Curriculum

Field of study: Automatic Control and Robotics

Specialty: Cyber-physical systems

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General characteristics of the field of study

Basic information

Faculty name:	Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering
Field of study:	Automatic Control and Robotics
Specialty name:	Cyber-physical systems
Level:	Second-cycle (engineer) programme
Profile:	General academic
Form:	Full-time studies
ISCED classification:	
Number of ECTS credits necessary to complete studies at a given level:	90
Professional title awarded to graduates:	magister inżynier
Cycle start date:	2025/2026, summer semester
Duration of studies (number of semesters):	3

Field of science to which the field of study is assigned:

Field engineering and technical sciences

Discipline of science to which the field of study is assigned:

Discipline	Percentage	ECTS
Automation, electronic, electrical engineering and space technologies	100%	90

Relationship between the field of study and the development strategy and mission of the university

The aim of education at the second-cycle studies in the field of Automation and Robotics, specialization in Cyber-physical systems is the education of automation, which will find itself in the dynamically growing area of cyber-physical systems and industry 4.0. The subjects of the modules in the proposed course plan were selected to cover all the most important aspects of cyber-physical systems, in which the physical world, computing technology, control methods and information transmission technologies are intertwined. The content of the specialty covers systems with a high degree of integration both at a low level (embedded systems, Internet of Things) as well as high (process automation, data management). An important part of the program are also the issues of data analysis and machine learning as well as optimization and computational methods which in combination with advanced, shaped by the student using the elective blocks, methods of control theory give him a set of tools for the implementation of automation tasks.

Information on taking into account the socio-economic demand while creating the curriculum and indication of the assumed learning outcomes matching the identified demand

The needs and expectations of the labor market are taken into account in the study program and in the content of individual modules. For the needs of cooperation with the industry and the economy, the Career Center was established in AGH. leads:
- monitoring the professional life of AGH UST graduates,
- exchange of information between the educational and industrial sector about the prospects of employing graduates,
- cooperation with individual faculties, units of the university.
- periodic presentation of reports elaborated to the University authorities and representatives of particular departments.

In addition, in the modernization of study programs, the opinions obtained as a result of direct contacts with graduates (graduate

students, PhD students) who often work in large international corporations (ABB, Aptiv, ASTOR, Comarch, Nokia, Xilinx, etc.) are taken into account.

Education paths – scope in Polish and in English

Graduation paths – scope in Polish and in English

The names of the majors in Polish and in English

Name [pl]	Name [en]
Cyber-physical systems	Cyber-physical systems

General information about the curriculum

Field of study: Automatic Control and Robotics
Specialty: Cyber-physical systems

General information related to the curriculum (general learning objectives and employment opportunities, typical jobs and opportunities for graduate continuing education)

The aim of education in the field of Automatic Control and Robotics is to provide a practical graduate engineering skills necessary in professional work, allowing for solving modern technological problems related to the field of automation and robotics. Graduates from Automation and Robotics will receive theoretical knowledge and practical skills allowing effective use of the latest techniques and technologies in the field of widely understood control, regulation and supervision systems. Employment opportunities of graduates are very broad. The basic ones are companies directly connected with automation and robotization of production, but also IT, electronic and R & D companies. Graduates have the opportunity to continue their scientific development as part of their third-cycle (doctoral) studies.

Information on including the conclusions from the students and graduates careers monitoring in the curriculum

The AGH Center has a Careers Center, leading, among others:
- monitoring the professional life of AGH UST graduates,
- exchange of information between the educational and industrial sector about the prospects of employing graduates,
- cooperation with individual departments, university units,
- periodic presentation of reports elaborated to the University authorities and representatives of particular departments.

Information on including the requirements and recommendations of the accreditation committees, in particular the Polish Accreditation Committee and industry accreditation committees in the curriculum

The results and recommendations of the accreditation commissions for the field of Automation and Robotics are analyzed and implemented in the curricula and contents of the modules.

Information on including examples of good practice in the curriculum

The Education Quality Assurance System operates in the EAIiIB department, which ensures that examples of good practices are included in the study program. The Faculty Education Quality Assurance System includes both the decision-making aspect (Faculty Council, Dean, Vice-deans) as well as the didactic system monitoring implemented by the Vice-Dean for Education (among others: didactic supervision, surveys, and hospitations) and the Education Quality Team and the Audit Team didactic. The decision-making structure is in line with the Statute and the Regulations of the AGH University of Science and Technology and the quality policy of education at AGH. The body that applies to the Ministry of Science and Higher Education for permission to create and run a course, and approves the directional effects of education is the University Senate after consulting the Senate Education and Student Affairs Committee and the Rector's Plenipotentiary for Education Quality. These activities are undertaken at the request of the Faculty Council, after being approved by the Faculty Committee for Education Quality, appointed for a term from among the members of the Faculty Council (from February 2013 - Faculty of Quality of Education (WZJK)), which is the Body's opinion and advisory body in the field of didactics and quality of education and the Faculty Council of Students' Self-government. Study plans are elaborated and possibly modified by a commission appointed for this purpose for a given faculty under the guidance of Vice-Dean for Education, reviewed by WZJK and approved by way of resolution by the Faculty Council. The dean is responsible for the education process at the Faculty (eg commissioning classes to particular Departments), and at the level of Departments, their Managers (they appoint persons responsible for specific modules). Part of the duties related to the coordination of certain tasks, the dean assigns by means of proxies for Vice-deans, Plenipotentiaries for practitioners, or Proxy for Quality of Education, etc. Decisions on limits and recruitment conditions for particular majors, grades and forms of studies are taken by the Senate at the request of the Department, which takes, in this case, an appropriate resolution after the opinion of WZJK and Kolegium Dziekańskie. For the needs of the diploma process at the Faculty, the Diploma Commissions for 1st-degree studies were established. Their task is to give opinions on the topics of the diploma theses, which are then approved by the Deputy Dean responsible for the field of study. These commissions also carry out diploma examinations. The deanship is responsible for the diploma thesis at the second level of studies. The themes of MA theses are reviewed by WZJK, and approved by the Deputy Dean, he also chairs the Commission conducting the diploma examination.

Information on cooperation in the preparation of the curriculum with external stakeholders, in particular associations, professional and social organizations

The needs and expectations of employers are monitored systematically (eg research of the Career Center
AGH), talks are conducted with employers and students regarding the education program in various forms of education. Negotiations are also conducted among employers in terms of job prospects and forecasts, knowledge and skills expected from the candidate (to increase the employability of the graduate in the company).

Duration, rules and form of the practical placement

Admission criteria, rules and policies

Field of study: Automatic Control and Robotics
Specialty: Cyber-physical systems

Description of competences expected from the candidate applying for admission to studies

The condition for admission to second-cycle studies is to have first-level qualifications and the competencies necessary to continue education at the second-cycle studies.

Recruitment conditions, including the winners and finalists of the central level high school scientific Olympics, as well as winners of international and national contests

Recruitment is conducted in accordance with the annual resolution of the AGH Senate, which specifies the conditions and procedures for admission to the first year of second-cycle studies in a given academic year.

The expected limit of admissions to studies along with an indication of the minimum number of admitted candidates required to successfully launch a study cycle

Minimum number of students: 10

Maximum number of students: 15

Learning outcomes

Field of study: Automatic Control and Robotics
Specialty: Cyber-physical systems

Knowledge

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
AiR2A_W01	ma podbudowaną teoretycznie wiedzę w zakresie zaawansowanych algorytmów i metod sterowania oraz analizy różnych typów układów dynamicznych	P7S_WG_A
AiR2A_W02	ma pogłębioną wiedzę w zakresie zaawansowanych systemów i platform do analizy, prototypowania i projektowania systemów automatyki i robotyki.	P7S_WG_A
AiR2A_W03	ma uporządkowaną wiedze w zakresie zaawansowanych rozwiązań algorytmyczne do szeroko rozumianego przetwarzania sygnałów (w tym wizyjnych) stosowane w systemach automatyki i robotyki, m.in. z zastosowaniem metod sztucznej inteligencji.	P7S_WG_A
AiR2A_W04	ma wiedze o podstawowych procesach zachodzące w cyklu życia urządzeń, obiektów i systemów technicznych w zakresie Automatyki i Robotyki	P7S_WG_A_Inz
AiR2A_W05	ma uporządkowaną wiedzę na temat fundamentalnych dylematów współczesnej cywilizacji; podstawowych ekonomicznych, prawnych, etycznych i innych uwarunkowań różnych rodzajów działalności zawodowej związanej z kierunkiem studiów, w tym podstawowych pojęć i zasad z zakresu ochrony własności przemysłowej i prawa autorskiego; podstawowych zasad tworzenia i rozwoju różnych form przedsiębiorczości, w tym indywidualnej	P7S_WK_A, P7S_WK_A_Inz

Skills

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
AiR2A_U01	dla złożonego i nietypowego problemu z zakresu szeroko rozumianej automatyki i robotyki (w tym automatyzacji procesów), w warunkach nie w pełni przewidywalnych, zaproponować jego rozwiązanie, w szczególności: - umiejętnie i krytycznie dobrać i przeanalizować źródła informacji (literatura fachowa oraz naukowa, ale też otwarte repozytoria kodu i inne zasoby dostępnie w Internecie), - zaproponować sposób (metodę) rozwiązania rozważanego problemu, - dobrać i odpowiednio przystosować niezbędne narzędzia - programowe oraz sprzętowe, - w uzasadnionych przypadkach opracować nowe metody oraz narzędzia (np. algorytmy, rozwiązania sprzętowe), - zaproponować i zastosować metodę ewaluacji rozwiązania, - podsumować pracę w postaci raportu oraz ew. dokumnetacji.	P7S_UW_A
AiR2A_U02	formułować i testować hipotezy związane z prostymi problemami badawczymi z obszaru automatyki i robotyki	P7S_UW_A
AiR2A_U03	komunikować się na tematy specjalistyczne z obszaru automatyki i robotyki ze zróżnicowanymi kręgami odbiorców; prowadzić debatę; posługiwać się językiem obcym na poziomie B2+ Europejskiego Systemu Opisu Kształcenia Językowego oraz specjalistyczną terminologią z obszaru automatyki i robotyki	P7S_UK_A
AiR2A_U04	kierować pracą zespołu; współdziałać z innymi osobami w ramach prac zespołowych i podejmować wiodącą rolę w zespołach	P7S_UO_A
AiR2A_U05	samodzielnie planować i realizować własne uczenie się przez całe życie i ukierunkowywać innych w tym zakresie	P7S_UU_A
AiR2A_U06	planować i przeprowadzać eksperymenty, w tym pomiary i symulacje komputerowe, interpretować uzyskane wyniki i wyciągać wnioski; przy identyfikacji i formułowaniu specyfikacji zadań inżynierskich z obszaru automatyki i robotyki oraz ich rozwiązywaniu: - wykorzystywać metody analityczne, symulacyjne i eksperymentalne, - dostrzegać ich aspekty systemowe i pozatechniczne, w tym aspekty etyczne, - dokonywać wstępnej oceny ekonomicznej proponowanych rozwiązań i podejmowanych działań inżynierskich; dokonywać krytycznej analizy sposobu funkcjonowania istniejących rozwiązań technicznych i oceniać te rozwiązania	P7S_UW_A_Inz_01

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
AiR2A_U07	projektować – zgodnie z zadaną specyfikacją – oraz wykonywać typowe w zakresie automatyki i robotyki proste urządzenia, obiekty, systemy lub realizować procesy, używając odpowiednio dobranych metod, technik, narzędzi i materiałów	P7S_UW_A_Inz_02

Social competence

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
AiR2A_K01	krytycznej oceny posiadanej wiedzy i odbieranych treści; uznawania znaczenia wiedzy w rozwiązywaniu problemów poznawczych i praktycznych oraz zasięgania opinii ekspertów w przypadku trudności z samodzielnym rozwiązaniem problemu	P7S_KK_A
AiR2A_K02	wypełniania zobowiązań społecznych, inspirowania i organizowania działalności na rzecz środowiska społecznego; inicjowania działań na rzecz interesu publicznego; myślenia i działania w sposób przedsiębiorczy	P7S_KO_A
AiR2A_K03	odpowiedzialnego pełnienia ról zawodowych, z uwzględnieniem zmieniających się potrzeb społecznych, w tym: - rozwijania dorobku zawodu, - podtrzymywania etosu zawodu, - przestrzegania i rozwijania zasad etyki zawodowej oraz działania na rzecz przestrzegania tych zasad	P7S_KR_A

