Curriculum

Field of study: Space Technologies

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General characteristics of the field of study

Basic information

Faculty name:	Faculty of Space Technologies
Field of study:	Space Technologies
Level:	Second-cycle (engineer) programme
Profile:	General academic
Form:	Full-time studies
ISCED classification:	0716
Number of ECTS credits necessary to complete studies at a given level:	90/120 (w przypadku udziału w semestrze wyrównującym)
Professional title awarded to graduates:	magister inżynier
Cycle start date:	2024/2025, summer semester
Duration of studies (number of semesters):	4

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	53%	48
Biomedical engineering	27%	24
Mechanical engineering	20%	18

Relationship between the field of study and the AGH University development strategy and the AGH University mission

The creation of the "Space Technologies" major at AGH is consistent with the university's strategy, especially in relation with the strategic goal 1.3 (transformation of selected specialties into new fields of study). The next stage in the development of this strategy will be significant deepening of cooperation with foreign universities through joint educational initiatives, joint diplomas, internships, professional internships and educational programs such as Erasmus+. Such initiatives lead to further internationalization of the education process, which is consistent with the strategic goal 1.4 of AGH. Additionally, the creation of the Space Technologies field fits perfectly into the goals set out in the AGH Strategy (strategic goal 1. Modern education attractive to students and the environment in Poland and abroad, operational goal no. 2. Matching the offer study program to current needs and expectations, operational goal No. 3. Increasing the attractiveness of second-cycle studies and operational goal No. 4. Strengthening the position of AGH UST in the international educational space).
Additionally, the "Space Technologies" field of study has been developed and will be implemented based on the UNIVERSEH project of the European Space University in close cooperation with a consortium of 7 universities (from Belgium, Sweden, France, Luxembourg, Germany, Italy and Poland).

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 dynamic development of the space technology sector, which is crucial for the growth and security of Europe, including Poland, has led to an increased demand for personnel in the space sector. This need is particularly important given the current geopolitical

situation. Personnel for the space sector are trained through the organization of studies in the field of space technologies. This is an entirely new educational field, known as space education. Currently, there is a shortage of this type of education at the higher education level in Poland. Therefore, there is an urgent need to launch second-cycle studies in the field of Space Technologies.

The technological revolution driven by the space technology sector impacts many aspects of our lives. Areas such as Earth science research, telecommunications, climate monitoring, scientific research, and defense are becoming increasingly dependent on these advancements. There is a clear rise in demand for specialists with deep and broad knowledge and advanced skills in key areas of space technology, hence the necessity to introduce a new field of study – "Space Technologies."

Thanks to the Universeh project being implemented at AGH – the European Space University for Earth and Humanity – and several years of experience gained during the project's implementation in space education, there is a real opportunity to launch this program at AGH. This program could become one of the first and leading courses in space technologies in Europe, and especially in Poland. Currently, only the Gdańsk University of Technology offers similar education at the second-cycle level, in the Space and Satellite Technologies program. However, it should be noted that the proposed program at AGH stands out due to its unique educational paths.

The main advantage of the newly created program is its interdisciplinary nature, the high quality of the proposed courses, digital content for all subjects, prepared with the participation of international experts experienced in space education, and project-based learning.

Education paths – scope in Polish and in English

Graduation paths – scope in Polish and in English

The new "Space Technologies" program aims to equip students with the skills and competencies in all key areas of space technologies. The study program is divided into three educational paths:

- "Upstream" – focuses on the construction and launch of objects into space.
- "Downstream" – concentrates on data processing and communication with devices in space.
- "Biomedical" – dedicated to the applications of biomedical technologies in space.

The names of the majors in Polish and in English

Name [pl]	Name [en]

General information about the curriculum

Field of study: Space Technologies

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

The teaching of the Space Technologies program is aligned with the principles of the Bologna Process and the Polish Qualifications Framework (PQF) through second-cycle studies (level 7). The program includes the introduction of the ECTS credit system, which allows for monitoring student progress and the implementation of a learning outcomes-based system. Additionally, students have the opportunity to participate in international exchanges, and the entire program is conducted in English.

The Space Technologies program responds to the growing demand for highly qualified specialists in the fields of space exploration, satellite communication systems, navigation, remote sensing, and rocket technologies. Graduates of the program possess the technical and analytical skills that enable them to creatively solve complex engineering problems, as well as adapt to the rapidly evolving space technology market. They learn to work in interdisciplinary teams and gain the competencies necessary for involvement in global research and industrial projects.

The faculty continuously improves the quality of education through the development of laboratory facilities, the implementation of national and international research and development projects, as well as active support for student initiatives and cooperation with the space industry. Graduates find employment in research institutions, space agencies such as ESA (European Space Agency), companies designing and building satellites, communication systems, navigation systems, as well as firms related to the defense, aerospace, and telecommunications industries. Typical workplaces also include satellite operation centers, research laboratories, and organizations involved in space policy and space management.

According to Career Center studies, a significant number of graduates find employment in renowned companies specializing in space and related technologies, such as Airbus, SpaceX, Thales Alenia Space, or Lockheed Martin. Graduates are also sought after by space-related startups, and career development opportunities in this field are steadily growing.

Second-cycle graduates have the opportunity to continue their education at the doctoral level (level 8), where they can deepen their knowledge in space technologies, as well as pursue postgraduate studies in project management or the development of navigation and telecommunications systems.

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

As part of the Career Center, there is a Professional Workforce Monitoring Center, whose task is to conduct ongoing labor market analysis, including tracking the career paths of AGH graduates. AGH graduates are surveyed multiple times after completing their studies. Reports are generated from these surveys, containing information such as the employment distribution of graduates, their strengths and weaknesses, as well as feedback from respondents on suggested changes to program curricula. These reports are then annually analyzed by faculty committees on education and quality. Based on these analyses, changes to individual programs or modules are proposed.

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 study program for the Space Technologies major is developed and implemented in accordance with the requirements and recommendations of accreditation commissions, particularly the Polish Accreditation Committee (PKA) and industry-specific accreditation bodies operating in the field of technical sciences. This process includes regular reviews and updates of the study program in line with PKA guidelines, which address areas such as the quality of education, achievement of learning outcomes, organization of professional internships, and the alignment of programs with labor market needs. The program also incorporates recommendations related to innovation, interdisciplinarity, and collaboration with industry and research institutions, which are crucial for the Space Technologies major. Continuous monitoring and adjustment of the program to these guidelines ensures a high standard of education, preparing graduates for work in the rapidly evolving space industry.

Information on including examples of good practice in the curriculum

The curriculum of the Space Technologies program integrates the rich teaching and research experience of the faculty, including insights gained from participation in international research projects and collaborations with the space sector. The program emphasizes creative problem-solving and a practical approach to challenges in space technology. The diversity of topics covered offers a broad perspective on space-related issues and facilitates the integration of interdisciplinary knowledge. A wide range of teaching methods and tools are applied, ensuring effective learning and skill development.

The program also draws upon best practices in teaching methodologies developed within the UNIVERSEH initiative, where dedicated instructional designers from AGH's eLearning Center (CEL) contribute to the design and delivery of innovative, student-centered learning experiences.

Students can tailor their educational paths by choosing one of the graduation pathways: upstream (focusing on the development and engineering of space systems), downstream (concentrating on applications of space technologies, such as data processing and analysis), or biomedical (addressing challenges in life sciences and health in space). The program incorporates good practices and practical examples drawn from both academia and the space sector, ensuring that graduates are prepared for the rapidly evolving demands of the space industry. A designated academic advisor maintains contact with student bodies and ensures the quality of education, fostering continuous improvement in the curriculum.

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

As part of the newly organized Faculty of Space Technologies, a Social Council will be established, consisting of representatives from the management and executive teams of companies and institutions associated with the space sector and collaborating with AGH. Council members will be surveyed annually regarding their needs and expectations for graduates of the Space Technologies program. The results of these surveys will be analyzed and considered in the development and modification of study programs to better align them with the current demands of the job market.

Duration, rules and form of the practical placement

The study program does not include mandatory professional internships.

Although a diploma internship is not mandatory as part of the second-cycle studies, students have the option to apply for such an internship with the dean's approval. Internships can be undertaken individually at companies or research laboratories aligned with the student's diploma work. Examples of key companies in Poland offering relevant opportunities include Astronika (mechanical devices for space missions), KP Labs (AI and onboard systems for satellites), Creotech Instruments (satellite systems and instruments), and SpaceForest (suborbital rockets and space technologies).
Alternatively, students may gain hands-on experience by participating in AGH student scientific clubs, such as AGH Space Systems or AGH Rover Team, contributing to research projects or preparing for international competitions. This flexibility allows students to develop practical skills and industry connections, enhancing their career prospects in the space sector.

Admission criteria, rules and policies

Field of study: Space Technologies

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

Candidates applying for admission to the program must possess qualifications at level 6 and an engineering diploma. Individuals who do not hold an engineering degree are subject to a separate recruitment process for a bridging semester aimed at filling gaps in engineering subjects (including mathematics, physics, and fundamentals of engineering). Upon completion of this semester, candidates may continue their studies in the second-cycle program.

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 admission order is determined by a ranking list based on examination results and the grades obtained in first-degree studies. More information is provided in here: https://rekrutacja.agh.edu.pl

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: 12. Maximum: 36

Learning outcomes

Field of study: Space Technologies

Knowledge

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
STE2A_W01	The student is aware of the importance of innovation and the transfer of space technologies to other industrial sectors. She/He possesses the competencies to initiate innovative solutions that can be applied both in the space industry and in everyday life, promoting technological advancement and personal development within engineering activities.	P7S_WG_A, P7S_WG_A_Inz
STE2A_W01_0	The student has knowledge of chemistry necessary to understand the fundamental chemical phenomena occurring in space elements and systems, as well as in their environment, and the properties of materials used in space.	P6S_WG_A_Inz
STE2A_W02	The student has advanced knowledge of materials engineering in space applications. She/he understands the specific properties of materials used in the space industry, including their strength, resistance to cosmic radiation, and the impact of extreme conditions on the performance of materials and structures in outer space.	P7S_WG_A, P7S_WG_A_Inz
STE2A_W02_0	The student has a basic knowledge of electronics and electrical engineering.	P6S_WG_A_Inz
STE2A_W03	The student has knowledge in spacecraft systems and engineering. She/he understands the principles of designing, integrating, and operating space systems, including propulsion, communication, and avionics systems. She/he is able to assess the interactions between various subsystems to ensure their optimal performance and the efficient use of resources.	P7S_WG_A, P7S_WK_A, P7S_WK_A_Inz, P7S_WG_A_Inz
STE2A_W03_0	The student has knowledge in the field of physics, including oscillatory and wave motion, thermodynamics, optics, electricity and magnetism, as well as solid-state physics. This knowledge is essential for understanding the fundamental physical phenomena occurring in mechatronic components and systems, as well as in their environment.	P6S_WG_A_Inz
STE2A_W04	The student understands the fundamentals of space biology and medicine. She/he has knowledge of the effects of space conditions, such as microgravity, radiation, and isolation, on human health and understands the mechanisms of the body's adaptation to these conditions.	P7S_WG_A, P7S_WK_A
STE2A_W04_0	The student has a well-structured and theoretically grounded knowledge in the field of technical mechanics, which is necessary for formulating and solving problems related to space technologies.	P6S_WK_A_Inz
STE2A_W05	The student understands the principles of signal processing and data analysis in the context of space technologies. She/he is able to apply methods for processing signals from sensors and onboard instruments, analyze satellite data, and process images from Earth observation systems for space-related applications.	P7S_WG_A, P7S_WG_A_Inz
STE2A_W05_0	The student has an extended and in-depth knowledge of mathematics, encompassing algebra, analysis, probability, as well as elements of discrete and applied mathematics, including mathematical methods and numerical methods essential for formulating and solving complex problems in the field of mechatronics.	P6S_WG_A_Inz
STE2A_W06	The student has knowledge of satellite communication systems and ground receiving stations. She/he understands the principles of communication systems used in space technologies, including data transmission between spacecraft and Earth, and is able to analyze transmission parameters and technical limitations.	P7S_WG_A, P7S_WG_A_Inz
STE2A_W06_0	The student knows and understands the key terms and principles of modern software development and systems engineering.	P6S_WG_A_Inz
STE2A_W07	The student has knowledge of space robotics and autonomous control systems. She/he understands the principles of robots used in space missions, including planetary exploration robots, and is capable of designing and implementing autonomous control and manipulation systems in space environments.	P7S_WG_A, P7S_WG_A_Inz

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
STE2A_W08	The student knows and understands the key terms and principles of modern software development, data engineering, and machine learning models, tools, methodologies, frameworks, and architectures in the context of space applications. They can select, assess, and apply appropriate system design, data engineering and machine learning techniques, architecture, and implementation strategies to ensure mission-specific requirements, relevant quality and fault tolerance, optimal performance, and efficient use of limited resources in space systems.	P7S_WG_A_Inz
STE2A_W09	The student knows and understands the core physics of the two-body problem and motion in a central potential, the concept of Keplerian laws and elements, and all the main foundational concepts of orbital mechanics. He/she knows how to apply those to design, analyze, and optimize spacecraft trajectories in the context of mission analysis.	P7S_WG_A, P7S_WG_A_Inz
STE2A_W10	The student can apply the accrued knowledge in orbital mechanics and mission analysis in support to a space program or mission. He/she can participate in reviews and advise boards on mission designs in complex gravitational environments, supporting accurate navigation and sustainable operations in Earth-bound and interplanetary missions.	P7S_WG_A, P7S_WG_A_Inz
STE2A_W11	The student knows the fundamental concepts of special and general relativity, understanding how gravity influences the fabric of spacetime and affects the motion of objects in strong gravitational fields. The student can apply this knowledge to problems in astrophysics, cosmology, high-precision timing and positioning, with the aim of designing or reviewing advanced space systems and instruments for modern satellite applications.	P7S_WG_A_Inz, P7S_WG_A
STE2A_W12	The student has knowledge of the commercial space ecosystem, including startup models, innovation strategies, and public-private partnerships specific to the space sector, as well as regulatory and ethical considerations in aerospace.	P7S_WG_A
STE2A_W13	The student is familiar with methodologies of space research, structure and standards for publishing aerospace research, and understanding of space mission documentation and reporting protocols.	P7S_WK_A
STE2A_W14	The student knows and understands the planetary environment of following bodies in Solar system such as: Moon, Mars, Venus, Mars and Jupiter moons, asteroids and comets. He/she knows how to transfer these environmental conditions into required parameters of spacecraft and its subsystems.	P7S_WG_A_Inz
STE2A_W15	The student knows and understands ECSS (European Cooperation for Space Standardisation) norms and its role in satellites and scientific payloads development.	P7S_WG_A_Inz

