
Date

....
Dean's signature

DIPLOMA EXAM TOPICS
in effect since 2022/2023

Main field of study: Control Engineering and Robotics
Specialization: Robotics (ARR)
Education level: second-level studies
Form of studies: full-time studies

Main field of studies topics: Zagadnienia kierunkowe:

1. Komputerowe modelowanie wielkości losowych.
2. Podejście parametryczne i nieparametryczne w identyfikacji systemów.
3. Zadania i metody optymalizacji nieliniowej.
4. Optymalizacja globalna – cele i metody (techniki) optymalizacji.
5. Sztuczne sieci neuronowe: rodzaje, architektury, strategie uczenia, zastosowania.
6. Koncepcja wirtualizacji systemów technicznych oraz oraz jej rola w automatyzacji procesów.
7. Stabilność w układach nieliniowych i metody jej analizy.
8. Zadania i algorytmy sterowania układów nieliniowych.

Specialization topics (ARR):

1. Zagadnienia sterowania odpornego i adaptacyjnego: problem, fundamentalne modele i twierdzenia, wybrane algorytmy sterowania.
2. Zagadnienia projektowe robota społecznego.
3. Algorytmy sterowania robotów manipulacyjnych w zależności od stopnia znajomości dynamiki obiektu.
4. Formalizmy modelowania systemów zdarzeniowych.
5. Ograniczenia holonomiczne, nieholonomiczne I i II rzędu: charakterystyka, własności, przykłady.
6. Przeszukiwanie z wykorzystaniem heurystyk.
7. Probabilistyczna reprezentacja wiedzy i związane z nią metody podejmowania decyzji.
8. Indukcyjne metody maszynowego uczenia się.
9. Robotyczne środowiska programistyczne dedykowane systemom rozproszonym.
10. Planowanie ruchu robotów manipulacyjnych i mobilnych: zadania i metody.
11. Metody budowania map i lokalizacji robotów mobilnych.
12. Automatyczny system rozpoznawania sceny robota: zadania, narzędzia.

DIPLOMA EXAM TOPICS
in effect since 2022/2023

Main field of study: Control Engineering and Robotics
Specialization: Electronic Control Systems (AEU)
Education level: second-level studies
Form of studies: full-time studies

Main field of studies topics:

Zagadnienia kierunkowe:

1. Komputerowe modelowanie wielkości losowych.
2. Podejście parametryczne i nieparametryczne w identyfikacji systemów.
3. Zadania i metody optymalizacji nieliniowej.
4. Optymalizacja globalna – cele i metody (techniki) optymalizacji.
5. Sztuczne sieci neuronowe: rodzaje, architektury, strategie uczenia, zastosowania.
6. Koncepcja wirtualizacji systemów technicznych oraz oraz jej rola w automatyzacji procesów.
7. Stabilność w układach nieliniowych i metody jej analizy.
8. Zadania i algorytmy sterowania układów nieliniowych.

Specialization topics (AEU):

1. Wymień i scharakteryzuj podstawowe elementy elektroniczne automatyki przemysłowej (podstawowe własności, zastosowania).
2. Metody dekompozycji tensora – modele, algorytmy i zastosowania.
3. Czujniki temperatury - rodzaje, konstrukcja, właściwości.
4. Omów główne rodzaje peryferiów mikrokontrolerów jednoukładowych.
5. Źródła światła koherentnego i niekoherentnego, klasyfikacja, detektory światła.
6. Urządzenia i algorytmy robotyki - percepcja, sterowanie, nawigacja.
7. Metahuerystyki w problemach automatyki i robotyki.
8. Wymień i opisz zasadę działania podstawowych elementów półprzewodnikowych mocy. Podaj ich podstawowe zastosowania.
9. Omów trzy mechanizmy synchronizacji i wymiany danych pomiędzy wątkami stosowane w systemach operacyjnych czasu rzeczywistego.
10. Omów i scharakteryzuj interfejsy komunikacyjne wykorzystywane w środowisku przemysłowym.
11. Sterowniki programowalne – budowa, parametry, możliwości.
12. Wzmacniacze operacyjne w układach wejściowych elementów automatyki przemysłowej (podstawowe parametry, konfiguracje, realizowane operacje na sygnałach wejściowych, zastosowanie).

DIPLOMA EXAM TOPICS
in effect since 2022/2023

Main field of study: Control Engineering and Robotics
Specialization : Embedded Robotics (AER)
Education level: second-level studies
Form of studies: full-time studies

Main field of studies topics:

1. Computer modeling of random variables.
2. Parametric and non-parametric approach to system identification.
3. Goals, tasks and methods of optimization.
4. Use of modal logic (LTL) and Büchy automata in automatic verification.
5. Artificial neural networks: types, architectures, learning strategies, applications.
6. The concept of technical systems virtualization and its role in process automation.
7. Stability in nonlinear systems and methods of its analysis.
8. Control objectives and algorithms for nonlinear systems.

Specialization topics (AER):

1. Robotic programing frameworks - distributed system design.
2. Formalisms for modeling Discrete Event Systems.
3. Programming environments, debugging tools and techniques used for embedded systems.
4. Describe microcontroller peripherals useful in embedded systems for robots.
5. Methods for mobile robot localization and mapping.
6. Motion planning for holonomic systems: task formulation, methods.
7. Motion planning for nonholonomic systems: task formulation, methods.
8. Design issues unique to socially interactive robots.
9. Probabilistic knowledge representation and methods for making decisions.
10. Inductive machine learning algorithms.
11. Accelerometers and gyroscopes: types and principles of operation.
12. Robustness of adaptive control systems, deployment of formally described control strategies to embedded controllers through automatic code generation.