Compliance table of engineering competence (Inz) with directional learning outcomes (KEU)

Major: Automatic Control and Robotics
Major: Cyber-physical systems

Knowledge

CEU symbol	Learning outcomes for qualifications including engineering competence	KEU references
P7S_WG_A_Inz	knowledge of basic processes taking place in the life cycle of technical devices, facilities and systems	AiR2A_W04
P7S_WK_A_Inz	knowledge of basic principles of creating and developing various forms of individual entrepreneurship	AiR2A_W05

Skills

CEU symbol	Learning outcomes for qualifications including engineering competence	KEU references
P7S_UW_A_Inz_01	ability to plan and carry out experiments, including measurements and computer simulations as well as to interpret the obtained results and draw conclusions out of them. When identifying and formulating the specification of engineering problems and solving them, being able to: - use analytical, simulation and experimental methods; - recognize their systemic and non-technical aspects, including ethical connotations; - conduct a preliminary economic assessment of the proposed solutions and planned engineering activities; - perform a critical analysis of the functioning of existing technical solutions to further evaluate them;	AiR2A_U06
P7S_UW_A_Inz_02	ability to design solutions in compliance with the given specification as well as being able to: create simple devices, facilities and systems typical for the study major or implement processes using skillfully chosen methods, techniques, tools and materials	AiR2A_U07

Field of study-prescribed outcomes coverage matrix

Field of study: Automatic Control and Robotics
Specialty: Cyber-physical systems

2025/2026/S/IIi/EAIiIB/AiR/CS

Course	Code	Semestr	AiR2A_W01	AiR2A_W02	AiR2A_W03	AiR2A_W04	AiR2A_W05	AiR2A_U01	AiR2A_U02	AiR2A_U03	AiR2A_U04	AiR2A_U05	AiR2A_U06	AiR2A_U07	AiR2A_K01	AiR2A_K02	AiR2A_K03
Data Analytics	EAiRCSS.IIi1O.07594.25	1s			x			x	x	x	x		x	x		x	
Advanced Vision Systems	EAiRCSS.IIi1S.12632.25	1s	x					x							x		
Advanced Databases	EAiRCSS.IIi1O.02933.25	1s			x			x						x	x		
Security of Cyber-Physical Systems	EAiRCSS.IIi1O.07592.25	1s		x	x			x							x	x	
Modelling and Simulation of Cyber-Physical Systems	EAiRCSS.IIi1O.07591.25	1s	x	x				x		x	x		x		x		
Digital Control	EAiRCSS.IIi1O.07595.25	1s	x		x			x					x		x		
Dynamic Vision Sensors	EAiRCSS.IIi1S.18804.25	1s	x	x	x			x							x	x	
Multicriteria Optimization and Reinforcement Learning	EAiRCSS.IIi2O.18772.25	2s	x		x								x				
Embedded Artificial Intelligence	EAiRCSS.IIi2O.14698.25	2s		x	x	x		x		x	x	x	x		x		x
German B2+ course - compulsory course for students of SECOND-CYCLE STUDIES at the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering AND the Faculty of Computer Science, Electronics and Telecommunications	EAiRCSS.IIi2O.02226.25	2s								x							
Elective Humanistic Course	EAiRCSS.IIi2O.05796.25	2s															
Capstone project I	EAiRCSS.IIi2O.07597.25	2s	x	x	x			x	x	x	x		x		x		x
Networked Control Systems	EAiRCSS.IIi2O.07593.25	2s	x					x					x	x			
Russian B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	EAiRCSS.IIi2O.02214.25	2s								x							
Adaptive and Predictive Control	EAiRCSS.IIi2O.07628.25	2s	x					x		x	x		x				

Course	Code	Semestr	AiR2A_W01	AiR2A_W02	AiR2A_W03	AiR2A_W04	AiR2A_W05	AiR2A_U01	AiR2A_U02	AiR2A_U03	AiR2A_U04	AiR2A_U05	AiR2A_U06	AiR2A_U07	AiR2A_K01	AiR2A_K02	AiR2A_K03
Język angielski B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów WEAIiIB-IT	EAiRCSS.IIi2O.02207.25	2s								x							
Smart Building Technologies: Advanced Control, IoT and Energy Management	EAiRCSS.IIi2O.18746.25	2s	x	x	x	x		x	x	x			x	x	x	x	x
Advanced Machine Learning and Text Analysis	EAiRCSS.IIi2O.18745.25	2s		x	x		x	x	x				x	x	x	x	x
French B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	EAiRCSS.IIi2O.05758.25	2s								x							
Internet of Things and Wireless Sensor Networks	EAiRCSS.IIi2O.07600.25	2s	x	x	x	x		x						x	x	x	
Spanish B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	EAiRCSS.IIi2O.04742.25	2s								x							
Autonomous Systems	EAiRCSS.IIi4O.08514.25	3s			x			x							x		
Cyber-Physical Systems for Power Processing and Smart Grids	EAiRCSS.IIi4O.07633.25	3s	x					x						x			
FPGA-Based Embedded Processor Design	EAiRCSS.IIi4O.18761.25	3s		x				x							x	x	
Programming of PLC-s	EAiRCSS.IIi4O.03944.25	3s		x	x			x						x		x	
Unconventional robotics	EAiRCSS.IIi4O.08720.25	3s	x	x				x							x		
Diploma Seminar	EAiRCSS.IIi4O.01432.25	3s				x		x		x						x	x
Vision systems in robotics	EAiRCSS.IIi4O.03079.25	3s	x	x	x	x		x					x		x		
Student Science Club	EAiRCSS.IIi4O.09010.25	3s	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Diploma Thesis	EAiRCSS.IIi4O.01412.25	3s	x	x	x	x	x	x		x	x	x	x	x		x	
Specialised sources of information	EAiRCSS.IIi4O.09009.25	3s	x	x	x			x							x		
Capstone project II	EAiRCSS.IIi4O.07624.25	3s	x	x	x			x		x	x		x		x		
Sum (obligatory):			9	10	12	4	2	15	3	7	6	2	8	5	12	7	4
Sum (elective):			8	6	6	3	1	10	2	8	2	1	6	5	6	4	2
Sum:			17	16	18	7	3	25	5	15	8	3	14	10	18	11	6

Characteristics matrix of learning outcomes in relation to modules

Major: Automatic Control and Robotics
Major: Cyber-physical systems

2025/2026/S/IIi/EAIiIB/AiR/CS

Course	Code	Semestr	P7S_WG_A	P7S_WG_A_Inz	P7S_WK_A	P7S_WK_A_Inz	P7S_UW_A	P7S_UK_A	P7S_UO_A	P7S_UU_A	P7S_UW_A_Inz_01	P7S_UW_A_Inz_02	P7S_KK_A	P7S_KO_A	P7S_KR_A
Data Analytics	EAiRCSS.IIi1O.07594.25	1s	x				x	x	x		x	x		x	
Advanced Vision Systems	EAiRCSS.IIi1S.12632.25	1s	x				x						x		
Advanced Databases	EAiRCSS.IIi1O.02933.25	1s	x				x					x	x		
Security of Cyber-Physical Systems	EAiRCSS.IIi1O.07592.25	1s	x				x						x	x	
Modelling and Simulation of Cyber-Physical Systems	EAiRCSS.IIi1O.07591.25	1s	x				x	x	x		x		x		
Digital Control	EAiRCSS.IIi1O.07595.25	1s	x				x				x		x		
Dynamic Vision Sensors	EAiRCSS.IIi1S.18804.25	1s	x				x						x	x	
Multicriteria Optimization and Reinforcement Learning	EAiRCSS.IIi2O.18772.25	2s	x								x				
Embedded Artificial Intelligence	EAiRCSS.IIi2O.14698.25	2s	x	x			x	x	x	x	x		x		x
German B2+ course - compulsory course for students of SECOND-CYCLE STUDIES at the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering AND the Faculty of Computer Science, Electronics and Telecommunications	EAiRCSS.IIi2O.02226.25	2s						x							
Elective Humanistic Course	EAiRCSS.IIi2O.05796.25	2s													
Capstone project I	EAiRCSS.IIi2O.07597.25	2s	x				x	x	x		x		x		x
Networked Control Systems	EAiRCSS.IIi2O.07593.25	2s	x				x				x	x			

Course	Code	Semestr	P7S_WG_A	P7S_WG_A_Inz	P7S_WK_A	P7S_WK_A_Inz	P7S_UW_A	P7S_UK_A	P7S_UO_A	P7S_UU_A	P7S_UW_A_Inz_01	P7S_UW_A_Inz_02	P7S_KK_A	P7S_KO_A	P7S_KR_A
Russian B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	EAiRCSS.IIi2O.02214.25	2s						x							
Adaptive and Predictive Control	EAiRCSS.IIi2O.07628.25	2s	x				x	x	x		x				
Język angielski B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów WEAiiIB-IT	EAiRCSS.IIi2O.02207.25	2s						x							
Smart Building Technologies: Advanced Control, IoT and Energy Management	EAiRCSS.IIi2O.18746.25	2s	x	x			x	x			x	x	x	x	x
Advanced Machine Learning and Text Analysis	EAiRCSS.IIi2O.18745.25	2s	x		x	x	x				x	x	x	x	x
French B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	EAiRCSS.IIi2O.05758.25	2s						x							
Internet of Things and Wireless Sensor Networks	EAiRCSS.IIi2O.07600.25	2s	x	x			x					x	x	x	
Spanish B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	EAiRCSS.IIi2O.04742.25	2s						x							
Autonomous Systems	EAiRCSS.IIi4O.08514.25	3s	x				x						x		
Cyber-Physical Systems for Power Processing and Smart Grids	EAiRCSS.IIi4O.07633.25	3s	x				x					x			
FPGA-Based Embedded Processor Design	EAiRCSS.IIi4O.18761.25	3s	x				x						x	x	
Programming of PLC-s	EAiRCSS.IIi4O.03944.25	3s	x				x					x		x	
Unconventional robotics	EAiRCSS.IIi4O.08720.25	3s	x				x						x		
Diploma Seminar	EAiRCSS.IIi4O.01432.25	3s		x			x	x						x	x
Vision systems in robotics	EAiRCSS.IIi4O.03079.25	3s	x	x			x				x		x		
Student Science Club	EAiRCSS.IIi4O.09010.25	3s	x	x	x	x	x	x	x	x	x	x	x	x	x
Diploma Thesis	EAiRCSS.IIi4O.01412.25	3s	x	x	x	x	x	x	x	x	x	x		x	
Specialised sources of information	EAiRCSS.IIi4O.09009.25	3s	x				x						x		

Course	Code	Semestr	P7S_WG_A	P7S_WG_A_Inz	P7S_WK_A	P7S_WK_A_Inz	P7S_UW_A	P7S_UK_A	P7S_UO_A	P7S_UU_A	P7S_UW_A_Inz_01	P7S_UW_A_Inz_02	P7S_KK_A	P7S_KO_A	P7S_KR_A
Capstone project II	EAiRCSS.IIi4O.07624.25	3s	x				x	x	x		x		x		
Sum (obligatory):			14	4	2	2	15	7	6	2	8	5	12	7	4
Sum (elective):			11	3	1	1	10	8	2	1	6	5	6	4	2
Sum:			25	7	3	3	25	15	8	3	14	10	18	11	6

Matrix of learning outcomes prescribed to a field of study with related forms of classes and the method of testing