Skills

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
STE2A_U01	The student is able to design, model, and analyze spaceflight trajectories and plan space missions. She/he can utilize engineering tools for simulating and optimizing orbits, as well as predicting the motion of objects in outer space.	P7S_UW_A_Inz_02 , P7S_UW_A_Inz_01 , P7S_UU_A, P7S_UO_A, P7S_UK_A, P7S_UW_A
STE2A_U01_0	The student is able to work independently and in a team; can estimate the time needed to complete a given task; and is capable of developing and implementing a work schedule that ensures deadlines are met.	P6S_UW_A_Inz_01
STE2A_U02	The student is able to design and integrate spacecraft systems and manage their operation. She/he can coordinate work on propulsion, power, and telecommunications systems, ensuring their compliance with mission objectives and technological requirements.	P7S_UW_A_Inz_02 , P7S_UW_A_Inz_01 , P7S_UU_A, P7S_UO_A, P7S_UK_A, P7S_UW_A
STE2A_U02_0	The student can formulate the specification for simple mechatronic systems at the level of their functions.	P6S_UW_A_Inz_01

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
STE2A_U03	The student is able to analyze and interpret satellite data and process images from space missions. She/he can utilize advanced signal and image processing techniques, as well as software for analyzing data from onboard instruments.	P7S_UW_A_Inz_02 , P7S_UW_A_Inz_01 , P7S_UU_A, P7S_UO_A, P7S_UK_A, P7S_UW_A
STE2A_U03_0	The student can formulate algorithms and uses high-level programming languages and appropriate software tools to develop computer programs.	P6S_UW_A_Inz_02
STE2A_U04	The student is able to design and program space robotics systems and autonomous units for space exploration. She/he can develop control algorithms for space robots and solve problems related to navigation and manipulation in extraterrestrial environments.	P7S_UW_A_Inz_02 , P7S_UW_A_Inz_01 , P7S_UU_A, P7S_UO_A, P7S_UK_A, P7S_UW_A
STE2A_U04_0	The student can assess the importance and understands the non-technical aspects and consequences of an engineer's activities, including their impact on the environment, as well as the responsibility associated with the decisions made.	P6S_UW_A_Inz_01
STE2A_U05	The student is able to design and develop telecommunication systems for space missions and manage ground receiving stations. She/he can configure data transmission systems, monitor signal quality, and diagnose issues related to communication between spacecraft and Earth.	P7S_UW_A_Inz_02 , P7S_UW_A_Inz_01 , P7S_UU_A, P7S_UO_A, P7S_UK_A, P7S_UW_A
STE2A_U06	The student is able to conduct analyses of the durability of materials and structures used in space technologies. She/he can assess the impact of extreme conditions in space, such as cosmic radiation and temperature fluctuations, on materials and structures, and design appropriate engineering solutions.	P7S_UW_A_Inz_02 , P7S_UW_A_Inz_01 , P7S_UU_A, P7S_UO_A, P7S_UK_A, P7S_UW_A
STE2A_U07	The student is able to manage risk and optimize logistical processes and supply chains in the context of space missions. She/he can plan and oversee individual stages of a mission, minimizing operational risk and optimizing the use of resources and technology in space projects.	P7S_UU_A, P7S_UO_A, P7S_UK_A, P7S_UW_A
STE2A_U08	The student speaks a specialized foreign language at the B2+ level, sufficient to communicate, read and understand professional literature, as well as prepare and deliver a presentation on the implementation of a project or research task	P7S_UK_A
STE2A_U09	The student has the ability to identify, analyze, and solve complex technical and strategic challenges in the space sector, with a focus on innovation in areas such as satellite technology, materials for space applications, and lunar exploration systems.	P7S_UW_A
STE2A_U10	The student is skilled in communicating complex space-related concepts in both scientific and business contexts, essential for collaborating with agencies, presenting to stakeholders, and publishing findings in the space industry.	P7S_UW_A
STE2A_U11	The student will be able to use biomedical engineering methods and tools, including designing materials, structures, methods, and devices; applying design patterns; selecting design support tools; and choosing prototyping and testing methods. Will also be able to analyse and critically evaluate the operation and technical solutions used in selected medical devices.	P7S_UW_A_Inz_01 , P7S_UW_A
STE2A_U12	The student will be able to recognise and respond effectively to medical situations, as well as understand how dietary choices can support disease prevention and psychological well-being in challenging conditions.	P7S_UW_A

Social competence

KEU symbol	Learning outcomes prescribed to a field of study	CEU symbol
STE2A_K01	The student is aware of global challenges related to space exploration and the importance of international cooperation in space projects. She/he understands the impact of space technology development on the economy, society, and ecosystems, and is capable of promoting sustainable development in the context of the space industry.	P7S_KR_A, P7S_KO_A, P7S_KK_A
STE2A_K02	The student possesses the skills for effective teamwork in interdisciplinary engineering teams and the competence to lead space projects. She/he is able to manage teams and research and development processes, effectively communicating with other specialists and making decisions in the dynamic and complex environment of space technologies.	P7S_KR_A, P7S_KO_A, P7S_KK_A
STE2A_K03	The student is aware of the importance of innovation and the transfer of space technologies to other industrial sectors. She/he has the competence to initiate innovative solutions that can be applied both in the space industry and in everyday life, promoting technological advancement and personal development within engineering activities.	P7S_KR_A, P7S_KO_A, P7S_KK_A
STE2A_K04	The student has the ability to effectively collaborate within international, cross-disciplinary teams involving engineers, scientists, business strategists, and government agencies in complex space projects, fostering a strong sense of teamwork and inclusivity.	P7S_KR_A
STE2A_K05	The student demonstrates flexibility and openness to new technological advancements, emerging challenges, and multicultural perspectives, which are essential in the dynamic and globally collaborative space industry.	P7S_KR_A

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

Major: Space Technologies

Knowledge

CEU symbol	Learning outcomes for qualifications including engineering competence	KEU references
P6S_WG_A_Inz	knowledge of basic processes taking place in the life cycle of technical devices, facilities and systems	STE2A_W01_0, STE2A_W02_0, STE2A_W03_0, STE2A_W05_0, STE2A_W06_0
P6S_WK_A_Inz	knowledge of basic principles of creating and developing various forms of individual entrepreneurship	STE2A_W04_0
P7S_WG_A_Inz	knowledge of basic processes taking place in the life cycle of technical devices, facilities and systems	STE2A_W01, STE2A_W02, STE2A_W03, STE2A_W05, STE2A_W06, STE2A_W07, STE2A_W08, STE2A_W09, STE2A_W10, STE2A_W11, STE2A_W14, STE2A_W15
P7S_WK_A_Inz	knowledge of basic principles of creating and developing various forms of individual entrepreneurship	STE2A_W03

Skills

CEU symbol	Learning outcomes for qualifications including engineering competence	KEU references
P6S_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	STE2A_U01_0, STE2A_U02_0, STE2A_U04_0
P6S_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	STE2A_U03_0
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;	STE2A_U01, STE2A_U02, STE2A_U03, STE2A_U04, STE2A_U05, STE2A_U06, STE2A_U11
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	STE2A_U01, STE2A_U02, STE2A_U03, STE2A_U04, STE2A_U05, STE2A_U06

Field of study-prescribed outcomes coverage matrix

Field of study: Space Technologies

2024/2025/S/IIi/WTK/STE/all

Course	Code	Semestr	STE2A_W01	STE2A_W01_0	STE2A_W02	STE2A_W02_0	STE2A_W03	STE2A_W03_0	STE2A_W04	STE2A_W04_0	STE2A_W05	STE2A_W05_0	STE2A_W06	STE2A_W06_0	STE2A_W07	STE2A_W08	STE2A_W09	STE2A_W10	STE2A_W11	STE2A_W12	STE2A_W13	STE2A_W14	STE2A_W15	STE2A_U01	STE2A_U01_0	STE2A_U02	STE2A_U02_0	STE2A_U03	STE2A_U03_0	STE2A_U04	STE2A_U04_0	STE2A_U05	STE2A_U06	STE2A_U07	STE2A_U08	STE2A_U09	STE2A_U10	STE2A_U11	STE2A_U12	STE2A_K01	STE2A_K02	STE2A_K03	STE2A_K04	STE2A_K05
Signal Processing	WTKSTES.IIi1K.17902.24	1s									x																				x									x			
Spacecraft engineering and systems (U)	WTKSTES.IIi1K.17899.24	1s	x																			x	x			x								x						x	x	x		
Fluid Mechanics	WTKSTES.IIi1K.04346.24	1s	x																							x						x								x	x	x		
Embedded electronics and avionics	WTKSTES.IIi1K.17900.24	1s					x				x															x		x		x											x	x		
Space Biology and Astrobiology I	WTKSTES.IIi1K.17999.24	1s					x		x												x												x	x	x	x			x	x	x	x	x
Experiments on rockets and balloons	WTKSTES.IIi1K.17906.24	1s	x		x		x																						x		x	x								x			
Spacecraft engineering and systems (B)	WTKSTES.IIi1K.17907.24	1s	x				x		x													x	x			x								x	x					x	x	x		
Remote Sensing and Image Analysis in Space Tech	WTKSTES.IIi1K.17903.24	1s									x		x															x												x	x	x		
Orbital mechanics and mission analysis	WTKSTES.IIi1P.17889.24	1s															x	x						x																	x	x		
Space engineering I	WTKSTES.IIi1P.17890.24	1s	x				x																	x				x												x		x		
Students Club I	WTKSTES.IIi1P.17891.24	1s	x				x															x	x					x		x				x	x	x			x	x		x	x
Materials for Space	WTKSTES.IIi1P.17892.24	1s			x																											x								x				
Space robotics and control theory	WTKSTES.IIi1P.17893.24	1s	x																x										x												x				
Social dimensions of space exploration	WTKSTES.IIi1P.17894.24	1s	x																	x																x	x			x	x		x	x
Astrophysics and Astronomy	WTKSTES.IIi1P.17895.24	1s														x	x		x		x							x							x	x	x							
English for Space Technology B2+	WTKSTES.IIi1JO.17896.24	1s																																x										
Space resources and robotics (summer school)	WTKSTES.IIi2K.17914.24	2s	x		x		x								x													x		x				x						x	x	x		

Course	Code	Semestr	STE2A_W01	STE2A_W01_0	STE2A_W02	STE2A_W02_0	STE2A_W03	STE2A_W03_0	STE2A_W04	STE2A_W04_0	STE2A_W05	STE2A_W05_0	STE2A_W06	STE2A_W06_0	STE2A_W07	STE2A_W08	STE2A_W09	STE2A_W10	STE2A_W11	STE2A_W12	STE2A_W13	STE2A_W14	STE2A_W15	STE2A_U01	STE2A_U01_0	STE2A_U02	STE2A_U02_0	STE2A_U03	STE2A_U03_0	STE2A_U04	STE2A_U04_0	STE2A_U05	STE2A_U06	STE2A_U07	STE2A_U08	STE2A_U09	STE2A_U10	STE2A_U11	STE2A_U12	STE2A_K01	STE2A_K02	STE2A_K03	STE2A_K04	STE2A_K05
Attitude determination and control of small satellites	WTKSTES.IIi2K.17917.24	2s					x				x				x											x								x						x				
Space Payload Design	WTKSTES.IIi2K.17918.24	2s			x		x									x						x	x			x				x			x						x				
Space propulsion and rocket performance	WTKSTES.IIi2K.17919.24	2s	x				x																			x								x						x	x	x		
Aerodynamics and Aeroelasticity	WTKSTES.IIi2K.17920.24	2s	x																							x								x						x	x	x		
Bioastronautics	WTKSTES.IIi2K.17934.24	2s	x		x		x		x		x															x				x		x	x	x	x					x	x	x		
English for Space Technology C1/C2	WTKSTES.IIi2JO.17908.24	2s																																	x										
Automated workflows in satellite image processing	WTKSTES.IIi2K.17921.24	2s	x				x				x																x													x	x				
Planetary bodies exploration	WTKSTES.IIi2K.17915.24	2s			x										x							x	x							x			x							x	x				
Machine Learning for space applications	WTKSTES.IIi2K.17922.24	2s	x								x					x		x						x			x		x											x	x	x		
Space Biology and Astrobiology II	WTKSTES.IIi2K.18000.24	2s					x		x										x		x													x	x	x	x			x	x	x	x	x
Data engineering for space applications	WTKSTES.IIi2K.17996.24	2s	x								x					x		x						x		x		x		x				x						x		x		
Satellite telecommunications and ground stations	WTKSTES.IIi2K.17924.24	2s					x						x														x				x										x				
General Relativity and Space Applications	WTKSTES.IIi2S.18001.24	2s	x																x																	x					x	x	x	x	x
Human Spaceflight: Medical and Technological Challenges	WTKSTES.IIi2K.17998.24	2s			x		x		x																													x	x	x	x			
Entrepreneurships, IP protection, Business psychology/StartTech/Design Thinking, Ethics	WTKSTES.IIi2HS.17909.24	2s	x																	x														x		x				x	x	x	x	x
Space Mission - Risk, Sustainability and Supply Chain Optimization	WTKSTES.IIi2K.17910.24	2s	x				x				x		x		x	x								x		x								x	x	x								
Space engineering II	WTKSTES.IIi2O.17911.24	2s	x				x																	x				x												x		x		
Students Club II	WTKSTES.IIi2O.17912.24	2s	x				x															x	x	x		x								x	x					x	x			
Space hackaton	WTKSTES.IIi4HS.17931.24	3s	x																	x															x	x	x				x		x	x	x

Course	Code	Semestr	STE2A_W01	STE2A_W01_0	STE2A_W02	STE2A_W02_0	STE2A_W03	STE2A_W03_0	STE2A_W04	STE2A_W04_0	STE2A_W05	STE2A_W05_0	STE2A_W06	STE2A_W06_0	STE2A_W07	STE2A_W08	STE2A_W09	STE2A_W10	STE2A_W11	STE2A_W12	STE2A_W13	STE2A_W14	STE2A_W15	STE2A_U01	STE2A_U01_0	STE2A_U02	STE2A_U02_0	STE2A_U03	STE2A_U03_0	STE2A_U04	STE2A_U04_0	STE2A_U05	STE2A_U06	STE2A_U07	STE2A_U08	STE2A_U09	STE2A_U10	STE2A_U11	STE2A_U12	STE2A_K01	STE2A_K02	STE2A_K03	STE2A_K04	STE2A_K05
Diploma Thesis	WTKSTES.IIi4K.01412.24	3s	x		x		x								x		x	x		x	x			x		x								x	x			x		x	x	x
Interpersonal skills	WTKSTES.IIi4HS.17932.24	3s	x																															x	x			x	x		x	x
Space engineering III	WTKSTES.IIi4O.17928.24	3s	x				x																	x			x												x		x		
Students Club III	WTKSTES.IIi4O.17929.24	3s	x				x															x	x	x		x		x		x		x	x	x					x	x			
Diploma Seminar	WTKSTES.IIi4K.01432.24	3s	x		x		x		x		x		x		x		x	x	x							x								x					x	x	x		
Science communication	WTKSTES.IIi4HS.17930.24	3s	x																	x	x			x											x	x			x	x	x	x	x
English for Engineering	WTKSTES.IIi80000JO.17882.24	20s																							x																			
Mathematics in engineering calculations	WTKSTES.IIi80000P.17883.24	20s										x													x																			
Physics 1	WTKSTES.IIi80000P.03161.24	20s						x		x																	x																	
Chemistry	WTKSTES.IIi80000P.01361.24	20s		x																												x											
Introduction to mechanics of the materials	WTKSTES.IIi80000P.17884.24	20s		x				x		x															x		x				x													
Mechanical Structures I	WTKSTES.IIi80000P.17885.24	20s								x															x		x																	
Basics of electronics	WTKSTES.IIi80000P.17886.24	20s				x					x														x	x		x																
Essentials of software development and systems engineering	WTKSTES.IIi80000P.17997.24	20s												x															x															
Engineering Project	WTKSTES.IIi80000P.17888.24	20s				x				x															x		x																	
Sum (obligatory):			23	2	7	2	21	2	6	4	11	1	4	1	4	5	4	5	4	4	5	6	6	11	6	16	4	13	1	9	1	5	9	10	15	8	8	1	1	26	25	21	7	7
Sum (elective):			4	0	2	0	1	0	0	0	0	0	0	0	2	0	0	0	1	1	0	1	1	0	0	0	0	1	0	2	0	0	1	0	2	2	3	0	0	5	4	3	3	3
Sum:			27	2	9	2	22	2	6	4	11	1	4	1	6	5	4	5	5	5	5	7	7	11	6	16	4	14	1	11	1	5	10	10	17	10	11	1	1	31	29	24	10	10

Characteristics matrix of learning outcomes in relation to modules

Major: Space Technologies

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Course	Code	Semestr	P7S_WG_A	P7S_WG_A_Inz	P6S_WG_A_Inz	P7S_WK_A	P7S_WK_A_Inz	P6S_WK_A_Inz	P7S_UW_A_Inz_02	P7S_UW_A_Inz_01	P7S_UU_A	P7S_UO_A	P7S_UK_A	P7S_UW_A	P6S_UW_A_Inz_01	P6S_UW_A_Inz_02	P7S_KR_A	P7S_KO_A	P7S_KK_A
Signal Processing	WTKSTES.IIi1K.17902.24	1s	x	x					x	x	x	x	x	x			x	x	x
Spacecraft engineering and systems (U)	WTKSTES.IIi1K.17899.24	1s	x	x					x	x	x	x	x	x			x	x	x
Fluid Mechanics	WTKSTES.IIi1K.04346.24	1s	x	x					x	x	x	x	x	x			x	x	x
Embedded electronics and avionics	WTKSTES.IIi1K.17900.24	1s	x	x		x	x		x	x	x	x	x	x			x	x	x
Space Biology and Astrobiology I	WTKSTES.IIi1K.17999.24	1s	x	x		x	x				x	x	x	x			x	x	x
Experiments on rockets and balloons	WTKSTES.IIi1K.17906.24	1s	x	x		x	x		x	x	x	x	x	x			x	x	x
Spacecraft engineering and systems (B)	WTKSTES.IIi1K.17907.24	1s	x	x		x	x		x	x	x	x	x	x			x	x	x
Remote Sensing and Image Analysis in Space Tech	WTKSTES.IIi1K.17903.24	1s	x	x					x	x	x	x	x	x			x	x	x
Orbital mechanics and mission analysis	WTKSTES.IIi1P.17889.24	1s	x	x					x	x	x	x	x	x			x	x	x
Space engineering I	WTKSTES.IIi1P.17890.24	1s	x	x		x	x		x	x	x	x	x	x			x	x	x
Students Club I	WTKSTES.IIi1P.17891.24	1s	x	x		x	x		x	x	x	x	x	x			x	x	x
Materials for Space	WTKSTES.IIi1P.17892.24	1s	x	x					x	x	x	x	x	x			x	x	x
Space robotics and control theory	WTKSTES.IIi1P.17893.24	1s	x	x					x	x	x	x	x	x			x	x	x
Social dimensions of space exploration	WTKSTES.IIi1P.17894.24	1s	x	x										x			x	x	x
Astrophysics and Astronomy	WTKSTES.IIi1P.17895.24	1s	x	x		x			x	x	x	x	x	x					

Course	Code	Semestr	P7S_WG_A	P7S_WG_A_Inz	P6S_WG_A_Inz	P7S_WK_A	P7S_WK_A_Inz	P6S_WK_A_Inz	P7S_UW_A_Inz_02	P7S_UW_A_Inz_01	P7S_UU_A	P7S_UO_A	P7S_UK_A	P7S_UW_A	P6S_UW_A_Inz_01	P6S_UW_A_Inz_02	P7S_KR_A	P7S_KO_A	P7S_KK_A
English for Space Technology B2+	WTKSTES.IIi1JO.17896.24	1s											x						
Space resources and robotics (summer school)	WTKSTES.IIi2K.17914.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
Attitude determination and control of small satellites	WTKSTES.IIi2K.17917.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
Space Payload Design	WTKSTES.IIi2K.17918.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
Space propulsion and rocket performance	WTKSTES.IIi2K.17919.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
Aerodynamics and Aeroelasticity	WTKSTES.IIi2K.17920.24	2s	x	x					x	x	x	x	x	x			x	x	x
Bioastronautics	WTKSTES.IIi2K.17934.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
English for Space Technology C1/C2	WTKSTES.IIi2JO.17908.24	2s											x						
Automated workflows in satellite image processing	WTKSTES.IIi2K.17921.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
Planetary bodies exploration	WTKSTES.IIi2K.17915.24	2s	x	x					x	x	x	x	x	x			x	x	x
Machine Learning for space applications	WTKSTES.IIi2K.17922.24	2s	x	x					x	x	x	x	x	x			x	x	x
Space Biology and Astrobiology II	WTKSTES.IIi2K.18000.24	2s	x	x		x	x				x	x	x	x			x	x	x
Data engineering for space applications	WTKSTES.IIi2K.17996.24	2s	x	x					x	x	x	x	x	x			x	x	x
Satellite telecommunications and ground stations	WTKSTES.IIi2K.17924.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
General Relativity and Space Applications	WTKSTES.IIi2S.18001.24	2s	x	x										x			x	x	x
Human Spaceflight: Medical and Technological Challenges	WTKSTES.IIi2K.17998.24	2s	x	x		x	x			x				x			x	x	x
Entrepreneurships, IP protection, Business psychology/StartTech/Design Thinking, Ethics	WTKSTES.IIi2HS.17909.24	2s	x	x									x	x			x	x	x
Space Mission - Risk, Sustainability and Supply Chain Optimization	WTKSTES.IIi2K.17910.24	2s	x	x		x	x		x	x	x	x	x	x					

Course	Code	Semestr	P7S_WG_A	P7S_WG_A_Inz	P6S_WG_A_Inz	P7S_WK_A	P7S_WK_A_Inz	P6S_WK_A_Inz	P7S_UW_A_Inz_02	P7S_UW_A_Inz_01	P7S_UU_A	P7S_UO_A	P7S_UK_A	P7S_UW_A	P6S_UW_A_Inz_01	P6S_UW_A_Inz_02	P7S_KR_A	P7S_KO_A	P7S_KK_A
Space engineering II	WTKSTES.IIi2O.17911.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
Students Club II	WTKSTES.IIi2O.17912.24	2s	x	x		x	x		x	x	x	x	x	x			x	x	x
Space hackaton	WTKSTES.IIi4HS.17931.24	3s	x	x									x	x			x	x	x
Diploma Thesis	WTKSTES.IIi4K.01412.24	3s	x	x		x	x		x	x	x	x	x	x			x	x	x
Interpersonal skills	WTKSTES.IIi4HS.17932.24	3s	x	x										x			x	x	x
Space engineering III	WTKSTES.IIi4O.17928.24	3s	x	x		x	x		x	x	x	x	x	x			x	x	x
Students Club III	WTKSTES.IIi4O.17929.24	3s	x	x		x	x		x	x	x	x	x	x			x	x	x
Diploma Seminar	WTKSTES.IIi4K.01432.24	3s	x	x		x	x		x	x	x	x	x	x			x	x	x
Science communication	WTKSTES.IIi4HS.17930.24	3s	x	x		x			x	x	x	x	x	x			x	x	x
English for Engineering	WTKSTES.IIi80000JO.17882.24	20s													x				
Mathematics in engineering calculations	WTKSTES.IIi80000P.17883.24	20s			x										x				
Physics 1	WTKSTES.IIi80000P.03161.24	20s			x			x							x				
Chemistry	WTKSTES.IIi80000P.01361.24	20s			x				x	x	x	x	x	x					
Introduction to mechanics of the materials	WTKSTES.IIi80000P.17884.24	20s			x			x							x				
Mechanical Structures I	WTKSTES.IIi80000P.17885.24	20s						x							x				
Basics of electronics	WTKSTES.IIi80000P.17886.24	20s	x	x	x				x	x	x	x	x	x	x				
Essentials of software development and systems engineering	WTKSTES.IIi80000P.17997.24	20s			x											x			
Engineering Project	WTKSTES.IIi80000P.17888.24	20s			x			x							x				
Sum (obligatory):			36	36	7	23	21	4	32	33	34	34	37	37	7	1	33	33	33

Course	Code	Semestr	P7S_WG_A	P7S_WG_A_Inz	P6S_WG_A_Inz	P7S_WK_A	P7S_WK_A_Inz	P6S_WK_A_Inz	P7S_UW_A_Inz_02	P7S_UW_A_Inz_01	P7S_UU_A	P7S_UO_A	P7S_UK_A	P7S_UW_A	P6S_UW_A_Inz_01	P6S_UW_A_Inz_02	P7S_KR_A	P7S_KO_A	P7S_KK_A
Sum (elective):			5	5	0	1	1	0	2	2	2	2	3	5	0	0	5	5	5
Sum:			41	41	7	24	22	4	34	35	36	36	40	42	7	1	38	38	38