Major: Automatic Control and Robotics
Major: Cyber-physical systems

2025/2026/S/IIi/EAIiIB/AiR/CS

Name of the module	Activity	Method of verification and assessment of learning outcomes achieved by the student in individual forms of classes and activities for the entire module	KEU references
Data Analytics	Lectures, Laboratory classes, Project classes	Execution of laboratory classes, Examination, Completion of laboratory classes, Execution of laboratory classes, Examination, Completion of laboratory classes, Execution of a project	AiR2A_W03, AiR2A_U01, AiR2A_U02, AiR2A_U03, AiR2A_U04, AiR2A_U06, AiR2A_U07, AiR2A_K02
Advanced Vision Systems	Lectures, Laboratory classes, Project classes	Examination, Execution of laboratory classes, Execution of a project	AiR2A_W01, AiR2A_U01, AiR2A_K01
Advanced Databases	Lectures, Laboratory classes	Execution of exercises, Execution of exercises, Case study, Completion of laboratory classes	AiR2A_W03, AiR2A_U01, AiR2A_U07, AiR2A_K01
Security of Cyber-Physical Systems	Lectures, Project classes	Activity during classes, Execution of a project, Case study, Activity during classes, Execution of a project, Test, Case study	AiR2A_W02, AiR2A_W03, AiR2A_U01, AiR2A_K01, AiR2A_K02
Modelling and Simulation of Cyber-Physical Systems	Lectures, Laboratory classes, Project classes	Activity during classes, Participation in a discussion, Activity during classes, Participation in a discussion, Execution of exercises, Execution of laboratory classes, Test, Report, Involvement in teamwork, Presentation, Completion of laboratory classes, Participation in a discussion, Execution of a project, Project, Report, Engineering project, Presentation	AiR2A_W01, AiR2A_W02, AiR2A_U01, AiR2A_U04, AiR2A_U06, AiR2A_U03, AiR2A_K01
Digital Control	Lectures, Auditorium classes	Activity during classes, Test, Test results, Activity during classes, Test	AiR2A_W01, AiR2A_W03, AiR2A_U06, AiR2A_U01, AiR2A_K01
Dynamic Vision Sensors	Lectures, Laboratory classes, Project classes	Examination, Completion of laboratory classes, Execution of a project, Presentation	AiR2A_W02, AiR2A_W01, AiR2A_W03, AiR2A_U01, AiR2A_K01, AiR2A_K02
Multicriteria Optimization and Reinforcement Learning	Lectures, Laboratory classes	Activity during classes, Execution of laboratory classes, Test results, Activity during classes, Execution of laboratory classes, Test results	AiR2A_W01, AiR2A_U06, AiR2A_W03
Embedded Artificial Intelligence	Lectures, Laboratory classes, Project classes	Examination, Completion of laboratory classes, Execution of a project, Presentation	AiR2A_W03, AiR2A_W04, AiR2A_W02, AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06, AiR2A_K01, AiR2A_K03

Name of the module	Activity	Method of verification and assessment of learning outcomes achieved by the student in individual forms of classes and activities for the entire module	KEU references
German B2+ course - compulsory course for students of SECOND-CYCLE STUDIES at the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering AND the Faculty of Computer Science, Electronics and Telecommunications	Foreign language classes	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Report, Scientific paper, Test results, Essays written during classes, Presentation	AiR2A_U03
Elective Humanistic Course	Lectures		
Capstone project I	Laboratory classes	Activity during classes, Report, Completion of laboratory classes	AiR2A_W02, AiR2A_W01, AiR2A_W03, AiR2A_U01, AiR2A_U02, AiR2A_U06, AiR2A_U03, AiR2A_U04, AiR2A_K01, AiR2A_K03
Networked Control Systems	Lectures, Laboratory classes	Completion of laboratory classes, Activity during classes, Completion of laboratory classes	AiR2A_W01, AiR2A_U01, AiR2A_U07, AiR2A_U06
Russian B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	Foreign language classes	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Report, Scientific paper, Test results, Essays written during classes, Presentation	AiR2A_U03
Adaptive and Predictive Control	Lectures, Project classes	Execution of a project, Test results, Activity during classes, Execution of a project, Test results	AiR2A_W01, AiR2A_U06, AiR2A_U01, AiR2A_U03, AiR2A_U04
Język angielski B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów WEAIiIB-IT	Foreign language classes	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Report, Scientific paper, Test results, Essays written during classes, Presentation	AiR2A_U03
Smart Building Technologies: Advanced Control, IoT and Energy Management	Lectures, Project classes	Activity during classes, Participation in a discussion, Activity during classes, Execution of a project, Test	AiR2A_W03, AiR2A_W04, AiR2A_W02, AiR2A_W01, AiR2A_U01, AiR2A_U02, AiR2A_U06, AiR2A_U07, AiR2A_U03, AiR2A_K01, AiR2A_K03, AiR2A_K02
Advanced Machine Learning and Text Analysis	Lectures, Laboratory classes	Execution of laboratory classes, Examination, Execution of laboratory classes	AiR2A_W02, AiR2A_W03, AiR2A_W05, AiR2A_U01, AiR2A_U06, AiR2A_U07, AiR2A_U02, AiR2A_K01, AiR2A_K02, AiR2A_K03
French B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	Foreign language classes	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Report, Scientific paper, Test results, Essays written during classes, Presentation	AiR2A_U03

Name of the module	Activity	Method of verification and assessment of learning outcomes achieved by the student in individual forms of classes and activities for the entire module	KEU references
Internet of Things and Wireless Sensor Networks	Lectures, Laboratory classes	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Completion of laboratory classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork	AiR2A_W03, AiR2A_W02, AiR2A_W01, AiR2A_W04, AiR2A_U07, AiR2A_U01, AiR2A_K01, AiR2A_K02
Spanish B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	Foreign language classes	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Report, Scientific paper, Test results, Essays written during classes, Presentation	AiR2A_U03
Autonomous Systems	Lectures, Laboratory classes	Activity during classes, Test results, Presentation, Test, Completion of laboratory classes	AiR2A_W03, AiR2A_U01, AiR2A_K01
Cyber-Physical Systems for Power Processing and Smart Grids	Lectures, Project classes	Activity during classes, Test, Activity during classes, Test	AiR2A_W01, AiR2A_U07, AiR2A_U01
FPGA-Based Embedded Processor Design	Laboratory classes	Execution of laboratory classes, Completion of laboratory classes	AiR2A_W02, AiR2A_U01, AiR2A_K01, AiR2A_K02
Programming of PLC-s	Lectures, Laboratory classes	Test, Test	AiR2A_W02, AiR2A_W03, AiR2A_U01, AiR2A_U07, AiR2A_K02
Unconventional robotics	Lectures, Laboratory classes	Activity during classes, Participation in a discussion, Presentation, Oral answer, Execution of laboratory classes, Report, Case study, Presentation, Preparation and conduct of scientific research	AiR2A_W02, AiR2A_W01, AiR2A_U01, AiR2A_K01
Diploma Seminar	Seminars	Presentation	AiR2A_W04, AiR2A_U01, AiR2A_U03, AiR2A_K02, AiR2A_K03
Vision systems in robotics	Lectures, Project classes	Project, Test results, Project, Test results	AiR2A_W03, AiR2A_W02, AiR2A_W04, AiR2A_W01, AiR2A_U01, AiR2A_U06, AiR2A_K01
Student Science Club	Participation in a student research club	Participation in a discussion, Project, Report, Scientific paper, Involvement in teamwork, Presentation	AiR2A_W01, AiR2A_W02, AiR2A_W03, AiR2A_W04, AiR2A_W05, AiR2A_U01, AiR2A_U02, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06, AiR2A_U07, AiR2A_K01, AiR2A_K02, AiR2A_K03
Diploma Thesis	Diploma Thesis	Diploma thesis preparation	AiR2A_W01, AiR2A_W02, AiR2A_W03, AiR2A_W04, AiR2A_W05, AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06, AiR2A_U07, AiR2A_K02

Name of the module	Activity	Method of verification and assessment of learning outcomes achieved by the student in individual forms of classes and activities for the entire module	KEU references
Specialised sources of information	Discussion seminars	Activity during classes, Execution of exercises	AiR2A_W01, AiR2A_W02, AiR2A_W03, AiR2A_U01, AiR2A_K01
Capstone project II	Laboratory classes	Activity during classes, Report, Completion of laboratory classes	AiR2A_W01, AiR2A_W03, AiR2A_W02, AiR2A_U01, AiR2A_U06, AiR2A_U04, AiR2A_U03, AiR2A_K01

Study plans

Field of study: Automatic Control and Robotics

Semester 1

Major: Cyber-physical systems

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Data Analytics	Lectures: 28 Laboratory classes: 18 Project classes: 10	5	Exam	Obligatory
Advanced Vision Systems	Lectures: 14 Laboratory classes: 28 Project classes: 28	5	Exam	Obligatory
Advanced Databases	Lectures: 28 Laboratory classes: 28	4	Completing the classes	Obligatory
Security of Cyber-Physical Systems	Lectures: 28 Project classes: 28	3	Completing the classes	Obligatory
Modelling and Simulation of Cyber-Physical Systems	Lectures: 28 Laboratory classes: 14 Project classes: 14	4	Completing the classes	Obligatory
Digital Control	Lectures: 28 Auditorium classes: 28	4	Completing the classes	Obligatory
Dynamic Vision Sensors	Lectures: 14 Laboratory classes: 28 Project classes: 28	5	Completing the classes	Obligatory
Sum	**420**	**30**		

Semester 2

Major: Cyber-physical systems

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Embedded Artificial Intelligence	Lectures: 14 Laboratory classes: 28 Project classes: 28	5	Exam	Obligatory
Capstone project I	Laboratory classes: 42	4	Completing the classes	Obligatory
Advanced Machine Learning and Text Analysis	Lectures: 28 Laboratory classes: 28	5	Exam	Obligatory
Internet of Things and Wireless Sensor Networks	Lectures: 28 Laboratory classes: 28	4	Completing the classes	Obligatory
Foreign Language		2	Exam	Obligatory
The rules for selecting groups/modules: Select one item from the offered modules.				
German B2+ course - compulsory course for students of SECOND-CYCLE STUDIES at the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering AND the Faculty of Computer Science, Electronics and Telecommunications	Foreign language classes: 30	2	Exam	Elective
Russian B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	Foreign language classes: 30	2	Exam	Elective
Język angielski B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów WEAIiIB-IT	Foreign language classes: 30	2	Exam	Elective
French B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	Foreign language classes: 30	2	Exam	Elective
Spanish B2+ course - compulsory course for students of SECOND-CYCLE STUDIES	Foreign language classes: 30	2	Exam	Elective
Humanities – Economics and Management		2	Completing the classes	Obligatory

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
The rules for selecting groups/modules: Select one item from the offered by the Humanistic Faculty modules.				
Elective Humanistic Course	Lectures: 28	2	Completing the classes	Elective
Elective Course 1		8	Completing the classes	Obligatory
The rules for selecting groups/modules: Select two items from the offered modules.				
Multicriteria Optimization and Reinforcement Learning	Lectures: 28 Laboratory classes: 28	4	Completing the classes	Elective
Networked Control Systems	Lectures: 28 Laboratory classes: 28	4	Completing the classes	Elective
Adaptive and Predictive Control	Lectures: 28 Project classes: 28	4	Completing the classes	Elective
Smart Building Technologies: Advanced Control, IoT and Energy Management	Lectures: 28 Project classes: 28	4	Completing the classes	Elective
Sum	**394**	**30**		

Semester 3

Major: Cyber-physical systems

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Diploma Seminar	Seminars: 14	1	Completing the classes	Obligatory
Diploma Thesis	Diploma Thesis: 0	20	Completing the classes	Obligatory
Specialised sources of information	Discussion seminars: 3	1	Completing the classes	Obligatory
Capstone project II	Laboratory classes: 42	3	Completing the classes	Obligatory
Humanities 2		2	Completing the classes	Obligatory
The rules for selecting groups/modules: Select one item from the offered by the Humanistic Faculty modules.				