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

Major: Space Technologies

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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
Signal Processing	Lectures, Laboratory classes	Examination, Execution of laboratory classes	STE2A_W05, STE2A_U05, STE2A_K03
Spacecraft engineering and systems (U)	Lectures, Laboratory classes	Execution of a project, Test, Presentation, Execution of exercises, Involvement in teamwork, Completion of laboratory classes	STE2A_W01, STE2A_W14, STE2A_W15, STE2A_U02, STE2A_U07, STE2A_K01, STE2A_K02, STE2A_K03
Fluid Mechanics	Lectures, Laboratory classes	Test, Completion of laboratory classes	STE2A_W01, STE2A_U02, STE2A_U06, STE2A_U08, STE2A_K01, STE2A_K02, STE2A_K03
Embedded electronics and avionics	Lectures, Laboratory classes	Presentation, Preparation and conduct of scientific research	STE2A_W05, STE2A_W03, STE2A_U04, STE2A_U03, STE2A_U02, STE2A_K02, STE2A_K03
Space Biology and Astrobiology I	Lectures, Laboratory classes, Project classes	Test, Report, Report	STE2A_W04, STE2A_W03, STE2A_W13, STE2A_U07, STE2A_U09, STE2A_U08, STE2A_U10, STE2A_K02, STE2A_K03, STE2A_K04, STE2A_K01, STE2A_K05
Experiments on rockets and balloons	Lectures, Laboratory classes, Project classes	Test, Execution of laboratory classes, Work done within the framework of a practical placement, Involvement in teamwork, Completion of laboratory classes, Report on completion of a practical placement, Presentation	STE2A_W01, STE2A_W02, STE2A_W03, STE2A_U04, STE2A_U05, STE2A_U06, STE2A_K02
Spacecraft engineering and systems (B)	Lectures, Laboratory classes	Execution of a project, Test, Examination, Presentation, Execution of exercises, Involvement in teamwork, Completion of laboratory classes	STE2A_W01, STE2A_W14, STE2A_W15, STE2A_W03, STE2A_W04, STE2A_U02, STE2A_U07, STE2A_U08, STE2A_K01, STE2A_K02, STE2A_K03
Remote Sensing and Image Analysis in Space Tech	Lectures, Laboratory classes	Test, Test, Project, Completion of laboratory classes	STE2A_W05, STE2A_W06, STE2A_U03, STE2A_K01, STE2A_K03, STE2A_K02
Orbital mechanics and mission analysis	Lectures, Project classes	Activity during classes, Examination, Involvement in teamwork, Execution of exercises, Completion of laboratory classes	STE2A_W09, STE2A_W10, STE2A_U01, STE2A_K02, STE2A_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
Space engineering I	Seminars	Activity during classes, Report on completion of a practical placement, Presentation	STE2A_W01, STE2A_W03, STE2A_U01, STE2A_U03, STE2A_K01, STE2A_K03
Students Club I	Participation in a student research club	Execution of a project	STE2A_W01, STE2A_W03, STE2A_W14, STE2A_W15, STE2A_U09, STE2A_U10, STE2A_U03, STE2A_U04, STE2A_U08, STE2A_K02, STE2A_K04, STE2A_K05, STE2A_K01
Materials for Space	Lectures, Laboratory classes	Project, Project	STE2A_W02, STE2A_U06, STE2A_K01
Space robotics and control theory	Lectures, Laboratory classes	Test, Test	STE2A_W01, STE2A_W11, STE2A_U04, STE2A_K02
Social dimensions of space exploration	Seminars	Test, Presentation	STE2A_W01, STE2A_W12, STE2A_U09, STE2A_U10, STE2A_K01, STE2A_K04, STE2A_K05, STE2A_K02
Astrophysics and Astronomy	Lectures, Laboratory classes	Activity during classes, Test, Execution of laboratory classes, Completion of laboratory classes	STE2A_W11, STE2A_W09, STE2A_W13, STE2A_W08, STE2A_U08, STE2A_U09, STE2A_U03, STE2A_U10
English for Space Technology B2+	Foreign language classes	Activity during classes, Participation in a discussion, Execution of exercises, Test, Examination, Report, Presentation	STE2A_U08
Space resources and robotics (summer school)	Lectures, Project classes, Fieldwork, Seminars	Execution of a project, Execution of a project, Involvement in teamwork, Execution of a project, Involvement in teamwork, Execution of a project, Involvement in teamwork	STE2A_W01, STE2A_W02, STE2A_W03, STE2A_W07, STE2A_U03, STE2A_U04, STE2A_U08, STE2A_K02, STE2A_K01, STE2A_K03
Attitude determination and control of small satellites	Lectures, Laboratory classes, Project classes	Test, Confirmation of completion of practical placement programme, Coordination, conduct of a research project, preparation of a scientific paper, organization, organization of conferences, camps and scientific trips.	STE2A_W05, STE2A_W03, STE2A_W07, STE2A_U02, STE2A_U08, STE2A_K02
Space Payload Design	Lectures, Laboratory classes	Participation in a discussion, Test results, Project, Report, Presentation	STE2A_W03, STE2A_W14, STE2A_W15, STE2A_W02, STE2A_W08, STE2A_U02, STE2A_U06, STE2A_U04, STE2A_K02
Space propulsion and rocket performance	Lectures, Laboratory classes, Project classes	Test, Involvement in teamwork, Presentation, Execution of exercises, Execution of a project, Execution of a project, Work done within the framework of a practical placement, Participation in scientific research, conferences, additional internships and training courses	STE2A_W01, STE2A_W03, STE2A_U06, STE2A_U02, STE2A_K01, STE2A_K02, STE2A_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
Aerodynamics and Aeroelasticity	Lectures, Laboratory classes	Test, Completion of laboratory classes	STE2A_W01, STE2A_U02, STE2A_U06, STE2A_K01, STE2A_K02, STE2A_K03
Bioastronautics	Lectures, Laboratory classes	Preparation and conduct of scientific research, Test, Report on completion of a practical placement, Work done within the framework of a practical placement, Confirmation of completion of practical placement programme	STE2A_W01, STE2A_W02, STE2A_W03, STE2A_W04, STE2A_W05, STE2A_U02, STE2A_U04, STE2A_U05, STE2A_U06, STE2A_U07, STE2A_U08, STE2A_K01, STE2A_K02, STE2A_K03
English for Space Technology C1/C2	Foreign language classes	Activity during classes, Participation in a discussion, Execution of exercises, Test, Report, Presentation	STE2A_U08
Automated workflows in satellite image processing	Lectures, Laboratory classes	Test, Test, Project, Completion of laboratory classes	STE2A_W05, STE2A_W01, STE2A_W03, STE2A_U03, STE2A_K02, STE2A_K01
Planetary bodies exploration	Lectures, Laboratory classes	Participation in a discussion, Examination, Project, Report, Presentation	STE2A_W07, STE2A_W14, STE2A_W15, STE2A_W02, STE2A_U04, STE2A_U06, STE2A_K01, STE2A_K02
Machine Learning for space applications	Lectures, Laboratory classes	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10, STE2A_U01, STE2A_U03, STE2A_U04, STE2A_K01, STE2A_K02, STE2A_K03
Space Biology and Astrobiology II	Lectures, Laboratory classes, Project classes	Examination, Report, Report	STE2A_W04, STE2A_W11, STE2A_W13, STE2A_W03, STE2A_U07, STE2A_U09, STE2A_U08, STE2A_U10, STE2A_K02, STE2A_K03, STE2A_K04, STE2A_K01, STE2A_K05
Data engineering for space applications	Lectures, Laboratory classes	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10, STE2A_U01, STE2A_U03, STE2A_U07, STE2A_U02, STE2A_U04, STE2A_K01, STE2A_K03
Satellite telecommunications and ground stations	Lectures, Laboratory classes	Examination, Oral answer, Execution of laboratory classes, Report	STE2A_W03, STE2A_W06, STE2A_U05, STE2A_U03, STE2A_K01
General Relativity and Space Applications	Lectures, Project classes	Participation in a discussion, Case study, Activity during classes, Execution of exercises	STE2A_W11, STE2A_W01, STE2A_U10, STE2A_K01, STE2A_K02, STE2A_K03, STE2A_K04, STE2A_K05
Human Spaceflight: Medical and Technological Challenges	Lectures, Laboratory classes, Project classes, Seminars	Examination, Activity during classes, Test results, Project, Engineering project, Presentation	STE2A_W04, STE2A_W02, STE2A_W03, STE2A_U11, STE2A_U12, STE2A_K01, STE2A_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
Entrepreneurships, IP protection, Business psychology/StartTech/Design Thinking, Ethics	Lectures, Project classes, Discussion seminars	Test, Activity during classes, Project, Presentation	STE2A_W01, STE2A_W12, STE2A_U08, STE2A_U10, STE2A_K01, STE2A_K03, STE2A_K04, STE2A_K05, STE2A_K02
Space Mission - Risk, Sustainability and Supply Chain Optimization	Lectures, Project classes	Execution of a project, Test, Examination, Participation in a discussion, Execution of exercises, Execution of a project, Examination, Engineering project, Involvement in teamwork, Presentation	STE2A_W01, STE2A_W03, STE2A_W05, STE2A_W06, STE2A_W07, STE2A_W08, STE2A_U01, STE2A_U02, STE2A_U07, STE2A_U08, STE2A_U09
Space engineering II	Seminars	Activity during classes, Report on completion of a practical placement, Presentation	STE2A_W01, STE2A_W03, STE2A_U01, STE2A_U03, STE2A_K01, STE2A_K03
Students Club II	Participation in a student research club	Work done within the framework of a practical placement	STE2A_W01, STE2A_W03, STE2A_W14, STE2A_W15, STE2A_U01, STE2A_U02, STE2A_U07, STE2A_U08, STE2A_K02, STE2A_K01
Space hackaton	Lectures, Auditorium classes	Presentation, Presentation, Participation in scientific research, conferences, additional internships and training courses	STE2A_W01, STE2A_W12, STE2A_U08, STE2A_U09, STE2A_U10, STE2A_K01, STE2A_K03, STE2A_K04, STE2A_K05
Diploma Thesis	Diploma Thesis	Diploma thesis	STE2A_W01, STE2A_W03, STE2A_W10, STE2A_W12, STE2A_W02, STE2A_W07, STE2A_W09, STE2A_W13, STE2A_U01, STE2A_U02, STE2A_U07, STE2A_U09, STE2A_U10, STE2A_K01, STE2A_K03, STE2A_K04, STE2A_K05
Interpersonal skills	Lectures, Auditorium classes	Oral answer, Execution of exercises	STE2A_W01, STE2A_U09, STE2A_U10, STE2A_K02, STE2A_K04, STE2A_K05, STE2A_K01
Space engineering III	Seminars	Activity during classes, Report on completion of a practical placement, Presentation	STE2A_W01, STE2A_W03, STE2A_U01, STE2A_U03, STE2A_K01, STE2A_K03
Students Club III	Participation in a student research club	Execution of a project	STE2A_W01, STE2A_W03, STE2A_W14, STE2A_W15, STE2A_U01, STE2A_U02, STE2A_U03, STE2A_U04, STE2A_U05, STE2A_U06, STE2A_U07, STE2A_U08, STE2A_K02, STE2A_K01
Diploma Seminar	Seminars	Review of a thesis, Diploma thesis preparation	STE2A_W01, STE2A_W02, STE2A_W03, STE2A_W04, STE2A_W05, STE2A_W06, STE2A_W07, STE2A_W11, STE2A_W09, STE2A_W10, STE2A_U02, STE2A_U08, STE2A_K01, STE2A_K02, STE2A_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
Science communication	Lectures, Auditorium classes	Project, Presentation, Participation in a discussion, Execution of exercises, Execution of a project, Involvement in teamwork	STE2A_W01, STE2A_W13, STE2A_W12, STE2A_U01, STE2A_U09, STE2A_U10, STE2A_K01, STE2A_K02, STE2A_K03, STE2A_K04, STE2A_K05
English for Engineering	Foreign language classes	Activity during classes, Participation in a discussion, Test, Report, Presentation	STE2A_U01_0
Mathematics in engineering calculations	Lectures, Auditorium classes	Activity during classes, Test, Oral answer	STE2A_W05_0, STE2A_U01_0
Physics 1	Lectures, Auditorium classes	Examination, Activity during classes, Test	STE2A_W03_0, STE2A_W04_0, STE2A_U02_0
Chemistry	Lectures, Auditorium classes, Laboratory classes, Project classes	Test, Test results, Execution of laboratory classes, Test, Report, Project	STE2A_W01_0, STE2A_U06
Introduction to mechanics of the materials	Lectures, Laboratory classes, Project classes	Test, Examination, Activity during classes, Test results, Execution of a project, Report, Presentation	STE2A_W01_0, STE2A_W03_0, STE2A_W04_0, STE2A_U01_0, STE2A_U02_0, STE2A_U04_0
Mechanical Structures I	Lectures, Laboratory classes	Test, Test	STE2A_W04_0, STE2A_U01_0, STE2A_U02_0
Basics of electronics	Laboratory classes, Project classes, Discussion seminars	Report, Completion of laboratory classes, Engineering project, Activity during classes, Participation in a discussion, Oral answer	STE2A_W02_0, STE2A_W05, STE2A_U01_0, STE2A_U02, STE2A_U03
Essentials of software development and systems engineering	Lectures, Laboratory classes	Examination, Activity during classes, Execution of laboratory classes, Completion of laboratory classes	STE2A_W06_0, STE2A_U03_0
Engineering Project	Project classes, Lectures	Project, Oral answer	STE2A_W02_0, STE2A_W04_0, STE2A_U01_0, STE2A_U02_0

Study plans

Field of study: Space Technologies

Semester 1

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Orbital mechanics and mission analysis	Lectures: 24 Project classes: 30	4	Exam	Obligatory
Space engineering I	Seminars: 25	1	Completing the classes	Obligatory
Students Club I	Participation in a student research club: 0	2	Completing the classes	Obligatory
Materials for Space	Lectures: 30 Laboratory classes: 15	3	Completing the classes	Obligatory
Space robotics and control theory	Lectures: 15 Laboratory classes: 30	3	Completing the classes	Obligatory
Social dimensions of space exploration	Seminars: 30	2	Completing the classes	Obligatory
Astrophysics and Astronomy	Lectures: 20 Laboratory classes: 20	3	Completing the classes	Obligatory
English for Space Technology B2+	Foreign language classes: 30	2	Exam	Obligatory
Graduation path – sem. 1		10	Completing the classes	Obligatory
The student chooses one path and completes all subjects assigned to it				
Upstream		10	Completing the classes	Elective
Spacecraft engineering and systems (U)	Lectures: 30 Laboratory classes: 21	4	Exam	Obligatory
Fluid Mechanics	Lectures: 20 Laboratory classes: 25	3	Completing the classes	Obligatory
Embedded electronics and avionics	Lectures: 15 Laboratory classes: 30	3	Completing the classes	Obligatory

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Biomedical		10	Completing the classes	Elective
Space Biology and Astrobiology I	Lectures: 15 Laboratory classes: 15 Project classes: 8	3	Completing the classes	Obligatory
Experiments on rockets and balloons	Lectures: 15 Laboratory classes: 15 Project classes: 15	3	Completing the classes	Obligatory
Spacecraft engineering and systems (B)	Lectures: 30 Laboratory classes: 21	4	Completing the classes	Obligatory
Downstream		10	Completing the classes	Elective
Signal Processing	Lectures: 30 Laboratory classes: 35	4	Exam	Obligatory
Remote Sensing and Image Analysis in Space Tech	Lectures: 15 Laboratory classes: 60	6	Completing the classes	Obligatory
Sum	**403**	**30**		

Semester 2

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
English for Space Technology C1/C2	Foreign language classes: 30	2	Completing the classes	Obligatory
Entrepreneurships, IP protection, Business psychology/StartTech/Design Thinking, Ethics	Lectures: 30 Project classes: 30 Discussion seminars: 7	4	Completing the classes	Obligatory
Space Mission - Risk, Sustainability and Supply Chain Optimization	Lectures: 15 Project classes: 15	3	Exam	Obligatory
Space engineering II	Seminars: 15	1	Completing the classes	Obligatory
Graduation path – sem. 2		15	Completing the classes	Obligatory
The student chooses one path and completes all subjects assigned to it				

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Upstream		15	Completing the classes	Elective
Attitude determination and control of small satellites	Lectures: 16 Laboratory classes: 28 Project classes: 14	4	Completing the classes	Obligatory
Space Payload Design	Lectures: 15 Laboratory classes: 30	4	Completing the classes	Obligatory
Space propulsion and rocket performance	Lectures: 21 Laboratory classes: 21 Project classes: 14	4	Completing the classes	Obligatory
Aerodynamics and Aeroelasticity	Lectures: 15 Laboratory classes: 30	3	Completing the classes	Obligatory
Downstream		15	Completing the classes	Elective
Automated workflows in satellite image processing	Lectures: 10 Laboratory classes: 45	4	Completing the classes	Obligatory
Machine Learning for space applications	Lectures: 30 Laboratory classes: 30	3	Completing the classes	Obligatory
Data engineering for space applications	Lectures: 30 Laboratory classes: 30	3	Completing the classes	Obligatory
Satellite telecommunications and ground stations	Lectures: 30 Laboratory classes: 15	5	Exam	Obligatory
Biomedical		15	Completing the classes	Elective
Bioastronautics	Lectures: 15 Laboratory classes: 45	5	Completing the classes	Obligatory
Space Biology and Astrobiology II	Lectures: 15 Laboratory classes: 30 Project classes: 20	5	Exam	Obligatory
Human Spaceflight: Medical and Technological Challenges	Lectures: 30 Laboratory classes: 30 Project classes: 20 Seminars: 10	5	Exam	Obligatory
Elective group		3	Completing the classes	Obligatory

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Space resources and robotics (summer school)	Lectures: 9 Project classes: 9 Seminars: 6 Fieldwork: 6	3	Completing the classes	Elective
Planetary bodies exploration	Lectures: 15 Laboratory classes: 15	3	Completing the classes	Elective
General Relativity and Space Applications	Lectures: 15 Project classes: 15	3	Completing the classes	Elective
Students Club II	Participation in a student research club: 0	2	Completing the classes	Obligatory
Sum	**341**	**30**		

Semester 3

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
Master Thesis	Diploma Thesis: 0	20	Completing the classes	Obligatory
Space engineering III	Seminars: 15	1	Completing the classes	Obligatory
Students Club III	Participation in a student research club: 0	2	Completing the classes	Obligatory
Seminar	Seminars: 15	1	Completing the classes	Obligatory
Science communication	Lectures: 15 Auditorium classes: 15	3	Completing the classes	Obligatory
Elective group		3	Completing the classes	Obligatory
Space hackaton	Lectures: 6 Auditorium classes: 30	3	Completing the classes	Elective
Interpersonal skills	Lectures: 15 Auditorium classes: 20	3	Completing the classes	Elective
Sum	**95**	**30**		

Semester 0

Course	Number of hours	ECTS credits	Form of verification	Mandatoriness
English for Engineering	Foreign language classes: 28	2	Completing the classes	Obligatory
Mathematics in engineering calculations	Lectures: 42 Auditorium classes: 42	4	Completing the classes	Obligatory
Physics I	Lectures: 30 Auditorium classes: 30	4	Exam	Obligatory
Chemistry	Lectures: 10 Auditorium classes: 10 Laboratory classes: 10 Project classes: 10	3	Completing the classes	Obligatory
Introduction to mechanics of the materials	Lectures: 18 Laboratory classes: 20 Project classes: 30	4	Exam	Obligatory
Mechanical Structures I	Lectures: 14 Laboratory classes: 28	3	Completing the classes	Obligatory
Basics of electronics	Laboratory classes: 24 Project classes: 10 Discussion seminars: 20	4	Completing the classes	Obligatory
Essentials of software development and systems engineering	Lectures: 28 Laboratory classes: 28	4	Exam	Obligatory
Engineering Project	Lectures: 7 Project classes: 28	2	Completing the classes	Obligatory
Sum	**467**	**30**		

ECTS credits calculations

Field of study: Space Technologies

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	45
core science classes relevant to a given major	70
practical classes, developing practical skills, including laboratory, design, practical and workshop classes	35
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)	31
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	12
foreign language classes	4
practical placements	0
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)	90
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)	

Syllabuses

Orbital mechanics and mission analysis

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1P.17889.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 1	Exam **Activities and hours** Lectures: 24 Project classes: 30	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	fundamental orbital mechanics principles, such as the laws of motion and gravitation, and can apply these to analyze different types of orbits.	STE2A_W09	Activity during classes, Execution of exercises, Examination, Completion of laboratory classes
W2	advanced methods for calculating delta-v and mission trajectories, including techniques for complex transfers and multi-body problems.	STE2A_W09, STE2A_W10	Activity during classes, Execution of exercises, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	the dynamics and challenges of mission analysis, including orbit selection, environmental considerations, and mission trade-offs.	STE2A_W09, STE2A_W10	Activity during classes, Execution of exercises, Examination, Completion of laboratory classes
W4	the effects of non-spherical gravitational fields, atmospheric drag, and solar radiation pressure on orbital paths and stability.	STE2A_W09, STE2A_W10	Activity during classes, Execution of exercises, Completion of laboratory classes
Skills – Student can:			
U1	formulate and solve orbital dynamics problems, including two-body, n-body, and perturbed orbit scenarios, both analytically and with computational tools.	STE2A_U01	Activity during classes, Execution of exercises, Examination, Completion of laboratory classes
U2	design and evaluate orbital maneuvers such as Hohmann transfers, bi-elliptic transfers, and plane changes, and calculate their respective delta-v requirements. Perform mission analysis, considering environmental effects, propulsion limitations, and orbital insertion requirements.	STE2A_U01	Activity during classes, Execution of exercises, Examination, Involvement in teamwork, Completion of laboratory classes
U3	develop and use computational simulations (e.g., with Python) to model orbital trajectories and predict the outcomes of various orbital maneuvers.	STE2A_U01	Activity during classes, Execution of exercises, Examination, Involvement in teamwork, Completion of laboratory classes
U4	plan interplanetary transfers, leveraging knowledge of patched conic approximations and the effects of gravity assists.	STE2A_U01	Activity during classes, Execution of exercises, Examination, Completion of laboratory classes
Social competences – Student is ready to:			
K1	undertaking mission feasibility analysis, evaluating orbit options, and assessing the impact of various mission design choices. Assess mission design challenges in both Earth-centric and interplanetary contexts.	STE2A_K02, STE2A_K03	Activity during classes, Execution of exercises, Examination, Involvement in teamwork, Completion of laboratory classes
K2	solving complex real-world problems in orbital mechanics, such as low-thrust propulsion trajectory planning, rendezvous planning, and trajectory optimization.	STE2A_K02, STE2A_K03	Activity during classes, Execution of exercises, Examination, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	24
Project classes	30

Realization of independently performed tasks	40
Preparation for classes	11
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 112
Workload involving teacher	**Hours** 54

* 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, W2, U2, U3, K1, W3, U4, K2, W4	Module 1: Orbital Mechanics Module 2: Mission Analysis Module 3: Advanced themes: rendezvous and orbital perturbations
Project classes	W1, U1, W2, U2, U3, K1, W3, U4, K2, W4	

Space engineering I

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1P.17890.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 1	Completing the classes **Activities and hours** Seminars: 25	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	How to explain complex technical concepts in a way that is accessible to both experts and non-specialists.	STE2A_W01	Activity during classes, Report on completion of a practical placement, Presentation
W2	How to logically arrange material to effectively introduce the audience to the topic, present the problem, methods, results, and conclusions.	STE2A_W01	Activity during classes, Report on completion of a practical placement, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	How to present both successes and encountered challenges or limitations, as well as pointing out potential applications or possibilities for improvement of the results.	STE2A_W01, STE2A_W03	Activity during classes, Report on completion of a practical placement, Presentation
Skills – Student can:			
U1	Prepare and deliver information clearly and convincingly, using appropriate visual aids.	STE2A_U01	Activity during classes, Presentation
U2	Engage in dialogue with the audience, respond to questions, clarify answers, and involve listeners in the discussion.	STE2A_U01, STE2A_U03	Activity during classes, Presentation
Social competences – Student is ready to:			
K1	Public speaking, managing stage fright, and staying calm in stressful situations, which allows for more confident and professional presentation of results.	STE2A_K01, STE2A_K03	Activity during classes, Presentation
K2	Take initiative and responsibility for personal learning by actively exploring project-related resources and consistently enhancing knowledge and skills.	STE2A_K01, STE2A_K03	Activity during classes, Report on completion of a practical placement, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Seminars	25
Contact hours	5
Student workload	**Hours** 30
Workload involving teacher	**Hours** 25

* 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, W2, W3, U1, U2, K1, K2	This course is an integral part of Students Club I and focuses on advancing students' practical skills in space engineering. Students will participate in hands-on project work and regular seminars, where they will present results from one of six specialized tracks selected during the Students Club I course. Each student joins a project team associated with a scientific club at AGH University, collaborating on real-world challenges in the space sector and working toward specific project objectives. Through periodic seminars, students share their progress, receive feedback, and refine their work based on insights from peers and instructors. Students may choose one of the following project teams: SpaceTeam AGH: This team focuses on developing a transport system for lunar regolith, tackling the challenges of lunar resource handling. AstroBio AGH: Dedicated to astrobiology, this team explores the possibilities for life in extraterrestrial environments and conducts space biology experiments. SatLAB AGH: Specializing in nanosatellite design and construction, SatLAB AGH is working on Poland's first student-built observational satellite, with a mission to monitor environmental changes in Poland using visible and near-infrared imaging. AGH LunarTech: Focused on developing technologies for lunar missions, this team collaborates with industry professionals to prepare students for practical applications in the space sector. AGH SpaceSystems: This team engages in a variety of space technology projects, including rockets, Mars rovers, planetary landers, and stratospheric balloon gondolas, providing experience across multiple space-related technologies. Cosmodrill: A team focused on promoting advancements in space technology, emphasizing the latest techniques and innovations relevant to the space industry. In Space Engineering I, students will gain invaluable experience in project-based learning, enhance their presentation and teamwork skills, and build foundational expertise in tackling the challenges and exploring innovations in space engineering.

Students Club I

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1P.17891.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 1	Completing the classes **Activities and hours** Participation in a student research club: 0	2

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	Fundamentals of Space Technology: Understand key concepts in space technology, including satellite systems, lunar transport, astrobiology, and space mission planning.	STE2A_W01, STE2A_W03, STE2A_W14, STE2A_W15	Execution of a project
W2	Project Methodology: Familiarize with the stages of project development, from initial planning to execution and evaluation, in a space-oriented context.	STE2A_W03, STE2A_W14, STE2A_W15	Execution of a project
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Develop the ability to identify and address technical challenges using knowledge of engineering, physics, and other related fields.	STE2A_U09, STE2A_U10	Execution of a project
U2	Enhance skills in working effectively within interdisciplinary teams, communicating with peers, and dividing tasks based on each member's expertise.	STE2A_U03, STE2A_U04, STE2A_U09, STE2A_U10	Execution of a project
U3	Conduct research, critically analyze information, and apply findings to make informed decisions within project activities.	STE2A_U08, STE2A_U09, STE2A_U10	Execution of a project
Social competences – Student is ready to:			
K1	Demonstrate initiative and responsibility for one’s own learning by exploring project-related resources and continuously improving knowledge and skills.	STE2A_K02, STE2A_K04, STE2A_K05	Execution of a project
K2	Encourage innovation by approaching complex space-related problems with creativity, considering new perspectives, and proposing original solutions.	STE2A_K01, STE2A_K04, STE2A_K05	Execution of a project

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Preparation for classes	10
Preparation of project, presentation, essay, report	10
Realization of independently performed tasks	35
Contact hours	5
Student workload	**Hours** 60

* 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, W2, U1, K1, U2, U3, K2	During this course, students will primarily engage in teamwork through participation in a selected project. The project classes consist of six parallel tracks, from which each student chooses one. After selecting a track, the student joins one of the project teams associated with a scientific club at AGH University and actively participates in completing at least one of the assigned tasks. Within these teams, students will address various challenges related to space technology.

Materials for Space

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1P.17892.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation Modules
Profile General academic	**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: 30 Laboratory classes: 15	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 know and understand electrical, thermal and magnetic properties of materials for space applications	STE2A_W02	Project
W2	Students know and understand concepts of coatings for properties modification of materials in space and their applications	STE2A_W02	Project
W3	Students know and understand basic properties of metamaterials for space and their applications	STE2A_W02	Project

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	A student can employ the knowledge on electrical, thermal and magnetic properties of materials in the design of space systems	STE2A_U06	Project
U2	A student can apply coatings for properties modification of materials in space	STE2A_U06	Project
U3	A student can employ his/her knowledge on metamaterials for designing critical elements of space systems	STE2A_U06	Project
Social competences – Student is ready to:			
K1	Students are ready to tackle advanced problems in the design of space systems and propose materials and their modifications for specific applications.	STE2A_K01	Project

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	15
Preparation for classes	15
Preparation of project, presentation, essay, report	25
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 45

* 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, K1, W2, U2, W3, U3	The three submodules covered within the course will consist of: Module 1: electrical, thermal and magnetic properties of materials for space applications. Module 2: coatings for properties modification of materials in space. Module 3: metamaterials for space. In each module, theoretical and practical classes will be caried out. In particular, the students will be familiarized with specific applications of materials and metamaterials in various fields.
Laboratory classes	W1, U1, K1, W2, U2, W3, U3	

Space robotics and control theory

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1P.17893.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 1	Completing the classes **Activities and hours** Lectures: 15 Laboratory classes: 30	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 and understands the structures of robots used in space	STE2A_W01	Test
W2	The student knows and understands the principles of building control systems for devices dedicated to work in space.	STE2A_W11	Test
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	The student is able to design mechatronic systems for systems operating in space	STE2A_U04	Test
U2	The student is able to design a control system for systems operating in space	STE2A_U04	Test
Social competences – Student is ready to:			
K1	The student is ready to construct and control mechatronic device systems dedicated to work in space.	STE2A_K02	Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	30
Contact hours	5
Examination or final test/colloquium	2
Realization of independently performed tasks	10
Preparation for classes	10
Preparation of project, presentation, essay, report	15
Student workload	**Hours** 87
Workload involving teacher	**Hours** 45

* 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	Basic knowledge related to control systems, Basic knowledge of Theory of machines and mechanisms, Basics of robotics, Basics of mechanics
Laboratory classes	W1, W2, U1, U2, K1	

Social dimensions of space exploration

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1P.17894.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 1	Completing the classes **Activities and hours** Seminars: 30	2

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 societal and ethical implications of space technology development and its potential applications across various industries	STE2A_W01, STE2A_W12	Test, Presentation
Skills – Student can:			
U1	The student is able to critically analyze the social impact of space exploration initiatives and collaborate effectively within multidisciplinary teams to address complex ethical and societal challenges	STE2A_U09, STE2A_U10	Test, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Social competences – Student is ready to:			
K1	The student is ready to engage and contribute to international dialogues that address the shared challenges and benefits of space activities for humanity	STE2A_K01, STE2A_K04, STE2A_K05	Test, Presentation
K2	The student is ready to assess and integrate diverse ethical and societal perspectives when formulating policies and strategies for space exploration	STE2A_K02, STE2A_K04, STE2A_K05	Test, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Seminars	30
Preparation for classes	18
Preparation of project, presentation, essay, report	10
Contact hours	2
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
Seminars	W1, U1, K1, K2	Students will explore the social, ethical, and cultural dimensions of space exploration. Topics include historical, political, and legal contexts, ethical concerns of human presence, societal impacts of space technologies, commercialization challenges, sustainability, planetary protection, and global equity in access.