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Przedmiot humanistyczny	Lectures: 28	2	Completing the classes	Elective
Elective Course 2		3	Completing the classes	Obligatory
The rules for selecting groups/modules: Select one item from the offered modules.				
Autonomous Systems	Lectures: 28 Laboratory classes: 14	3	Completing the classes	Elective
Cyber-Physical Systems for Power Processing and Smart Grids	Lectures: 14 Project classes: 28	3	Completing the classes	Elective
FPGA-Based Embedded Processor Design	Laboratory classes: 42	3	Completing the classes	Elective
Programming of PLC-s	Lectures: 14 Laboratory classes: 28	3	Completing the classes	Elective
Unconventional robotics	Lectures: 14 Laboratory classes: 28	3	Completing the classes	Elective
Vision systems in robotics	Lectures: 28 Project classes: 14	3	Completing the classes	Elective
Student Science Club	Participation in a student research club: 0	3	Completing the classes	Elective
Sum	**129**	**30**		

ECTS credits calculations

Field of study: Automatic Control and Robotics
Specialty: Cyber-physical systems

The total number of ECTS credits the student needs to obtain in the form of:

classes conducted with the direct participation of academic teachers or other persons conducting classes	90
core science classes relevant to a given major	nie dotyczy
practical classes, developing practical skills, including laboratory, design, practical and workshop classes	78
classes subject to choice by the student (in the amount of not less than 30% of the number of ECTS credits necessary to obtain qualifications corresponding to the level of education)	90
classes in the field of humanities or social sciences - in the case of fields of study assigned to disciplines within fields other than humanities or social sciences, respectively	5
foreign language classes	2
practical placements	nie dotyczy
classes related to the academic activity conducted at the University in the discipline or disciplines to which the field of study is assigned, in the amount greater than 50% of the number of ECTS credits required to complete studies at a given level, taking into account the participation of students in classes preparing to conduct scientific activity or participate in this activity (applies only to studies with a general academic profile)	83
classes shaping practical skills in the amount greater than 50% of the number of ECTS credits required to complete studies at a given level (applies only to studies with a practical profile)	nie dotyczy

Sylabusy

Data Analytics

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi1O.07594.25 **Lecture languages** English **Mandatoriness** Obligatory **Block** General Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 1	Exam **Activities and hours** Lectures: 28 Laboratory classes: 18 Project classes: 10	5

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student knows the most important methods of data analysis.	AiR2A_W03	Execution of a project, Examination
Skills – Student can:			
U1	Student is able to independently analyze data and carry out the inference process based on data analysis.	AiR2A_U01, AiR2A_U02, AiR2A_U03, AiR2A_U04, AiR2A_U06, AiR2A_U07	Execution of a project, Execution of laboratory classes, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Student is able to choose the method of analysis to the problem.	AiR2A_U01, AiR2A_U03	Execution of a project, Execution of laboratory classes, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Student has skills allowing presenting the results of analysis to a non profesional.	AiR2A_K02	Execution of laboratory classes, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	18
Project classes	10
Examination or final test/colloquium	2
Preparation for classes	36
Preparation of project, presentation, essay, report	30
Contact hours	5
Student workload	**Hours** 129
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, U1, U2	The course focuses on statistical methods of data analysis and inference with a special consideration of Bayesian methods.
Laboratory classes	W1, U1, U2, K1	
Project classes	W1, U1, U2, K1	

Advanced Vision Systems

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi1S.12632.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Major Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

USOS code
120-INT-xS-194

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 1	Exam **Activities and hours** Lectures: 14 Laboratory classes: 28 Project classes: 28	5

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Knows advanced image and video analysis algorithms.	AiR2A_W01	Examination
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Is able to select and apply appropriate methods of image processing and analysis.	AiR2A_U01	Execution of a project, Execution of laboratory classes
U2	Is able to implement advanced image and video analysis algorithms.	AiR2A_U01	Execution of a project, Execution of laboratory classes
Social competences – Student is ready to:			
K1	Is ready to creatively solve problems related to the design of vision systems. Can use vision systems in a wide range of industrial applications.	AiR2A_K01	Examination

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	14
Laboratory classes	28
Project classes	28
Realization of independently performed tasks	28
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	28
Contact hours	5
Student workload	**Hours** 133
Workload involving teacher	**Hours** 70

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Laboratory classes	U1, U2	During the course the most important advanced image/video processing and analysis algorithms will be presented: foreground object segmentation, optical flow, stereovision, RGB-D images, object detection on thermal images, HOG+SVM for pedestrian detection, feature point detection and matching, template matching, generalized Hough transform, Hausdorff metric, object tracking, visual odometry.
Lectures	W1, K1	
Project classes	U1, U2	

Advanced Databases

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi1O.02933.25 **Lecture languages** English **Mandatoriness** Obligatory **Block** General Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 1	Completing the classes **Activities and hours** Lectures: 28 Laboratory classes: 28	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Is familiar with security-oriented software assessment	AiR2A_W03	Execution of exercises
W2	Students know and understand principles of creating and management database systems	AiR2A_W03	Execution of exercises
Skills – Student can:			
U1	Students can program databases using SQL	AiR2A_U01	Execution of exercises, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Students can design and implement database schemas	AiR2A_U07	Execution of exercises, Completion of laboratory classes
U3	Student knows how to utilize existing tools and solutions to provide systems and applications protection	AiR2A_U01	Execution of exercises, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Students orient themselves to the available methods and utilities of database creation and protection. Student can use them efficiently.	AiR2A_K01	Case study, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	28
Preparation for classes	10
Realization of independently performed tasks	27
Preparation of project, presentation, essay, report	20
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 120
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2	The course is meant to familiarize students with an advanced database systems solution used in industrial. Students will learn how to design, implement data structure and query in relational databases.
Laboratory classes	W1, W2, U1, U2, U3, K1	

Security of Cyber-Physical Systems

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi1O.07592.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
No

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 1	Completing the classes **Activities and hours** Lectures: 28 Project classes: 28	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Student will gain a knowledge on the modern approaches to security management.	AiR2A_W02	Activity during classes, Execution of a project, Case study
W2	Student will gain a knowledge on the tools utilized within the security management process.	AiR2A_W03	Activity during classes, Execution of a project, Case study
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Student will be able to identify assets and the nature of potential threats.	AiR2A_U01	Activity during classes, Execution of a project, Case study
U2	Student will be able to conduct an in-depth analysis of the threat.	AiR2A_U01	Activity during classes, Execution of a project, Case study
U3	Student will be able to produce and to apply the risk mitigation strategy.	AiR2A_U01	Activity during classes, Execution of a project, Case study
U4	Student will be able to conduct a risk and vulnerabilities assessment.	AiR2A_U01	Activity during classes, Execution of a project, Case study
Social competences – Student is ready to:			
K1	Student will be able to plan his work on self-improvement.	AiR2A_K01	Activity during classes, Execution of a project, Case study
K2	Student will increase his confidence in relation to professional security knowledge.	AiR2A_K02	Activity during classes, Execution of a project, Case study
K3	Student will gain knowledge of what are the current security challenges and modern approaches to security management.	AiR2A_K01	Activity during classes, Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Project classes	28
Preparation for classes	8
Realization of independently performed tasks	8
Preparation of project, presentation, essay, report	10
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 89
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2	Students will gain a knowledge on the multidisciplinary nature of the security and modern approaches to the security management with consideration of cyber-physical systems.
Project classes	U1, U2, U3, U4, K1, K2, K3	

Modelling and Simulation of Cyber-Physical Systems

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi1O.07591.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 1	Completing the classes **Activities and hours** Lectures: 28 Laboratory classes: 14 Project classes: 14	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student knows and understands the principles of modeling dynamic systems	AiR2A_W01, AiR2A_W02	Activity during classes, Participation in a discussion, Test, Project, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	The student knows and understands the principles of designing digital twins	AiR2A_W01, AiR2A_U01, AiR2A_U04, AiR2A_U06	Activity during classes, Participation in a discussion, Test, Project, Completion of laboratory classes
Skills – Student can:			
U1	The student is able to develop a complete simulation model of the selected component/device with the control method	AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U06	Activity during classes, Test, Project, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Knows the essence and need of modeling and simulation studies of dynamical systems in contemporary reality, in particular in the context of industrial applications. Understands the need for a broad view of the dynamics of processes, control systems, measurement systems in the context of design, modeling and analysis in an integrated manner.	AiR2A_K01	Activity during classes, Participation in a discussion, Execution of exercises, Execution of a project, Execution of laboratory classes, Project, Report, Engineering project, Involvement in teamwork, Presentation, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	14
Project classes	14
Realization of independently performed tasks	15
Preparation of project, presentation, essay, report	42
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 120
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, U1, K1	The course presents an essence and a need of modeling and simulation studies of dynamical systems in contemporary reality, in particular in the context of industrial applications.
Laboratory classes	W1, W2, U1, K1	
Project classes	W1, W2, U1, K1	

Digital Control

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi1O.07595.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Nie

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 1	Completing the classes **Activities and hours** Lectures: 28 Auditorium classes: 28	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student understands differences between continuous-time and discrete-time models of dynamical systems and processes.	AiR2A_W01, AiR2A_W03	Activity during classes, Test results
W2	The student is able to analyse properties of discrete-time system models, like: stability, reachability, and observability.	AiR2A_W01, AiR2A_W03	Activity during classes, Test results
W3	The student knows various types of discrete-time controllers and is able to characterise their properties.	AiR2A_W01, AiR2A_W03	Activity during classes, Test results

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	The student is able to choose an appropriate controller for a given process model and tune its parameters.	AiR2A_W01, AiR2A_W03	Activity during classes, Test results
Skills – Student can:			
U1	The student can synthetize a discrete-time model of a given physical plant or process.	AiR2A_W01, AiR2A_U06	Activity during classes, Test
U2	The student is able to prepare and adapt discrete-time models and algorithms for implementation on various computational software and hardware platforms and for computer simulations.	AiR2A_U01, AiR2A_U06	Activity during classes, Test
U3	The student can effectively use various mathematical, simulational and computational tools to synthetize linear discrete-time controllers.	AiR2A_U01, AiR2A_U06	Activity during classes, Test
Social competences – Student is ready to:			
K1	The student appreciates the importance of theoretical knowledge and its usefulness and indispensability to solve complex technical and engineering problems.	AiR2A_K01	Activity during classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Auditorium classes	28
Preparation for classes	28
Realization of independently performed tasks	17
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 108
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module

Lectures	W1, W2, W3, W4, K1	The module addresses the following topics: • control theory of discrete-time dynamical systems • signal sampling, quantisation, and reconstruction • parametric and non-parametric mathematical models od linear time-inveriant discrete-time systems • fundamental properties of a dynamical system like stability, reachability, observability • various types of regulators, compensators, and control techniques • digital control systems design, synthesis, analysis, and implementation • observers and state reconstruction • plant model parameter estimation
Auditorium classes	U1, U2, U3, K1	

Dynamic Vision Sensors

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi1S.18804.25 **Lecture languages** English **Mandatoriness** Obligatory **Block** Major Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak **USOS code** 120-INT-xS-216

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 1	Completing the classes **Activities and hours** Lectures: 14 Laboratory classes: 28 Project classes: 28	5

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	construction, principle of operation, advantages and disadvantages of event cameras	AiR2A_W02	Examination
W2	applications in which event cameras can be used	AiR2A_W01	Examination
W3	basic ways of event data processing	AiR2A_W03	Examination

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	implement a simple system of event data analysis - loading, preparing an appropriate representation, detection/classification	AiR2A_U01	Execution of a project, Presentation, Completion of laboratory classes
U2	use AI methods: convolutional neural networks and impulse neural networks for event data analysis	AiR2A_U01	Execution of a project, Presentation, Completion of laboratory classes
U3	use event camera in selected applications	AiR2A_U01	Execution of a project, Presentation, Completion of laboratory classes
Social competences – Student is ready to:			
K1	use an event camera in a computer vision system. Is able to indicate the areas of application of these devices and their importance in the modern, data driven economy. Can effectively promote knowledge about event cameras Knows the advantages and disadvantages of this technology in comparison with classical cameras and other vision sensors.	AiR2A_K01, AiR2A_K02	Examination, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	14
Laboratory classes	28
Project classes	28
Preparation for classes	28
Preparation of project, presentation, essay, report	28
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 133
Workload involving teacher	**Hours** 70

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, W3, K1	The course will discuss the most important theoretical information related to event cameras (principle of operation, types of sensors, applications) and will show to practically use this technology in different vision systems.
Laboratory classes	U1, U2, U3	
Project classes	U1, U2, U3, K1	

Embedded Artificial Intelligence

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.14698.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Exam **Activities and hours** Lectures: 14 Laboratory classes: 28 Project classes: 28	5