Astrophysics and Astronomy

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1P.17895.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation Modules
Profile General academic	**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: 20 Laboratory classes: 20	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 most important astronomical objects in various bands of electromagnetic radiation, their properties and physical processes occurring in them.	STE2A_W11	Activity during classes, Test
W2	main issues of space physics.	STE2A_W09, STE2A_W13	Activity during classes, Test

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	basic methods of astronomical observations, including observations from space, in various bands of electromagnetic radiation and basic methods of detecting cosmic rays, neutrinos and gravitational waves.	STE2A_W08	Activity during classes, Execution of laboratory classes, Test, Completion of laboratory classes
Skills – Student can:			
U1	obtain information from scientific articles and preprints on arxiv.org.	STE2A_U08, STE2A_U09	Activity during classes, Execution of laboratory classes, Test, Completion of laboratory classes
U2	obtain the data from open databases of various observatories.	STE2A_U08, STE2A_U09	Execution of laboratory classes, Completion of laboratory classes
U3	perform the basic analysis of various types of astronomical data.	STE2A_U03	Execution of laboratory classes, Completion of laboratory classes
U4	interpret the obtained results.	STE2A_U03, STE2A_U08, STE2A_U09, STE2A_U10	Execution of laboratory classes, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	20
Laboratory classes	20
Preparation for classes	16
Preparation of project, presentation, essay, report	10
Realization of independently performed tasks	17
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 40

* 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, W3, U2, U3, U4, W2	The course is an introduction to the basic issues of modern astronomy and astrophysics regarding the observations in various bands of electromagnetic radiation, using neutrinos, cosmic rays and gravitational waves. It covers the most important observation/detection methods (with particular emphasis on the observations from space), as well as the astronomical objects for each band/type of observation. During the laboratory exercises, students have the opportunity to learn the basics of data analysis for various types of modern astronomical observatories.
Laboratory classes	W1, W3, U1, U2, U3, U4	

English for Space Technology B2+

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.Ili1JO.17896.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foreign Language
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 1	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	The student knows basic technical vocabulary in the field of modern space technologies	STE2A_U08	Activity during classes, Execution of exercises, Test, Examination
U2	The student knows the structure of scientific publications of reports and documentation and conference presentations	STE2A_U08	Activity during classes, Execution of exercises, Test, Examination
U3	The student knows the basic vocabulary used in professional communication	STE2A_U08	Activity during classes, Execution of exercises, Test, Examination

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U4	The student is able to write a short report using specialised engineering vocabulary, including modern space technology vocabulary	STE2A_U08	Activity during classes, Examination, Report
U5	The student is able to prepare and deliver a short technical presentation in English on a subject related to space technologies	STE2A_U08	Activity during classes, Presentation
U6	The student is able to speak and give an opinion on a presented topic at a formal professional meeting on space technologies, if the topic discussed at the meeting is familiar to the student	STE2A_U08	Activity during classes, Participation in a discussion, Examination

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	30
Preparation for classes	15
Preparation of project, presentation, essay, report	5
Realization of independently performed tasks	3
Examination or final test/colloquium	2
Contact hours	5
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, U6	During the course, students have the opportunity to acquire knowledge of specialised vocabulary and phraseology in the field of modern space technologies, depending on the path taken. The course covers vocabulary and phraseology used in professional communication and project work, and proposes assignments to practise the acquired skills. The aim of the course is to provide students with the knowledge and skills necessary to use English effectively in a work environment in the space sector.

Spacecraft engineering and systems (U)

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1K.17899.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 1	Exam **Activities and hours** Lectures: 30 Laboratory classes: 21	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 complete lifecycle of space systems, including development, testing, and deployment phases. The principles of reliability engineering, redundancy, and system resiliency.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of a project, Test, Involvement in teamwork, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	the physical and environmental factors that influence space system design, such as radiation, solar wind, and micrometeoroids.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of exercises, Execution of a project, Test, Involvement in teamwork, Presentation, Completion of laboratory classes
W3	cost sources, economic principles, and financial metrics relevant to space projects The importance of human factors, habitability, and ergonomic design in space missions.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of a project, Test, Involvement in teamwork, Presentation
W4	the fundamentals of power generation, energy storage, and power system integration for space missions. The principles of heat transfer, radiative equilibrium, and material properties relevant to thermal control.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of exercises, Execution of a project, Test, Involvement in teamwork, Presentation, Completion of laboratory classes
Skills – Student can:			
U1	define and achieve key project milestones, such as design reviews and requirement validations. Analyze and mitigate the risks posed by the space environment on system components and operations. Apply cost estimation techniques, including heuristics and life cycle costing, to forecast project budgets.	STE2A_U02	Execution of a project, Test, Involvement in teamwork, Presentation
U2	design simple workstation layouts, storage solutions, and crew accommodations that optimize functionality and comfort.	STE2A_U02	Execution of exercises, Execution of a project, Test, Involvement in teamwork, Presentation, Completion of laboratory classes
U3	analyze and select appropriate power generation and storage options based on mission requirements. Evaluate and design thermal systems, including radiators and insulation, for effective thermal management in space.	STE2A_U07	Execution of exercises, Execution of a project, Test, Involvement in teamwork, Presentation, Completion of laboratory classes
Social competences – Student is ready to:			
K1	working in a team to create comprehensive requirements documents and work breakdown structures for complex projects, evaluating project costs with consideration of inflation, discounting, and return on investment, reviewing resilience strategies in mission-critical space systems to mitigate intercorrelated failures.	STE2A_K01, STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Involvement in teamwork, Presentation, Completion of laboratory classes
K2	working in a team or providing independent input on applying knowledge of planetary environments, spacecraft charging, principles of anthropometrics and physiological adaptation to create safe and efficient living spaces and improve overall mission safety and reliability.	STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Involvement in teamwork, Presentation, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
K3	challenge and integrate industrial standards on power systems, and components to maintain stable spacecraft temperatures into spacecraft designs.	STE2A_K01, STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Involvement in teamwork, Presentation, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	21
Preparation for classes	4
Realization of independently performed tasks	40
Preparation of project, presentation, essay, report	16
Contact hours	5
Examination or final test/colloquium	2
Student workload	**Hours** 118
Workload involving teacher	**Hours** 51

* 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, K1, W2, K2, W3, U2, U3, K3, W4	Module 1: space system engineering, probability analysis, cost analysis. Module 2: space environment, human factors, anthropometrics and habitability. Module 3: power systems, thermal systems.
Laboratory classes	W2, K2, K1, U3, K3, W4	

Fluid Mechanics

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1K.04346.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 1	Completing the classes **Activities and hours** Lectures: 20 Laboratory classes: 25	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	Knowledge of understanding and describing phenomena occurring during fluid flow	STE2A_W01	Test, Completion of laboratory classes
W2	Knowledge enabling the analysis and description of phenomena related to the phenomena of statics and dynamics of fluids	STE2A_W01	Test, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	Knowledge enabling complementation of thermodynamics and supplementing the acquired knowledge in the field of mathematics and physics for the analysis and description of phenomena in the field of fluid mechanics	STE2A_W01	Test, Completion of laboratory classes
Skills – Student can:			
U1	Able to use knowledge of mathematics in relation to the description of specific phenomena in the field of fluid mechanics	STE2A_U02, STE2A_U06, STE2A_U08	Test, Completion of laboratory classes
U2	Able to use knowledge of phisics in relation to the description of specific phenomena in the field of fluid mechanics	STE2A_U02, STE2A_U06, STE2A_U08	Test, Completion of laboratory classes
U3	Able to work as a team and solve specific tasks and scientific and technical problems in team	STE2A_U02, STE2A_U06, STE2A_U08	Test, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Students can cooperate with others to solve problems	STE2A_K01, STE2A_K02, STE2A_K03	Test, Completion of laboratory classes
K2	Students understand the need to broaden their knowledge in the field of fluid flow mechanics	STE2A_K01, STE2A_K02, STE2A_K03	Test, Completion of laboratory classes
K3	Students understand the need for continuous training and improving professional and personal competences	STE2A_K01, STE2A_K02, STE2A_K03	Test, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	20
Laboratory classes	25
Preparation for classes	10
Realization of independently performed tasks	10
Examination or final test/colloquium	2
Contact hours	2
Preparation of project, presentation, essay, report	16

Student workload	**Hours** 85
Workload involving teacher	**Hours** 45

* 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, U2, U3, K1, K2, K3	Fluid mechanics covers density, viscosity, and surface tension, with fluid statics explaining pressure and buoyancy. Fluid dynamics examines flow types, Reynolds number, and conservation principles. It also looks at Navier-Stokes equations, drag, lift, cavitation, and computational methods for simulations.
Laboratory classes	W1, W2, W3, U1, U2, U3, K1, K2, K3	

Embedded electronics and avionics

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.Ili1K.17900.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core Modules
Profile General academic	**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: 15 Laboratory classes: 30	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 know the modern technologies in embedded electronics as well as the development directions for future applications	STE2A_W05	Presentation
W2	Students know modern technologies in avionics as well as the development directions for future applications	STE2A_W03	Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	Students know modern technologies in space technology as well as the development directions for future applications	STE2A_W03	Presentation
Skills – Student can:			
U1	Students can plan the process of designing modern embedded electronic devices using currently available technological processes and novel technologies not yet available.	STE2A_U04	Preparation and conduct of scientific research
U2	Students can plan the process of designing modern avionics applications using currently available technological processes and novel technologies not yet available.	STE2A_U03	Preparation and conduct of scientific research
U3	Students can plan the process of designing modern space systems from the electronics perspective using currently available technological processes and novel technologies not yet available.	STE2A_U02, STE2A_U04	Preparation and conduct of scientific research
Social competences – Student is ready to:			
K1	Students are ready to design modern embedded electronic devices with the use of available technological processes to solve significant social and economic problems and with respect for the environment	STE2A_K02, STE2A_K03	Presentation, Preparation and conduct of scientific research
K2	Students are ready to design modern electronic devices as a team-work in interdisciplinary teams	STE2A_K02	Presentation, Preparation and conduct of scientific research
K3	Students are competent to initiate innovative solutions that can be applied both in the space industry and everyday life, promoting technological advancement and personal development within engineering activities.	STE2A_K03	Presentation, Preparation and conduct of scientific research

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	30
Preparation for classes	10
Preparation of project, presentation, essay, report	20
Realization of independently performed tasks	10
Contact hours	5

Student workload	**Hours** 90
Workload involving teacher	**Hours** 45

* 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 curriculum includes a lecture and laboratory design activities.
Laboratory classes	W1, U1, U2, U3, K1, K2, K3	

Space Biology and Astrobiology I

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1K.17999.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 1	Completing the classes **Activities and hours** Lectures: 15 Laboratory classes: 15 Project classes: 8	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 scope and fundamental concepts in Space Biology and Astrobiology, including the origins and historical development of these fields.	STE2A_W04	Test
W2	the key environmental parameters of space, such as microgravity, vacuum, plasma, radiation, lighting, thermal conditions, availability of resources, and the main health hazards associated with space environments.	STE2A_W04	Test

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	the methods for conducting experiments involving space conditions in laboratory settings, simulating space conditions on Earth, in analogue environments, parabolic flights, near-space stratosphere conditions, in orbit, and on space stations.	STE2A_W03, STE2A_W04, STE2A_W13	Test
W4	the principles behind measurement instruments used in space biology and astrobiology.	STE2A_W03, STE2A_W04, STE2A_W13	Test
W5	examples from the literature that describe the latest and/or most important studies in Space Biology and Astrobiology.	STE2A_W04, STE2A_W13	Test
Skills – Student can:			
U1	correctly design and test a biological experiment for simulated or near-space conditions.	STE2A_U07, STE2A_U09	Report
U2	analyse the results and prepare reports that mimic a scientific journal publication.	STE2A_U08, STE2A_U09, STE2A_U10	Report
U3	read and present specialized literature in space biology and astrobiology with comprehension.	STE2A_U08, STE2A_U10	Report
Social competences – Student is ready to:			
K1	working independently and in a team to plan and develop research projects that are innovative, methodologically correct, and in line with current knowledge in the field.	STE2A_K02, STE2A_K03, STE2A_K04	Report
K2	read, understand and interpret scientific literature, and write scientific reports.	STE2A_K01, STE2A_K02, STE2A_K04, STE2A_K05	Report

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	15
Project classes	8
Preparation for classes	15
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	20
Contact hours	5
Student workload	**Hours** 80

Workload involving teacher	Hours 38

* 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, W3, W4	Introduction to Space Biology and Astrobiology: Foundations of Space Biology and Astrobiology, Environmental Parameters and Hazards of Space, Experimental Methods and Instrumentation in Space Biology, Current Research in Space Biology and Astrobiology.
Laboratory classes	W1, W2, U1, U2, K1, W3, W4, W5, U3, K2	
Project classes	W1, W2, U1, U2, K1, W3, W4	