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	the importance of embedded AI systems in modern science and economy.	AiR2A_W03, AiR2A_W04	Examination, Presentation
W2	basic architectures of deep neural networks, methods of their training and applications.	AiR2A_W03, AiR2A_W04	Examination, Presentation
W3	hardware platforms used for implementation of embedded artificial intelligence systems.	AiR2A_W02, AiR2A_W03	Examination, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	basic hardware accelerator architectures.	AiR2A_W03, AiR2A_W04	Examination, Presentation
W5	methods of reducing computational complexity - architecture modification, quantization and pruning.	AiR2A_W03, AiR2A_W04	Examination, Presentation
Skills – Student can:			
U1	run a selected deep network on an embedded device.	AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06	Execution of a project, Completion of laboratory classes
U2	optimise the number of arithmetic operations in a given neural network.	AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06	Execution of a project, Completion of laboratory classes
U3	select the network architecture, optimisation method and hardware platform to the specificity of the considered problem.	AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06	Execution of a project, Completion of laboratory classes
Social competences – Student is ready to:			
K1	chose an appropriate platform (with adequate computing performance, architecture suited to the task and energy efficiency) for an embedded AI systems. Can indicate the areas in which these systems are used and how significant they are for the modern economy. Can effectively promote knowledge about embedded AI systems. Know the advantages and disadvantages of particular embedded AI platforms.	AiR2A_K01, AiR2A_K03	Examination, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	14
Laboratory classes	28
Project classes	28
Preparation of project, presentation, essay, report	28
Realization of independently performed tasks	28
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 133
Workload involving teacher	**Hours** 70

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, W3, W4, W5, K1	The course will discuss the most important theoretical information related to embedded artificial intelligence systems (network architectures, computational platforms, optimization techniques) and will show practical methods and tools for their implementation on selected hardware platforms.
Laboratory classes	U1, U2, U3	
Project classes	U1, U2, U3, K1	

Capstone project I

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi2O.07597.25 **Lecture languages** English **Mandatoriness** Obligatory **Block** General Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Completing the classes **Activities and hours** Laboratory classes: 42	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student knows methods of integration of a control plant and a computer control system. Understands rules of and reasons for measurement signal conditioning and control signal amplification.	AiR2A_W02	Activity during classes, Report, Completion of laboratory classes
W2	The student knows various types of methematical models of control plants and methods for models transformation and simplification.	AiR2A_W01, AiR2A_W03	Activity during classes, Report, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	The student knows various control tasks and popular performance indices used for control system performance evaluation.	AiR2A_W01	Activity during classes, Report, Completion of laboratory classes
W4	The student knows methods of control system design and development, from initial familiarization with the plant to final real-world tests of the complete solution.	AiR2A_W01	Activity during classes, Report, Completion of laboratory classes
Skills – Student can:			
U1	The student can develop a phenomenological mathematical model of the plant and identify its parameters using results of specifically designed experiments.	AiR2A_U01, AiR2A_U02, AiR2A_U06	Activity during classes, Report, Completion of laboratory classes
U2	The student is able to choose a structure of a controller for a given plant and control task and to compute its parameters using numerical optimisation methods.	AiR2A_U01, AiR2A_U06	Activity during classes, Report, Completion of laboratory classes
U3	The student is able to prepare a final report describing in details a controller development process.	AiR2A_U01, AiR2A_U03	Activity during classes, Report, Completion of laboratory classes
U4	The student is able to work in a project team, efficiently manage time, assign tasks to team members, and coordinate the team work.	AiR2A_U04	Activity during classes, Report, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Recognizes the necessity of having specialist knowledge to solve complex engineering problems.	AiR2A_K01, AiR2A_K03	Activity during classes, Report, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Laboratory classes	42
Realization of independently performed tasks	30
Preparation of project, presentation, essay, report	30
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 109
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Laboratory classes	W1, W2, W3, W4, U1, U2, U3, U4, K1	In the course of laboratory exercises, students design and implement a digital controller for a selected control plant. This process includes modeling the plant, identifying model parameters, selecting the structure of a controller, controller tuning, implementing the control algorithm, conducting computer simulations and real-time real-world experiments. Computer tools for model-in-the-loop simulations and rapid controller prototyping are used. Model-based design techniques are employed.

Advanced Machine Learning and Text Analysis

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.18745.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Exam **Activities and hours** Lectures: 28 Laboratory classes: 28	5

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student has in-depth knowledge of advanced machine learning models and computational methods applicable to structured and unstructured data.	AiR2A_W02, AiR2A_W03	Execution of laboratory classes, Examination
W2	The student understands the theoretical foundations and practical implementations of modern natural language processing techniques, including large language models and attention-based architectures.	AiR2A_W02, AiR2A_W03	Execution of laboratory classes, Examination

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	The student is familiar with methods for evaluating model performance, interpretability, and reliability, including ethical and responsible AI principles.	AiR2A_W03, AiR2A_W05	Execution of laboratory classes, Examination
Skills – Student can:			
U1	The student is able to design, implement, and evaluate advanced ML models for tabular, time series, and text data using appropriate Python tools and libraries.	AiR2A_U01, AiR2A_U06, AiR2A_U07	Execution of laboratory classes, Examination
U2	The student can critically analyse and preprocess data, select suitable models, and apply interpretability techniques to assess model decisions.	AiR2A_U01, AiR2A_U02, AiR2A_U06, AiR2A_U07	Execution of laboratory classes, Examination
U3	The student is capable of interacting with pre-trained language models through prompt engineering and integrating them into structured tasks (e.g., summarisation, structured generation, retrieval-based workflows).	AiR2A_U01, AiR2A_U02, AiR2A_U06, AiR2A_U07	Execution of laboratory classes, Examination
Social competences – Student is ready to:			
K1	The student demonstrates responsibility in the application of machine learning techniques, recognising the ethical, social, and legal implications of automated decision-making systems.	AiR2A_K01, AiR2A_K02, AiR2A_K03	Execution of laboratory classes, Examination

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	28
Realization of independently performed tasks	48
Examination or final test/colloquium	2
Preparation for classes	28
Contact hours	5
Student workload	**Hours** 139
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to

the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, W3, U1, K1	The course content combines theoretical foundations and applied techniques in advanced machine learning and natural language processing, focusing on structured (tabular, time series) and unstructured (text) data. Through a progression from classical models to deep learning and large language models, the course equips students with the knowledge, skills, and ethical awareness necessary to build, analyse, and responsibly deploy modern AI systems.
Laboratory classes	W1, W2, W3, U1, U2, U3, K1	

Internet of Things and Wireless Sensor Networks

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi2O.07600.25 **Lecture languages** English **Mandatoriness** Obligatory **Block** General Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Completing the classes **Activities and hours** Lectures: 28 Laboratory classes: 28	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Student knows and understands basic security aspects of IoT technology.	AiR2A_W03	Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Completion of laboratory classes
W2	Student knows the wired and wireless standards for data exchange between devices of the IoT.	AiR2A_W02	Execution of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	Student knows and understands the application restrictions resulting from the use of low-bandwidth wireless communication and the battery powering of network nodes	AiR2A_W01, AiR2A_W04	Participation in a discussion, Execution of laboratory classes
Skills – Student can:			
U1	Student is able to design, run and test an electronic wireless sensors system based on BLE and ZigBee technologies.	AiR2A_U07	Execution of laboratory classes, Involvement in teamwork
U2	Student is able to configure small intelligent sensor and actuator nodes network to solve monitoring and control problems.	AiR2A_U01, AiR2A_U07	Participation in a discussion, Execution of laboratory classes, Involvement in teamwork
Social competences – Student is ready to:			
K1	Student is able to cooperate in a small group to solve a new practical tasks	AiR2A_K01	Execution of laboratory classes
K2	Student understands, can consciously assess and explain the positive and negative impact of the widespread use of the IoT on society.	AiR2A_K02	Activity during classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	28
Preparation for classes	18
Realization of independently performed tasks	28
Preparation of project, presentation, essay, report	10
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 119
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to

the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Laboratory classes	W3, U1, U2, K1	The module addresses issues related to wireless data exchange technologies that enable building Internet of Things network. Additionally applications of wireless sensors in control systems are shown.
Lectures	W1, W2, W3, U1, U2, K2	

German B2+ course - compulsory course for students of SECOND-CYCLE STUDIES at the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering AND the Faculty of Computer Science, Electronics and Telecommunications

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.02226.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
No

Course shaping practical skills
Nie

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Exam **Activities and hours** Foreign language classes: 30	2

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Rozumie dłuższe, nawet skomplikowane wypowiedzi pisemne i ustne np. teksty z literatury fachowej, wykłady i prezentacje, dotyczące studiowanego kierunku lub spraw bieżących, komunikaty i polecenia w środowisku pracy. Potrafi interpretować uzyskane wiadomości dostrzegając także znaczenia ukryte, wyrażone pośrednio.	AiR2A_U03	Activity during classes, Participation in a discussion, Test, Examination
U2	Potrafi przygotować różnorodne opracowania pisemne np. rozbudowany tekst informacyjny i argumentacyjny z zakresu studiowanego kierunku i specjalności, również przedstawiający wyniki własnych badań naukowych oraz formułować przejrzyste i rozbudowane wypowiedzi ustne, szczególnie z zakresu języka potrzebnego do funkcjonowania w środowisku akademickim, w trakcie praktyk zawodowych, procesu rekrutacji i w środowisku pracy.	AiR2A_U03	Execution of exercises, Examination, Report, Scientific paper, Essays written during classes
U3	Potrafi przygotować rozbudowaną prezentację ustną z zakresu studiowanego kierunku i specjalności oraz zainteresowań zawodowych. Potrafi płynnie i spontanicznie brać udział w dyskusjach, również w środowisku zawodowym budując przejrzyste złożone wypowiedzi opisujące zjawiska i wyrażające różne punkty widzenia.	AiR2A_U03	Activity during classes, Participation in a discussion, Presentation
U4	Potrafi prowadzić korespondencję typową dla środowiska zawodowego z użyciem języka branżowego. Potrafi korzystać samodzielnie z dostępnych materiałów dydaktycznych.	AiR2A_U03	Execution of exercises, Test, Examination
U5	Potrafi wykorzystywać konstrukcje gramatyczne, frazeologię, słownictwo pozwalające na zrozumienie tekstów z zakresu studiowanego kierunku studiów oraz tekstów o charakterze akademickim, dostrzegając także znaczenia ukryte, wyrażone pośrednio oraz pozwalające na płynne i spontaniczne porozumiewanie się w środowisku akademickim i zawodowym, używając precyzyjnego słownictwa branżowego.	AiR2A_U03	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Test results

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	30
Preparation for classes	4
Realization of independently performed tasks	15
Examination or final test/colloquium	2
Contact hours	1
Preparation of project, presentation, essay, report	8

Student workload	**Hours** 60
Workload involving teacher	**Hours** 30

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	**Course's learning outcomes**	**Program content ensuring the achievement of the learning outcomes prescribed to the module**
Foreign language classes	U1, U2, U3, U4, U5	Język niemiecki B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów Wydziału Elektrotechniki, Automatyki, Informatyki i Inżynierii Biomedycznej oraz Wydziału Informatyki, Elektroniki i Telekomunikacji

Russian B2+ course - compulsory course for students of SECOND-CYCLE STUDIES

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.02214.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
No

Course shaping practical skills
Nie

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Exam **Activities and hours** Foreign language classes: 30	2

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	Potrafi przygotować różnorodne opracowania pisemne np. rozbudowany tekst informacyjny i argumentacyjny z zakresu studiowanego kierunku i specjalności, również przedstawiający wyniki własnych badań naukowych oraz formułować przejrzyste i rozbudowane wypowiedzi ustne, szczególnie z zakresu języka potrzebnego do funkcjonowania w środowisku akademickim, w trakcie praktyk zawodowych, procesu rekrutacji i w środowisku pracy.	AiR2A_U03	Execution of exercises, Examination, Report, Scientific paper, Essays written during classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Potrafi przygotować rozbudowaną prezentację ustną z zakresu studiowanego kierunku i specjalności oraz zainteresowań zawodowych. Potrafi płynnie i spontanicznie brać udział w dyskusjach, również w środowisku zawodowym budując przejrzyste złożone wypowiedzi opisujące zjawiska i wyrażające różne punkty widzenia.	AiR2A_U03	Activity during classes, Participation in a discussion, Presentation
U3	Potrafi prowadzić korespondencję typową dla środowiska zawodowego z użyciem języka branżowego. Potrafi korzystać samodzielnie z dostępnych materiałów dydaktycznych.	AiR2A_U03	Execution of exercises, Test, Examination
U4	Potrafi wykorzystywać konstrukcje gramatyczne, frazeologię, słownictwo pozwalające na zrozumienie tekstów z zakresu studiowanego kierunku studiów oraz tekstów o charakterze akademickim, dostrzegając także znaczenia ukryte, wyrażone pośrednio oraz pozwalające na płynne i spontaniczne porozumiewanie się w środowisku akademickim i zawodowym, używając precyzyjnego słownictwa branżowego.	AiR2A_U03	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Test results
U5	Rozumie dłuższe, nawet skomplikowane wypowiedzi pisemne i ustne np. teksty z literatury fachowej, wykłady i prezentacje, dotyczące studiowanego kierunku lub spraw bieżących, komunikaty i polecenia w środowisku pracy. Potrafi interpretować uzyskane wiadomości dostrzegając także znaczenia ukryte, wyrażone pośrednio.	AiR2A_U03	Activity during classes, Participation in a discussion, Test, Examination

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	30
Preparation for classes	4
Realization of independently performed tasks	15
Examination or final test/colloquium	2
Contact hours	1
Preparation of project, presentation, essay, report	8
Student workload	**Hours** 60
Workload involving teacher	**Hours** 30

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Foreign language classes	U1, U2, U3, U4, U5	Russian Language B2+

Język angielski B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów WEAIiIB-IT

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.02207.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
No

Course shaping practical skills
Nie

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Exam **Activities and hours** Foreign language classes: 30	2

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	Rozumie dłuższe, nawet skomplikowane wypowiedzi pisemne i ustne np. teksty z literatury fachowej, wykłady i prezentacje, dotyczące studiowanego kierunku lub spraw bieżących, komunikaty i polecenia w środowisku pracy. Potrafi interpretować uzyskane wiadomości dostrzegając także znaczenia ukryte, wyrażone pośrednio.	AiR2A_U03	Activity during classes, Participation in a discussion, Test, Examination

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Potrafi przygotować różnorodne opracowania pisemne np. rozbudowany tekst informacyjny i argumentacyjny z zakresu studiowanego kierunku i specjalności, również przedstawiający wyniki własnych badań naukowych oraz formułować przejrzyste i rozbudowane wypowiedzi ustne, szczególnie z zakresu języka potrzebnego do funkcjonowania w środowisku akademickim, w trakcie praktyk zawodowych, procesu rekrutacji i w środowisku pracy.	AiR2A_U03	Execution of exercises, Examination, Report, Scientific paper, Essays written during classes
U3	Potrafi przygotować rozbudowaną prezentację ustną z zakresu studiowanego kierunku i specjalności oraz zainteresowań zawodowych. Potrafi płynnie i spontanicznie brać udział w dyskusjach, również w środowisku zawodowym budując przejrzyste złożone wypowiedzi opisujące zjawiska i wyrażające różne punkty widzenia.	AiR2A_U03	Activity during classes, Participation in a discussion, Presentation
U4	Potrafi prowadzić korespondencję typową dla środowiska zawodowego z użyciem języka branżowego. Potrafi korzystać samodzielnie z dostępnych materiałów dydaktycznych.	AiR2A_U03	Execution of exercises, Test, Examination
U5	Potrafi wykorzystywać konstrukcje gramatyczne, frazeologię, słownictwo pozwalające na zrozumienie tekstów z zakresu studiowanego kierunku studiów oraz tekstów o charakterze akademickim, dostrzegając także znaczenia ukryte, wyrażone pośrednio oraz pozwalające na płynne i spontaniczne porozumiewanie się w środowisku akademickim i zawodowym, używając precyzyjnego słownictwa branżowego.	AiR2A_U03	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Test results

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	30
Preparation for classes	4
Realization of independently performed tasks	15
Examination or final test/colloquium	2
Contact hours	1
Preparation of project, presentation, essay, report	8
Student workload	**Hours** 60
Workload involving teacher	**Hours** 30

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Foreign language classes	U1, U2, U3, U4, U5	Język angielski B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów WEAIiIB-IT-AR

French B2+ course - compulsory course for students of SECOND-CYCLE STUDIES

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi2O.05758.25 **Lecture languages** Polish **Mandatoriness** Elective **Block** General Modules **Course related to scientific research** No **Course shaping practical skills** Nie

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Exam **Activities and hours** Foreign language classes: 30	2

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	Potrafi prowadzić korespondencję typową dla środowiska zawodowego z użyciem języka branżowego. Potrafi korzystać samodzielnie z dostępnych materiałów dydaktycznych.	AiR2A_U03	Execution of exercises, Test, Examination

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Potrafi przygotować różnorodne opracowania pisemne np. rozbudowany tekst informacyjny i argumentacyjny z zakresu studiowanego kierunku i specjalności, również przedstawiający wyniki własnych badań naukowych oraz formułować przejrzyste i rozbudowane wypowiedzi ustne, szczególnie z zakresu języka potrzebnego do funkcjonowania w środowisku akademickim, w trakcie praktyk zawodowych, procesu rekrutacji i w środowisku pracy.	AiR2A_U03	Execution of exercises, Examination, Report, Scientific paper, Essays written during classes
U3	Rozumie dłuższe, nawet skomplikowane wypowiedzi pisemne i ustne np. teksty z literatury fachowej, wykłady i prezentacje, dotyczące studiowanego kierunku lub spraw bieżących, komunikaty i polecenia w środowisku pracy. Potrafi interpretować uzyskane wiadomości dostrzegając także znaczenia ukryte, wyrażone pośrednio.	AiR2A_U03	Activity during classes, Participation in a discussion, Test, Examination
U4	Potrafi wykorzystywać konstrukcje gramatyczne, frazeologię, słownictwo pozwalające na zrozumienie tekstów z zakresu studiowanego kierunku studiów oraz tekstów o charakterze akademickim, dostrzegając także znaczenia ukryte, wyrażone pośrednio oraz pozwalające na płynne i spontaniczne porozumiewanie się w środowisku akademickim i zawodowym, używając precyzyjnego słownictwa branżowego.	AiR2A_U03	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Test results
U5	Potrafi przygotować rozbudowaną prezentację ustną z zakresu studiowanego kierunku i specjalności oraz zainteresowań zawodowych. Potrafi płynnie i spontanicznie brać udział w dyskusjach, również w środowisku zawodowym budując przejrzyste złożone wypowiedzi opisujące zjawiska i wyrażające różne punkty widzenia.	AiR2A_U03	Activity during classes, Participation in a discussion, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	30
Preparation for classes	4
Realization of independently performed tasks	15
Examination or final test/colloquium	2
Contact hours	1
Preparation of project, presentation, essay, report	8
Student workload	**Hours** 60

Workload involving teacher	Hours 30

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Foreign language classes	U1, U2, U3, U4, U5	Język francuski B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia dla studentów wszystkich wydziałów - język francuski w pracy i biznesie

Spanish B2+ course - compulsory course for students of SECOND-CYCLE STUDIES

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi2O.04742.25 **Lecture languages** English **Mandatoriness** Elective **Block** General Modules **Course related to scientific research** No **Course shaping practical skills** Nie

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Exam **Activities and hours** Foreign language classes: 30	2

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	Potrafi przygotować różnorodne opracowania pisemne np. rozbudowany tekst informacyjny i argumentacyjny z zakresu studiowanego kierunku i specjalności, również przedstawiający wyniki własnych badań naukowych oraz formułować przejrzyste i rozbudowane wypowiedzi ustne, szczególnie z zakresu języka potrzebnego do funkcjonowania w środowisku akademickim, w trakcie praktyk zawodowych, procesu rekrutacji i w środowisku pracy.	AiR2A_U03	Execution of exercises, Examination, Report, Scientific paper, Essays written during classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Potrafi przygotować rozbudowaną prezentację ustną z zakresu studiowanego kierunku i specjalności oraz zainteresowań zawodowych. Potrafi płynnie i spontanicznie brać udział w dyskusjach, również w środowisku zawodowym budując przejrzyste złożone wypowiedzi opisujące zjawiska i wyrażające różne punkty widzenia.	AiR2A_U03	Activity during classes, Participation in a discussion, Presentation
U3	Potrafi prowadzić korespondencję typową dla środowiska zawodowego z użyciem języka branżowego. Potrafi korzystać samodzielnie z dostępnych materiałów dydaktycznych.	AiR2A_U03	Execution of exercises, Test, Examination
U4	Potrafi wykorzystywać konstrukcje gramatyczne, frazeologię, słownictwo pozwalające na zrozumienie tekstów z zakresu studiowanego kierunku studiów oraz tekstów o charakterze akademickim, dostrzegając także znaczenia ukryte, wyrażone pośrednio oraz pozwalające na płynne i spontaniczne porozumiewanie się w środowisku akademickim i zawodowym, używając precyzyjnego słownictwa branżowego.	AiR2A_U03	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Test results
U5	Rozumie dłuższe, nawet skomplikowane wypowiedzi pisemne i ustne np. teksty z literatury fachowej, wykłady i prezentacje, dotyczące studiowanego kierunku lub spraw bieżących, komunikaty i polecenia w środowisku pracy. Potrafi interpretować uzyskane wiadomości dostrzegając także znaczenia ukryte, wyrażone pośrednio.	AiR2A_U03	Activity during classes, Participation in a discussion, Test, Examination

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	30
Preparation for classes	4
Realization of independently performed tasks	15
Examination or final test/colloquium	2
Contact hours	1
Preparation of project, presentation, essay, report	8
Student workload	**Hours** 60
Workload involving teacher	**Hours** 30

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Foreign language classes	U1, U2, U3, U4, U5	Język hiszpański B2+ - obowiązkowy kurs języka specjalistycznego na studiach II stopnia - język hiszpański w pracy i biznesie

Elective Humanistic Course

Course description sheet

Basic information

Field of study Automatic Control and Robotics	**Didactic cycle** 2025/2026
Major Cyber-physical systems	**Course code** EAiRCSS.IIi2O.05796.25
Organisational unit Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Elective
Form of study Full-time studies	**Block** General Modules
Profile General academic	**Course related to scientific research** No
	Course shaping practical skills Nie

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Completing the classes **Activities and hours** Lectures: 28	2

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Realization of independently performed tasks	20

Student workload	**Hours** 48
Workload involving teacher	**Hours** 28

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module

Multicriteria Optimization and Reinforcement Learning

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.18772.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Completing the classes **Activities and hours** Lectures: 28 Laboratory classes: 28	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Knows and understands the basic set of related concepts with multicriteria optimization and reinforcement learning	AiR2A_W01	Activity during classes, Test results
W2	Students know the main areas of application of multicriteria optimization, multicriteria decision theory, and reinforcement learning	AiR2A_W01	Activity during classes, Execution of laboratory classes, Test results
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Is able to use advanced programming tools to implement solutions of real-life multicriteria decision problems using multicriteria optimization and reinforcement learning methods	AiR2A_W01, AiR2A_U06	Activity during classes, Execution of laboratory classes
U2	Is able to distinguish the subseqent stages of solving real-life multicriteria decision problems and pick out appropriate multicriteria optimization methods to solve them	AiR2A_W01, AiR2A_W03, AiR2A_U06	Activity during classes, Execution of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	28
Preparation for classes	10
Realization of independently performed tasks	26
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	20
Contact hours	5
Student workload	**Hours** 119
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, U1, U2	Course focuses on advanced programming tools to implement solutions of real-life multicriteria decision problems using multicriteria optimization and reinforcement learning methods
Laboratory classes	W1, W2, U1, U2	

Networked Control Systems

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi2O.07593.25 **Lecture languages** English **Mandatoriness** Elective **Block** General Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Completing the classes **Activities and hours** Lectures: 28 Laboratory classes: 28	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student has an extended knowledge about the architecture of distributed control systems	AiR2A_W01	Completion of laboratory classes
W2	Student has knowledge about industrial data transmission protocols (wired and wireless)	AiR2A_W01	Completion of laboratory classes
W3	Student understands how data transmission channels in the control loop influence the dynamics of the model	AiR2A_W01	Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	Student knows how to compensate some dynamical effects introduced by data transmission networks	AiR2A_W01	Completion of laboratory classes
W5	Student knows and understands the influence of a data transmission channels on ther control system dynamics	AiR2A_W01	Completion of laboratory classes
Skills – Student can:			
U1	The student is able to configure and program PLC controllers and other automation devices for process data exchange over an industrial communication network.	AiR2A_U01, AiR2A_U07	Activity during classes, Completion of laboratory classes
U2	The student is able to assess the quality of control in a networked control system by conducting specifically designed experiments and processing their results.	AiR2A_U06	Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	28
Preparation for classes	28
Realization of independently performed tasks	29
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 120
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Laboratory classes	U1, U2	A students acquires knowledge and masters skills regarding networked control system configuration and programming.
Lectures	W1, W2, W3, W4, W5	