Experiments on rockets and balloons

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1K.17906.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 1	Completing the classes **Activities and hours** Lectures: 15 Laboratory classes: 15 Project classes: 15	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:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W1	The student knows what are the methods of conducting experiments in the field of life sciences in laboratory conditions on Earth, in analog conditions, parabolic flights, in the near-space environment in the stratosphere, in orbit and on space stations; the student knows what the procedure for launching space projects looks like, what are the available opportunities for people wishing to develop this field of engineering and science, what are the roadmaps of space agencies and critical topics for further development; the student is able to characterise and explain the principle of operation of measuring instruments for the application of life sciences in the orbit; the student knows what are the parameters of the space environment: vacuum, plasma, radiation, lighting, thermal, resources, the student knows what are the methods of searching for life in space, is able to list the celestial bodies on which life is searched; knows the rocket and balloon missions carried out and their effects on contemporary research.	STE2A_W01, STE2A_W02, STE2A_W03	Execution of laboratory classes, Test, Report on completion of a practical placement, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Completion of laboratory classes
W2	The student is able to properly design a biological/medical experiment to be carried out on the rocket and in the near-space environment in the stratosphere (Project); the student is able to perform measurements of morphological, histological and biochemical parameters of biological materials (e.g. tissues) subjected to simulated space conditions (vacuum, variable temperature, microgravity, ionizing radiation); the student is able to use specialist instruments for simulating microgravity (random positioning machines centrifuges) (exercises), the student is able to read and present specialist literature in the field. The student takes part in designing, testing on Earth and launching either on the rocket or on the balloon her/his experiment, then analyzes the results in the laboratory and prepares reports in accordance with the conventions of space agencies.	STE2A_W01, STE2A_W02, STE2A_W03	Execution of laboratory classes, Test, Report on completion of a practical placement, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Completion of laboratory classes
Skills – Student can:			
U1	Ability to design and conduct biological and environmental experiments under stratospheric and space analog conditions, accounting for unique variables such as temperature, radiation, and limited resources. This includes knowledge of the full experimental lifecycle, from planning to execution and data interpretation.	STE2A_U04, STE2A_U05, STE2A_U06	Execution of laboratory classes, Test, Work done within the framework of a practical placement, Involvement in teamwork, Completion of laboratory classes
U2	Proficiency in the integration of mission-critical subsystems (e.g., power, thermal management, on-board computing, and telecommunications) for experiments conducted in stratospheric or space analog conditions. This includes managing the complex interplay between hardware, software, and experimental objectives to ensure mission success and scientific validity.	STE2A_U04, STE2A_U05, STE2A_U06	Execution of laboratory classes, Test, Work done within the framework of a practical placement, Involvement in teamwork, Completion of laboratory classes
Social competences – Student is ready to:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
K1	Ability to work effectively in interdisciplinary teams, combining expertise in biology, engineering, and environmental sciences to achieve common objectives. This includes navigating the challenges of team-based mission planning, integrating diverse perspectives, and managing collective decision-making under time-sensitive conditions.	STE2A_K02	Report on completion of a practical placement, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	15
Project classes	15
Preparation for classes	8
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	15
Realization of independently performed tasks	20
Student workload	**Hours** 90
Workload involving teacher	**Hours** 45

* 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	1. knowledge of development trends and the most important latest achievements in space engineering and, to a lesser extent, automation, robotics, mechanical engineering, electronics and computer science; 2. theoretical, detailed knowledge of selected aspects of testing, modeling, design, production and operation of space systems and devices, as well as the materials and information processing methods used; 3. the ability to obtain information from literature, databases and other sources, integrate the information obtained, interpret and critically evaluate it, draw conclusions and formulate and justify opinions; 4. Sufficient competence in a foreign language to discuss professional topics, read and understand scientific literature, and prepare and deliver short presentations regarding the implementation of a research project or task; 5. ability to design space systems and devices for various applications, taking into account given functional and economic criteria and, if necessary, adapt existing or develop new design methods and CAD and CAE tools; 6. the ability to propose improvements to existing design solutions and models of space components, devices and systems
Laboratory classes	W1, W2, U1, U2, K1	
Project classes	W1, W2, U1, U2, K1	

Spacecraft engineering and systems (B)

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1K.17907.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 1	Exam **Activities and hours** Lectures: 30 Laboratory classes: 21	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 complete lifecycle of space systems, including development, testing, and deployment phases.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of a project, Test, Examination, Involvement in teamwork, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	the physical and environmental factors that influence space system design, such as radiation, solar wind, and micrometeoroids.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
W3	cost sources, economic principles, and financial metrics relevant to space projects.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of a project, Test, Examination, Involvement in teamwork, Presentation
W4	the principles of reliability engineering, redundancy, and system resiliency.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
W5	the importance of human factors, habitability, and ergonomic design in space missions.	STE2A_W03, STE2A_W04, STE2A_W14, STE2A_W15	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
W6	the fundamentals of power generation, energy storage, and power system integration for space missions.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
W7	the principles of heat transfer, radiative equilibrium, and material properties relevant to thermal control.	STE2A_W01, STE2A_W14, STE2A_W15	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
Skills – Student can:			
U1	define and achieve key project milestones, such as design reviews and requirement validations.	STE2A_U02	Execution of a project, Test, Examination, Involvement in teamwork, Presentation
U2	analyze and mitigate the risks posed by the space environment on system components and operations.	STE2A_U02	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U3	apply cost estimation techniques, including heuristics and life cycle costing, to forecast project budgets.	STE2A_U02	Execution of a project, Test, Examination, Involvement in teamwork, Presentation
U4	calculate reliability metrics, design redundancy into systems, and interpret reliability diagrams.	STE2A_U02, STE2A_U07	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
U5	design simple workstation layouts, storage solutions, and crew accommodations that optimize functionality and comfort.	STE2A_U02	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
U6	analyze and select appropriate power generation and storage options based on mission requirements.	STE2A_U02, STE2A_U07, STE2A_U08	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
U7	evaluate and design thermal systems, including radiators and insulation, for effective thermal management in space.	STE2A_U02	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
Social competences – Student is ready to:			
K1	working in a team to create comprehensive requirements documents and work breakdown structures for complex projects, evaluating project costs with consideration of inflation, discounting, and return on investment, reviewing resilience strategies in mission-critical space systems to mitigate intercorrelated failures.	STE2A_K01, STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
K2	working in a team or providing independent input on applying knowledge of planetary environments, spacecraft charging, principles of anthropometrics and physiological adaptation to create safe and efficient living spaces and improve overall mission safety and reliability.	STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes
K3	challenge and integrate industrial standards on power systems, and components to maintain stable spacecraft temperatures into spacecraft designs.	STE2A_K01, STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Examination, Involvement in teamwork, Presentation, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	21
Preparation for classes	8
Realization of independently performed tasks	28
Preparation of project, presentation, essay, report	18
Contact hours	3
Examination or final test/colloquium	2
Student workload	**Hours** 110
Workload involving teacher	**Hours** 51

* 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, K1, W2, U2, K2, W3, U3, W4, U4, W5, U5, W6, U6, K3, W7, U7	This course provides an in-depth look at the engineering principles and processes involved in the design, development, and management of space systems. Emphasis is placed on the complete lifecycle of space systems, from initial concept through operational deployment, with special consideration of the unique challenges posed by the space environment.
Laboratory classes	W2, U2, K2, W4, U4, K1, W6, U6, K3, W7, U7	

Signal Processing

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1K.17902.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core Modules
Profile General academic	**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	Exam **Activities and hours** Lectures: 30 Laboratory classes: 35	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	Has basis knowledge on system identification.	STE2A_W05	Examination
W2	Has basic knowledge on monitoring of mechatronic systems.	STE2A_W05	Examination
W3	Has basic knowledge on the time and frequency of signals.	STE2A_W05	Examination
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Can perform operation on analog and digital signals	STE2A_U05	Execution of laboratory classes
Social competences – Student is ready to:			
K1	Is aware of the need of constant learning and development.	STE2A_K03	Execution of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	35
Preparation for classes	35
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 107
Workload involving teacher	**Hours** 65

* 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	This module covers foundational concepts in signal processing, including the types of signals, Fourier analysis, and mathematical foundations like the Laplace and Z-transforms. Students will explore time-domain analysis through convolution and correlation, as well as frequency-domain techniques such as filtering and spectral analysis. The course delves into digital signal processing methods, including quantization, DFT, and adaptive filtering, while also examining applications in audio, image, and biomedical processing. Practical laboratory exercises and projects using software tools will reinforce theoretical knowledge, with assessments including quizzes, laboratory reports, and group projects to ensure comprehensive learning outcomes.
Laboratory classes	W1, W2, W3, U1, K1	

Remote Sensing and Image Analysis in Space Tech

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi1K.17903.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core Modules
Profile General academic	**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: 15 Laboratory classes: 60	6

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	Fundamentals of Remote Sensing, Satellite Systems and Sensors	STE2A_W05, STE2A_W06	Test, Project, Completion of laboratory classes
W2	Data Acquisition and Preprocessing	STE2A_W05	Test, Project, Completion of laboratory classes
W3	Image Analysis Techniques	STE2A_W05	Test, Project, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	Applications of Remote Sensing Across Various Sectors	STE2A_W05	Test, Project, Completion of laboratory classes
Skills – Student can:			
U1	Understanding the principles of satellite-based remote sensing systems.	STE2A_U03	Test, Project, Completion of laboratory classes
U2	Practical knowledge in satellite data handling, e.g. conducting multispectral and SAR data analysis, feature extraction, and classification.	STE2A_U03	Test, Project, Completion of laboratory classes
U3	Fluent in using software, programming languages, libraries, and cloud computing environments for remote sensing data processing.	STE2A_U03	Test, Project, Completion of laboratory classes
U4	Ability to solve real-world geospatial problems through satellite imagery.	STE2A_U03	Test, Project, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Equipped to understand the societal and environmental implications of using remote sensing for Earth observation.	STE2A_K01, STE2A_K03	Test
K2	Capable of sharing technical knowledge and methodologies within multidisciplinary teams.	STE2A_K02	Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	60
Preparation of project, presentation, essay, report	80
Preparation for classes	10
Contact hours	2
Examination or final test/colloquium	2
Realization of independently performed tasks	5

Student workload	**Hours** 174
Workload involving teacher	**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
Lectures	W1, U1, K1, W2, W3, U2, U3, U4, K2	The course content covers the fundamentals of SAR and optical remote sensing, focusing on multispectral and hyperspectral data, along with modern cloud-based data processing techniques using Python. Students will engage in hands-on sessions, including SAR and optical data analysis, spectroradiometer and hyperspectral camera lab work, and practical exercises in cloud platforms. The course culminates in a semester-long project, where students apply their knowledge to real-world remote sensing challenges, resulting in a comprehensive final report and presentation.
Laboratory classes	W1, U1, K1, W2, W3, U2, U3, U4, K2, W4	

English for Space Technology C1/C2

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2JO.17908.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foreign Language
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** 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	The student knows advanced technical vocabulary in the field of modern space technologies	STE2A_U08	Activity during classes, Test
U2	The student knows and understands the technical jargon associated with space operations	STE2A_U08	Activity during classes, Test
U3	The student is familiar with the publication structure of scientific reports and documentation, as well as conference presentations	STE2A_U08	Activity during classes, Execution of exercises, Test

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U4	The student knows the vocabulary used in professional communication	STE2A_U08	Activity during classes, Execution of exercises, Test
U5	The student is able to write a report, a grant application using specialised engineering vocabulary, including modern space technology vocabulary and financial vocabulary	STE2A_U08	Activity during classes, Report
U6	The student is able to prepare and deliver an advanced technical presentation in English on a subject related to space technologies	STE2A_U08	Activity during classes, Presentation
U7	The student is able to speak and give an opinion on a presented topic at a formal professional meeting concerning space technologies, also in multicultural teams	STE2A_U08	Activity during classes, Participation in a discussion
U8	The student is able to lead a face-to-face and online meeting effectively, also in multicultural teams	STE2A_U08	Activity during classes, Participation in a discussion, Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	30
Preparation for classes	15
Preparation of project, presentation, essay, report	5
Realization of independently performed tasks	3
Examination or final test/colloquium	2
Contact hours	5
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, U6, U7, U8	During the course, students have the opportunity to expand their knowledge of specialised vocabulary and phraseology in the field of modern space technologies, depending on the path taken. The course covers vocabulary and phraseology used in professional communication and project work, including vocabulary and phraseology used to prepare grant proposals, manage and report on projects, and prepare publications. The course offers practical assignments to practise the acquired skills. The aim of the course is to provide students with the knowledge and skills necessary to use English effectively in a work environment in the space sector.