Adaptive and Predictive Control

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.07628.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Completing the classes **Activities and hours** Lectures: 28 Project classes: 28	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Student knows principles of adaptive control	AiR2A_W01	Execution of a project, Test results
W2	Student knows principles of predictive control	AiR2A_W01	Execution of a project, Test results
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Student is able to select appropriate adaptive and predictive control strategy for different types of problem	AiR2A_U06	Execution of a project
U2	Student is able to solve complicated control problems in group and document their operation	AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U06	Activity during classes, Execution of a project

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Project classes	28
Realization of independently performed tasks	45
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 108
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2	Adaptive and predictive control theory is given at this lectures. The application of the theoretical results and the implementation of the adaptive or predictive controllers are realized as a part of the project.
Project classes	W1, W2, U1, U2	

Smart Building Technologies: Advanced Control, IoT and Energy Management

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi2O.18746.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 2	Completing the classes **Activities and hours** Lectures: 28 Project classes: 28	4

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student knows and understands technological systems in modern buildings that affect energy consumption, including automation, control, building management systems (BMS), safety, and telecommunication systems.	AiR2A_W03, AiR2A_W04	Activity during classes, Participation in a discussion

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	The student knows and understands EU legal regulations concerning energy efficiency in buildings and related standards such as ISO 5120 and ISO 16484.	AiR2A_W04	Activity during classes, Participation in a discussion
W3	The student is familiar with innovative solutions in the field of distributed control systems, especially IoT-based, cloud computing, and Digital Twin technologies.	AiR2A_W02, AiR2A_W03	Activity during classes, Participation in a discussion
W4	The student understands the principles of designing automation systems and integrating subsystems to improve energy efficiency and safety in buildings.	AiR2A_W01	Activity during classes, Participation in a discussion
Skills – Student can:			
U1	Assess the quality and effectiveness of the automation system in the existing building and propose upgrades that improve the building's energy efficiency, both in terms of changes in technology and in terms of control. Design a building automation, control and technical management system for a new building that will ensure adequate energy efficiency of the building, depending on the investor's expectations.	AiR2A_U01, AiR2A_U02	Activity during classes, Execution of a project, Test
U2	Select and design data transmission infrastructure for a distributed automation system, building technical management and management, and BMS system. Specify the functionalities of individual automation circuits of technological installations in accordance with EN 16484, both in the field of automation at the facility level and the BMS system.	AiR2A_U06, AiR2A_U07	Activity during classes, Execution of a project, Test
U3	Analyze and implement new, innovative solutions in automation, control and technical building management systems, especially in the field of the Internet of Things, cloud computing and processing large amounts of data in terms of control prediction and early prediagnosis and protection against system failures. Students will be able to formulate and execute a project that utilizes course topics in machine learning and optimization methods for a novel application. Students will be able to create a digital twin of a physical process that computes in parallel to a real-time microcontroller.	AiR2A_U01, AiR2A_U03, AiR2A_U06, AiR2A_U07	Activity during classes, Execution of a project, Test
Social competences – Student is ready to:			
K1	Cooperation with industry designers in the selection of technological installations that will enable effective control of the reduction of energy consumption by the building.	AiR2A_K01, AiR2A_K03	Participation in a discussion, Execution of a project
K2	Searching for new solutions in the field of automation and control in order to effectively control technological installations in buildings and homes.	AiR2A_K02, AiR2A_K03	Participation in a discussion, Execution of a project

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Project classes	28
Preparation for classes	18
Realization of independently performed tasks	18
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	14
Contact hours	5
Student workload	**Hours** 113
Workload involving teacher	**Hours** 56

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, W3, W4	The course focuses on smart buildings and smart homes technologies with a special consideration of advanced control with Digital Twins concept and machine learning for energy management. During the course the student is familiarized with the issues regarding the overview of technical systems in buildings, the role of automation, control, technical management and security systems in buildings and the influence of systems on energy efficiency. After completing the module, the student will be able to use system synergy to increase the energy efficiency of buildings and new technologies in energy consumption management in intelligent buildings: demand-driven control, Internet of Things applications, identification and prediction of user behavior with machine learning.
Project classes	U1, U2, U3, K1, K2	

Diploma Seminar

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.01432.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
No

Course shaping practical skills
Nie

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Seminars: 14	1

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Student knows requirements concerning the form of the preparation of Master thesis and the presentation for the thesis defence.	AiR2A_W04	Presentation
Skills – Student can:			
U1	Student is able to prepare a presentation of the thesis results.	AiR2A_U01, AiR2A_U03	Presentation
U2	Student is able to choose and correctly cite the sources (bibliography).	AiR2A_U01	Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Social competences – Student is ready to:			
K1	Student working in a group is able to assess the quality of the thesis presentation.	AiR2A_K02, AiR2A_K03	Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Seminars	14
Realization of independently performed tasks	14
Examination or final test/colloquium	2
Student workload	**Hours** 30
Workload involving teacher	**Hours** 14

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Seminars	W1, U1, U2, K1	The student will prepare a diploma thesis on a chosen topic. It will match the requirements set out in the department instructions, in terms of content, structure and formatting.

Diploma Thesis

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.01412.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Diploma Thesis: 0	20

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Has knowledge of the field of Automation and Robotics indispensable for the implementation of tasks defined in the diploma thesis topic	AiR2A_W01, AiR2A_W02, AiR2A_W03, AiR2A_W04, AiR2A_W05	Diploma thesis preparation
Skills – Student can:			
U1	Is able to plan and describe tasks related to the subject of the diploma thesis	AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06, AiR2A_U07	Diploma thesis preparation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Is able to independently solve design tasks resulting from the thesis topic	AiR2A_U01, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06, AiR2A_U07	Diploma thesis preparation
Social competences – Student is ready to:			
K1	Is aware of the importance of the tasks it performs for the university and its research work or company, in cooperation with which the task is carried out	AiR2A_K02	Diploma thesis preparation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Realization of independently performed tasks	250
Preparation of project, presentation, essay, report	230
Contact hours	120
Student workload	**Hours** 600

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Diploma Thesis	W1, U1, U2, K1	Preparation of diploma thesis

Specialised sources of information

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.09009.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
No

Course shaping practical skills
Nie

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Discussion seminars: 3	1

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	A student knows basic specialized and general sources of information relevant to the field of study and rules for compiling bibliographic descriptions of cited references	AiR2A_W01, AiR2A_W02, AiR2A_W03	Activity during classes, Execution of exercises
Skills – Student can:			
U1	A student can compile a bibliographic description of a given publication (from an original article and from metadata)	AiR2A_U01	Activity during classes, Execution of exercises

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	A student can effectively search for literature on a given subject in specialized sources of information	AiR2A_U01	Activity during classes, Execution of exercises
Social competences – Student is ready to:			
K1	A student understands the need for permanent tracing the latest scientific achievements in the selected field and the relevant literature	AiR2A_K01	Activity during classes, Execution of exercises

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Discussion seminars	3
Realization of independently performed tasks	22
Student workload	**Hours** 25
Workload involving teacher	**Hours** 3

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Discussion seminars	W1, U1, U2, K1	

Capstone project II

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.07624.25

Lecture languages
English

Mandatoriness
Obligatory

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Nie

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Laboratory classes: 42	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student knows various types of methematical models of control plants and methods for models transformation and simplification.	AiR2A_W01, AiR2A_W03	Activity during classes, Report, Completion of laboratory classes
W2	The student knows various control tasks and popular performance indices used for control system performance evaluation.	AiR2A_W01	Activity during classes, Report, Completion of laboratory classes
W3	The student knows methods of control system design and development, from initial familiarization with the plant to final real-world tests of the complete solution.	AiR2A_W01	Activity during classes, Report, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	The student knows methods of integration of a control plant and a computer control system. Understands rules of and reasons for measurement signal conditioning and control signal amplification.	AiR2A_W02	Activity during classes, Report, Completion of laboratory classes
Skills – Student can:			
U1	The student is able to choose a structure of a controller for a given plant and control task and to compute its parameters using numerical optimisation methods.	AiR2A_U01, AiR2A_U06	Activity during classes, Report, Completion of laboratory classes
U2	The student is able to work in a project team, efficiently manage time, assign tasks to team members, and coordinate the team work.	AiR2A_U04	Activity during classes, Report, Completion of laboratory classes
U3	The student can develop a phenomenological mathematical model of the plant and identify its parameters using results of specifically designed experiments.	AiR2A_U01, AiR2A_U06	Activity during classes, Report, Completion of laboratory classes
U4	The student is able to prepare a final report describing in details a controller development process.	AiR2A_U01, AiR2A_U03	Activity during classes, Report, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Recognizes the necessity of having specialist knowledge to solve complex engineering problems.	AiR2A_K01	Activity during classes, Report, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Laboratory classes	42
Realization of independently performed tasks	14
Preparation of project, presentation, essay, report	27
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to

the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Laboratory classes	W1, W2, W3, W4, U1, U2, U3, U4, K1	In the course of laboratory exercises, students design and implement a digital controller for a selected robotic platform. This process includes modeling the system, identifying model parameters, selecting the structure of a controller, controller tuning, implementing the control algorithm, conducting computer simulations and real-time real-world experiments. Computer tools for model-in-the-loop simulations and rapid controller prototyping are used. Model-based design techniques are employed.

Autonomous Systems

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi4O.08514.25 **Lecture languages** English **Mandatoriness** Elective **Block** General Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 3	Completing the classes **Activities and hours** Lectures: 28 Laboratory classes: 14	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Students attending the classes will become familiar with the basics of autonomous systems theory and their design and analysis. The issues of decision-making by such systems will be presented in detail, including the issue of freedom of decision choice ("freewill") and indicators defining the level of autonomy (LoA).	AiR2A_W03	Activity during classes, Test, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	Graduates of the course will get practical knowledge about the specific areas of application of autonomous systems, especially in mobile robotics and transport. Particular attention will be paid to the problem of coordination of mobile robot teams. Applications of autonomous systems theory in the design of web bots and autonomous financial and management systems will also be presented.	AiR2A_W03	Activity during classes, Test, Presentation
Skills – Student can:			
U1	Graduates of the course will have the ability to determine the level of autonomy of a designed or analyzed system and to adjust such level to the planned scope of operation of a robot or group of robots.	AiR2A_U01	Test results, Completion of laboratory classes
U2	Graduates of the course will have the ability to design decision-making algorithms for autonomous mobile robots, especially those based on multi-criteria analysis and reinforcement learning methods	AiR2A_U01	Test results, Presentation, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Collaborate in a small team to solve a design problem for a selected autonomous system	AiR2A_K01	Activity during classes, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Laboratory classes	14
Realization of independently performed tasks	26
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	15
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to

the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, U1, U2, K1	The course presents the foundations of artificial autonomous decision systems (AADS): theory, design and implementation, focusing on autonomous decision making, autonomy indices, anticipatory networks and systems. The lecture will present the issues of decision-making by autonomous systems, models and architectures of autonomous systems, the theory of freewill with indicators of the level of autonomy (LoA), optimal coordination of robot teams, as well as Issues related to the awareness and creativity of artificial autonomous systems. The laboratory will provide information on existing and planned applications of AADS in robotics, such as autonomous vehicles, robot motion planning, model-based reinforcement learning, providing practical aspects and focusing on programming AADS algorithms. Methods of autonomous decision-making applied to network bots and systems, automatic trade systems in finance, and other areas of applications, will also be presented.
Laboratory classes	W1, W2, U1, U2, K1	

Cyber-Physical Systems for Power Processing and Smart Grids

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.07633.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Lectures: 14 Project classes: 28	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Have a global view on recent development on power electronic s and be aware of applications of power electronics in various industries	AiR2A_W01	Test
W2	The last laboratory exercise is intended for writing the tests which were not passed by students.	AiR2A_W01	Test
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Understand the international standards on power electronics design.	AiR2A_U07	Test
U2	Acquire a good understanding of power supply concept and design and be able to analyse the industrial needs for static power conversion.	AiR2A_U01	Activity during classes, Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	14
Project classes	28
Realization of independently performed tasks	34
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 83
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Project classes	U2	The course realises material related to power electronics and smart grids in cyber physical systems.
Lectures	W1, W2, U1, U2	

FPGA-Based Embedded Processor Design

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.18761.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
No

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Laboratory classes: 42	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Familiar with the architecture of RISC-V processors.	AiR2A_W02	Execution of laboratory classes, Completion of laboratory classes
W2	Able to use the SystemVerilog language to design digital circuits.	AiR2A_W02	Execution of laboratory classes, Completion of laboratory classes
W3	Knows how to design and implement processors on FPGAs.	AiR2A_W02	Execution of laboratory classes, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	Understands the principles of software design for RISC-V processors.	AiR2A_W02	Execution of laboratory classes, Completion of laboratory classes
Skills – Student can:			
U1	Student can implement an MCU/CPU in a hardware description language.	AiR2A_U01	Execution of laboratory classes, Completion of laboratory classes
U2	The student knows how to integrate modules into a complete processor and implement it in an FPGA device.	AiR2A_U01	Execution of laboratory classes, Completion of laboratory classes
U3	The student is able to create simple programs for the designed processor and test the interaction between hardware and software.	AiR2A_U01	Execution of laboratory classes, Completion of laboratory classes
Social competences – Student is ready to:			
K1	The student understands the role of configurable RISC-V processors in modern technology and the economy.	AiR2A_K01, AiR2A_K02	Execution of laboratory classes, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Laboratory classes	42
Realization of independently performed tasks	41
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Laboratory classes	W1, W2, W3, W4, U1, U3, K1, U2	The course is structured to provide students with both theoretical knowledge and practical skills in microcontroller design, focusing on the development of a pipelined 32-bit RISC-V processor.

Programming of PLC-s

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.03944.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Lectures: 14 Laboratory classes: 28	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Student has the knowledge about PLC hardware, covering construction and real-time requirements fulfilment during work of PLC.	AiR2A_W02, AiR2A_W03	Test
W2	Student has systematic knowledge about programming methods of PLC-s with respect to the IEC61131 standard. This knowledge covers software model, data and variable types, communication model and program organization units.	AiR2A_W02, AiR2A_W03	Test

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	Student has systematized knowledge about PLC programming languages and rules of their use in different areas of applications.	AiR2A_W02, AiR2A_W03	Test
W4	Student has knowledge about practical implementation of control systems employing PLCs.	AiR2A_W02, AiR2A_W03	Test
Skills – Student can:			
U1	Student is able to configure a PLC to realize a particular control job.	AiR2A_U01, AiR2A_U07	Test
U2	Student is able to select a POU-s and language to implement a certain control algorithm at a particular PLC platform.	AiR2A_U01, AiR2A_U07	Test
U3	Student is able to estimate real-time requirements fulfilment during work of a PLC in a certain configuration and using particular data types.	AiR2A_U01, AiR2A_U07	Test
Social competences – Student is ready to:			
K1	Student has the knowledge about the role of automation engineer in society.	AiR2A_K02	Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	14
Laboratory classes	28
Preparation for classes	15
Realization of independently performed tasks	26
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module

Lectures	W1, W2, W3, W4, U1, U2, U3, K1	The course covers main issues asscociated to PLC programming with respect to IEC 61131 standard. Data types, Program Organization Units (POU-s) and programming languages are presented. Real PLC systems (mainly SIEMENS, families: 300, 1200 and 1500) are also considered.
Laboratory classes	W1, W2, W3, W4, U1, U2, U3, K1	

Unconventional robotics

Course description sheet

Basic information

Field of study Automatic Control and Robotics **Major** Cyber-physical systems **Organisational unit** Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** EAiRCSS.IIi4O.08720.25 **Lecture languages** English **Mandatoriness** Elective **Block** General Modules **Course related to scientific research** Yes **Course shaping practical skills** Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 3	Completing the classes **Activities and hours** Lectures: 14 Laboratory classes: 28	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Student knows and understands the operation of various robot configurations	AiR2A_W02	Participation in a discussion, Execution of laboratory classes, Case study, Presentation, Oral answer, Preparation and conduct of scientific research

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	The student knows the dynamics and control in complex robotic systems.	AiR2A_W01	Activity during classes, Participation in a discussion, Execution of laboratory classes, Report, Case study, Presentation, Oral answer, Preparation and conduct of scientific research
Skills – Student can:			
U1	Student is able to perform detailed analysis of the scientific publication, present information in the concise form and is open for discussion on the selected topic	AiR2A_U01	Activity during classes, Participation in a discussion, Report, Case study, Presentation, Oral answer, Preparation and conduct of scientific research
Social competences – Student is ready to:			
K1	Student is able to join the open discussion on the particular problem and address the doubts, propose a solution.	AiR2A_K01	Activity during classes, Participation in a discussion, Execution of laboratory classes, Report, Case study, Presentation, Oral answer, Preparation and conduct of scientific research

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	14
Laboratory classes	28
Realization of independently performed tasks	16
Preparation of project, presentation, essay, report	25
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Lectures	W1, W2, U1, K1	The aim of the course is to provide knowledge of the construction and control methods of various types of robots depending on the application and configuration. Technical problems is supplemented with information in the field of sociology and biology. The goal is to broaden the horizons in robotics applications and inspire students to develop their own configurations and control methods.
Laboratory classes	W1, W2, U1, K1	

Vision systems in robotics

Course description sheet

Basic information

Field of study
Automatic Control and Robotics

Major
Cyber-physical systems

Organisational unit
Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2025/2026

Course code
EAiRCSS.IIi4O.03079.25

Lecture languages
English

Mandatoriness
Elective

Block
General Modules

Course related to scientific research
Yes

Course shaping practical skills
Tak

Period	Method of verification of the learning outcomes	Number of ECTS credits
Semester 3	Completing the classes **Activities and hours** Lectures: 28 Project classes: 14	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Has a structured knowledge of video signal processing.	AiR2A_W03	Test results
W2	Has in-depth, theoretically structured knowledge of advanced robotics topics.	AiR2A_W02	Test results
W3	Has knowledge of development trends and the most relevant new developments in automation and robotics and computer science.	AiR2A_W04	Test results

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	Has in-depth knowledge of solving advanced optimisation problems.	AiR2A_W01	Test results
Skills – Student can:			
U1	Can prepare detailed documentation of the results of an experiment; can prepare a paper discussing these results.	AiR2A_U01	Project
U2	Can formulate and solve a complex optimisation problem.	AiR2A_U01	Project
U3	Is able - when formulating and solving tasks related to modelling and designing automation systems - to integrate knowledge from the field of automation, electronics, computer science, operations research and other disciplines, using a systems approach, taking into account non-technical aspects.	AiR2A_U01	Project
U4	Be able to use the mathematical methods and models that he/she has learnt - modifying them as necessary - to analyse the operation and design of components, systems and controls, monitoring and supervision of industrial processes.	AiR2A_U06	Project
Social competences – Student is ready to:			
K1	Able to think and act creatively.	AiR2A_K01	Project

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	28
Project classes	14
Preparation for classes	20
Realization of independently performed tasks	21
Examination or final test/colloquium	2
Contact hours	5

Student workload	**Hours** 90
Workload involving teacher	**Hours** 42

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Project classes	W4, U1, U2, U3, U4, K1	Students will learn methods used for the development of computer vision systems and acquire skills needed for their practical application in robotics.
Lectures	W1, W2, W3, W4, U3, U4	

Student Science Club

Course description sheet

Basic information

Field of study Automatic Control and Robotics	**Didactic cycle** 2025/2026
Major Cyber-physical systems	**Course code** EAiRCSS.IIi4O.09010.25
Organisational unit Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Elective
Form of study Full-time studies	**Block** General Modules
Profile General academic	**Course related to scientific research** No
	Course shaping practical skills Tak

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 3	Completing the classes **Activities and hours** Participation in a student research club: 0	3

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	The student expands and raises the level of his knowledge that goes beyond the current study program through participation in scientific research, scientific sessions, scientific conferences, additional courses and specialist training	AiR2A_W01, AiR2A_W02, AiR2A_W03, AiR2A_W04, AiR2A_W05	Participation in a discussion, Scientific paper, Involvement in teamwork, Presentation
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Conducting an active activity in a student scientific club, the student is able to plan a small research / scientific project independently or in a team, coordinate its implementation (eg the Rector's Grant), and then prepare a report and settlement.	AiR2A_U01, AiR2A_U02, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06, AiR2A_U07	Project, Report, Scientific paper, Involvement in teamwork, Presentation
U2	Conducting active activity in the student scientific circle, the student is able to use professional literature and internet sources. Based on the results of the project, he can prepare a paper or scientific publication and presentation and present it in public.	AiR2A_U01, AiR2A_U02, AiR2A_U03, AiR2A_U04, AiR2A_U05, AiR2A_U06, AiR2A_U07	Project, Report, Scientific paper, Involvement in teamwork, Presentation
Social competences – Student is ready to:			
K1	The student understands the need for constant training, the value of independent and creative thinking, responsibility for joint activities and the need to promote knowledge and scientific achievements	AiR2A_K01, AiR2A_K02, AiR2A_K03	Scientific paper, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Realization of independently performed tasks	35
Preparation of project, presentation, essay, report	40
Student workload	**Hours** 75

* hour means 45 minutes

Program content ensuring the achievement of the learning outcomes prescribed to the module

Activities	Course's learning outcomes	Program content ensuring the achievement of the learning outcomes prescribed to the module
Participation in a student research club	W1, U1, U2, K1	As part of the module, students have the opportunity to pass the elective subject on the basis of active work in a student scientific club.

Detailed rules of the implementation of the curriculum estabilished by the Dean of the Faculty (the so-called Study Rules)

Field of study: Automatic Control and Robotics
Specialty: Cyber-physical systems

Enrollment rules for the next semester

Maintaining the point deficit not exceeding 15 ECTS points.

Enrollment rules for the next semester as a part of the so-called ECTS credits debt ceiling

The permissible ECTS credits deficit is in line with the requirements set out in the Regulations of the First and Second Degree Studies of the AGH University of Science and Technology.

ECTS credits debt ceiling

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Organization of classes within the so-called blocks of classes (i.e. such organization of subjects or individual forms of classes that creates exceptions to the cyclical nature of classes in particular weeks of a given semester of studies)

There is a possible implementation of modules of classes in the so-called blocks of classes.

Monitoring semesters

Study rules in case of the individual organization of studies approved for a specific student

The condition for applying for individual studies is the completion of first-cycle studies with an average grade not lower than 4.70 and passing the first semester of the second-cycle program without ECTS deficit, with an average not lower than 4.70.

Implementation of practical placements including monitoring system and completion rules

Rules of elective modules taking

Rules of education paths, graduation paths, major choice/eligibility

Recruitment will be based on the ranking list according to the number of available places. The basis for preparing this list will be the recruitment rate, which is the weighted average of the result from the entrance examination and the average from the first-cycle studies.
As part of the specialty, no education paths and diploma paths are envisaged.

Rules related to the preparation of diploma projects and theses as well as the implementation of the degree granting

Second level studies finish with the preparation of the master thesis under the care of a chosen supervisor. The subject of work must be reviewed in advance by the Education Quality Committee, appointed by the Faculty Council and approved by the Dean. The work is subject to review. The reviewer is indicated by the Dean. After submitting the thesis, a one-part (oral) diploma exam is taken before the Commission, chaired by the Dean, and includes the supervisor and reviewer of the work.

Principles for determining the overall evaluation of graduation (the final grade)

The condition for graduation, according to the Regulations of the AGH University of Science and Technology, is:
1) obtaining educational effects specified in the education program;
2) completion of all modules of the classes provided for in the curriculum; 3) obtaining the number of ECTS points required by the study program;
4) submitting a diploma thesis;
5) submitting the diploma exam.
The result of higher education is determined as the average
weighted as follows:
1) the average grade from studies, determined in accordance with § 14 of the Regulations of the AGH University of Science and Technology; 2) the final evaluation of the diploma thesis;
3) evaluation of the diploma exam;
3. Evaluation weights, determined by the Faculty Council, with the average of grades from studies being considered with a weight not less than 60%.
4. The grades, as well as the result of graduation, are determined to two decimal places, without rounding,
according to the following rule depending on a numerical value: 1) from 3.00 verbal mark: sufficient (3.0)
2) from 3.21 verbal mark: plus sufficient (3.5)
3) from 3.71 verbal mark: good (4.0)
4) from 4.21 verbal mark: plus good (4.5)
5) from 4.71 verbal mark: very good (5.0).

Other requirements related to the implementation of the curriculum resulting from the AGH University Study Regulations or other regulations in force at the University