Entrepreneurships, IP protection, Business psychology/StartTech/Design Thinking, Ethics

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2HS.17909.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Humanities and Social Sciences Modules
Profile General academic	**Course related to scientific research** Yes
	Course shaping practical skills Tak
	USOS code 130-INT-xS-227

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Completing the classes **Activities and hours** Lectures: 30 Project classes: 30 Discussion seminars: 7	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	Students are familiar with basic subjects research on the psychological aspects of entrepreneurial activity	STE2A_W01, STE2A_W12	Test

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	Basic knowledge on social aspects of entrepreneurial activity	STE2A_W01, STE2A_W12	Test
W3	Basic knowledge on market-oriented design process	STE2A_W01, STE2A_W12	Test
Skills – Student can:			
U1	Students can formulate product specification	STE2A_U08, STE2A_U10	Project
Social competences – Student is ready to:			
K1	Students are able to use their social skills in entrepreneurial setting	STE2A_K01, STE2A_K03, STE2A_K04, STE2A_K05	Activity during classes, Project, Presentation
K2	Students are able to design market products on a conceptual level	STE2A_K01, STE2A_K02, STE2A_K03, STE2A_K04, STE2A_K05	Activity during classes, Project, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Project classes	30
Preparation of project, presentation, essay, report	23
Contact hours	5
Preparation for classes	20
Discussion seminars	7
Examination or final test/colloquium	2
Student workload	**Hours** 117
Workload involving teacher	**Hours** 67

* 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, K2	Basic knowledge on the research in psychology of entrepreneurship activity, basic knowledge on the design process of market-oriented products, basic knowledge on the formulation of business model using CANVAS approach
Project classes	W1, W2, W3, U1, K1, K2	
Discussion seminars	W1, W2, W3, U1, K1, K2	

Space Mission - Risk, Sustainability and Supply Chain Optimization

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17910.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core Modules
Profile General academic	**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: 15 Project classes: 15	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 is able to identify the type of space mission risks, sustainability and supply chain optimization models.	STE2A_W01, STE2A_W03, STE2A_W05, STE2A_W06, STE2A_W07, STE2A_W08	Participation in a discussion, Execution of exercises, Execution of a project, Test, Examination, Engineering project, Involvement in teamwork, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	Student is able to identify and explain mathematical formulation of space mission risks, sustainability and supply chain optimization models.	STE2A_W01, STE2A_W03, STE2A_W05, STE2A_W06, STE2A_W07, STE2A_W08	Participation in a discussion, Execution of exercises, Execution of a project, Test, Examination, Engineering project, Involvement in teamwork, Presentation
Skills – Student can:			
U1	Student is able to acquire knowledge by oneself.	STE2A_U01, STE2A_U02, STE2A_U07, STE2A_U08	Participation in a discussion, Execution of exercises, Execution of a project, Test, Examination, Engineering project, Involvement in teamwork, Presentation
U2	Student is familiar with space mission risks, sustainability and supply chain optimization models.	STE2A_U01, STE2A_U02, STE2A_U07, STE2A_U08, STE2A_U09	Participation in a discussion, Execution of exercises, Execution of a project, Test, Examination, Engineering project, Involvement in teamwork, Presentation
U3	Student knows mathematical formulation of space mission risks, sustainability and supply chain optimization models.	STE2A_U01, STE2A_U02, STE2A_U07, STE2A_U08, STE2A_U09	Participation in a discussion, Execution of exercises, Execution of a project, Test, Examination, Engineering project, Involvement in teamwork, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Project classes	15
Preparation of project, presentation, essay, report	38
Examination or final test/colloquium	2
Contact hours	5
Realization of independently performed tasks	15

Student workload	**Hours** 90
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**
Lectures	W1, W2, U1, U2, U3	Participation in a discussion, Execution of exercises, Execution of a project, Engineering project, Involvement in teamwork, Test results, Presentation.
Project classes	W1, W2, U1, U2, U3	

Space engineering II

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2O.17911.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
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** Seminars: 15	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	How to explain complex technical concepts in a way that is accessible to both experts and non-specialists.	STE2A_W01	Activity during classes, Report on completion of a practical placement, Presentation
W2	How to logically arrange material to effectively introduce the audience to the topic, present the problem, methods, results, and conclusions.	STE2A_W01	Activity during classes, Report on completion of a practical placement, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	How to present both successes and encountered challenges or limitations, as well as pointing out potential applications or possibilities for improvement of the results.	STE2A_W01, STE2A_W03	Activity during classes, Report on completion of a practical placement, Presentation
Skills – Student can:			
U1	Prepare and deliver information clearly and convincingly, using appropriate visual aids.	STE2A_U01	Activity during classes, Presentation
U2	Engage in dialogue with the audience, respond to questions, clarify answers, and involve listeners in the discussion.	STE2A_U01, STE2A_U03	Activity during classes, Presentation
Social competences – Student is ready to:			
K1	Public speaking, managing stage fright, and staying calm in stressful situations, which allows for more confident and professional presentation of results.	STE2A_K01, STE2A_K03	Activity during classes, Presentation
K2	Take initiative and responsibility for personal learning by actively exploring project-related resources and consistently enhancing knowledge and skills.	STE2A_K01, STE2A_K03	Activity during classes, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Seminars	15
Preparation of project, presentation, essay, report	10
Contact hours	5
Student workload	**Hours** 30
Workload involving teacher	**Hours** 15

* 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, W2, W3, U1, U2, K1, K2	This course is an integral part of Students Club II and focuses on advancing students' practical skills in space engineering. Students will participate in hands-on project work and regular seminars, where they will present results from one of six specialized tracks selected during the Students Club II course. Each student joins a project team associated with a scientific club at AGH University, collaborating on real-world challenges in the space sector and working toward specific project objectives. Through periodic seminars, students share their progress, receive feedback, and refine their work based on insights from peers and instructors. Students can choose one of the space technology project teams. In Space Engineering II, students will gain invaluable experience in project-based learning, enhance their presentation and teamwork skills, and build foundational expertise in tackling the challenges and exploring innovations in space engineering.

Attitude determination and control of small satellites

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17917.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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: 16 Laboratory classes: 28 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:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W1	Knowledge of dynamics of rigid body in three dimensions and attitude representation	STE2A_W05	Test, Coordination, conduct of a research project, preparation of a scientific paper, organization, organization of conferences, camps and scientific trips., Confirmation of completion of practical placement programme
W2	Knowledge of principal solutions of systems for attitude determination control system	STE2A_W03, STE2A_W07	Test, Coordination, conduct of a research project, preparation of a scientific paper, organization, organization of conferences, camps and scientific trips., Confirmation of completion of practical placement programme
W3	Knowledge of the objective of the guidance, navigation and control system of satellites	STE2A_W03	Test
Skills – Student can:			
U1	Ability to design, manufacture and assemble an attitude determination and control system for small satellites	STE2A_U02	Coordination, conduct of a research project, preparation of a scientific paper, organization, organization of conferences, camps and scientific trips.
U2	Ability of reporting and presenting work carried out	STE2A_U08	Coordination, conduct of a research project, preparation of a scientific paper, organization, organization of conferences, camps and scientific trips.
Social competences – Student is ready to:			
K1	Organization of the work inside a team	STE2A_K02	Coordination, conduct of a research project, preparation of a scientific paper, organization, organization of conferences, camps and scientific trips.
K2	Avoid conflicts inside a team	STE2A_K02	Coordination, conduct of a research project, preparation of a scientific paper, organization, organization of conferences, camps and scientific trips.

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	16
Laboratory classes	28
Project classes	14
Preparation of project, presentation, essay, report	35
Realization of independently performed tasks	20
Contact hours	5
Student workload	**Hours** 118
Workload involving teacher	**Hours** 58

* 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	W3, W1, W2, U1	Theoretical understanding of fundamentals attitude dynamics, attitude determination and control of a satellite. The sutdent will solve problems and implement numerical models during laboratory classes. The coulse will be enforced by hands-on experience provided by practical projects carried out by the students.
Laboratory classes	W1, W2, U1	
Project classes	U1, U2, K1, K2	

Space Payload Design

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17918.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core Modules
Profile General academic	**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: 15 Laboratory classes: 30	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	Spacecraft classifications and its key functions	STE2A_W03, STE2A_W14, STE2A_W15	Participation in a discussion, Test results
W2	Functions of space payloads mounted on satellites	STE2A_W03, STE2A_W14, STE2A_W15	Participation in a discussion, Test results
W3	Methods of mechanical and electronical components design and verification	STE2A_W02, STE2A_W03, STE2A_W08, STE2A_W14, STE2A_W15	Participation in a discussion, Report, Test results

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	ECSS norms and space payload testing approach	STE2A_W03, STE2A_W14, STE2A_W15	Participation in a discussion, Report, Test results
Skills – Student can:			
U1	Define and analyze key requirements for space payloads	STE2A_U02	Participation in a discussion, Report
U2	Design mechanical and electronical components of space payloads	STE2A_U06	Participation in a discussion, Project, Report
U3	Verify performance of space payload components	STE2A_U02, STE2A_U04	Participation in a discussion, Project, Report
Social competences – Student is ready to:			
K1	Promote development of space payloads in the frame of ESA programs	STE2A_K02	Participation in a discussion, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	30
Preparation for classes	10
Preparation of project, presentation, essay, report	30
Examination or final test/colloquium	2
Contact hours	5
Realization of independently performed tasks	15
Student workload	**Hours** 107
Workload involving teacher	**Hours** 45

* 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, U3, K1	Classes within the module are conducted in the form of lectures and laboratory exercises with following contents: - typical electronics used in space payloads - typical mechanisms used in space payloads - methodologies in design electronical subsystems - methodologies in design mechatronics - ECSS norms and ESA documentation - Testing of space payloads
Laboratory classes	W3, W4, U1, U2, K1	

Space propulsion and rocket performance

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17919.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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: 21 Laboratory classes: 21 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:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W1	The rocket equation and its implications for rocket design and performance. The relationship between mass ratio, structural and payload mass fractions, and overall vehicle performance. The principles of multistaging and how optimal delta-v distribution affects efficiency.	STE2A_W01, STE2A_W03	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
W2	The iterative design approach and the importance of mass margins as a design driver. The concept of Mass Estimating Relations (MER) and their role in vehicle component mass estimation.	STE2A_W01, STE2A_W03	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
W3	The taxonomy of propulsion systems and the fundamentals of rocket engine operation. The fundamentals of rocket testing and performance evaluation.	STE2A_W01, STE2A_W03	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
W4	The basics of liquid propellant engines, including thrust chambers, combustion processes, and turbopump design. The basics of solid propellant engines, including combustion and motor design. The principles and applications of electric propulsion.	STE2A_W01	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
Skills – Student can:			
U1	Apply the rocket equation to calculate mass ratios, delta-v, and performance metrics for rockets. Calculate structural and payload mass fractions, trade-off ratios, and evaluate their effects on rocket efficiency. Design and analyze multistage rockets, including parallel and modular staging configurations.	STE2A_U06	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Use Mass Estimating Relations to create mass budgets and conduct vehicle design analysis. Interpret rocket testing data to validate propulsion system performance.	STE2A_U02	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
U3	Design thrust chambers, analyze combustion processes, and evaluate the functionality of turbopumps in liquid propellant engines. Calculate and optimize solid rocket motor designs based on combustion principles and component requirements.	STE2A_U02, STE2A_U06	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
U4	Evaluate the performance and feasibility of electric propulsion systems for specific mission applications.	STE2A_U02, STE2A_U06	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
Social competences – Student is ready to:			
K1	interaction with industry on integrating mass margin considerations into the iterative design process to refine vehicle design and applying Mass Estimating Relations in budgeting and design analysis for complex rocket systems.	STE2A_K01, STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses
K2	critically assess propulsion systems, discussing the advantages, limitations, and suitability of different propulsion types for various mission scenarios. Participate in propulsion system testing and performance evaluation, understanding the goals, setup, and analysis required to validate engine performance.	STE2A_K01, STE2A_K02, STE2A_K03	Execution of exercises, Execution of a project, Test, Work done within the framework of a practical placement, Involvement in teamwork, Presentation, Participation in scientific research, conferences, additional internships and training courses

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	21
Laboratory classes	21
Project classes	14
Preparation for classes	4
Realization of independently performed tasks	38
Preparation of project, presentation, essay, report	6
Contact hours	5
Student workload	**Hours** 109
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, K1, W2, U2, W3, W4, U3, U4, K2	This course covers the principles and methods of rocket dynamics and propulsion system design. Students will learn to analyze and optimize rocket performance, estimate mass requirements, and design propulsion systems for various applications, including liquid, solid, and electric propulsion systems.
Laboratory classes	W1, U1, K1, W2, U2, W3, W4, U3, U4, K2	
Project classes	W1, U1, K1, W2, U2, W3, W4, U3, U4, K2	

Aerodynamics and Aeroelasticity

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi2K.17920.24

Lecture languages
English

Mandatoriness
Obligatory

Block
Core 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 2	Completing the classes **Activities and hours** Lectures: 15 Laboratory classes: 30	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	Understands the basic and advanced laws and equations describing fluid flow	STE2A_W01	Test, Completion of laboratory classes
W2	Knows the principles of aerodynamic forces and the impact of air parameters on flow	STE2A_W01	Test, Completion of laboratory classes
W3	Familiar with concepts related to aeroelasticity and the mechanisms affecting structural vibrations	STE2A_W01	Test, Completion of laboratory classes
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Able to analyze and calculate aerodynamic forces acting on objects of various shapes	STE2A_U02, STE2A_U06	Test, Completion of laboratory classes
U2	Capable of identifying aeroelastic issues in structures and performing basic calculations in this area	STE2A_U02, STE2A_U06	Test, Completion of laboratory classes
U3	Proficient in conducting and interpreting results from aerodynamic simulations and experiments	STE2A_U02, STE2A_U06	Test, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Can work in a team to solve engineering problems related to aerodynamics	STE2A_K01, STE2A_K02, STE2A_K03	Test, Completion of laboratory classes
K2	Able to communicate the results of their work and present them in both written and oral forms	STE2A_K01, STE2A_K02, STE2A_K03	Test, Completion of laboratory classes
K3	Students understand the need for continuous training and improving professional and personal competences	STE2A_K01, STE2A_K02, STE2A_K03	Test, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	30
Preparation for classes	10
Realization of independently performed tasks	10
Examination or final test/colloquium	2
Contact hours	2
Preparation of project, presentation, essay, report	16
Student workload	**Hours** 85
Workload involving teacher	**Hours** 45

* 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, U2, U3, K1, K2, K3	We studied aerodynamic flow types (inviscid, viscous, compressible, incompressible) and their implications. Main concepts included lift, drag, the Buckingham Pi theorem, boundary layers, Bernoulli’s equation, and airfoil theory, with historical insights grounding our understanding of aerodynamics.
Laboratory classes	W1, W2, W3, U1, U2, U3, K1, K2, K3	

Automated workflows in satellite image processing

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi2K.17921.24

Lecture languages
English

Mandatoriness
Obligatory

Block
Core 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: 10 Laboratory classes: 45	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	Principles of automated workflows and pipelines in remote sensing	STE2A_W05	Test, Project, Completion of laboratory classes
W2	Data ingestion, preprocessing, and analysis using cloud computing platforms (e.g., Google Earth Engine, CREODIAS)	STE2A_W01, STE2A_W03, STE2A_W05	Test, Project, Completion of laboratory classes
W3	Methods for analyzing satellite data in scale: spectral indices, time series analysis, object detection, and classification	STE2A_W01, STE2A_W05	Test, Project, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	Ability to design, build, and optimize automated workflows for remote sensing data processing	STE2A_U03	Test, Project, Completion of laboratory classes
U2	Practical skills in developing Python-based data pipelines for multispectral, hyperspectral, and/or SAR data	STE2A_U03	Test, Project, Completion of laboratory classes
U3	Applying cloud computing techniques to automate time series analysis and EO data processing in scale	STE2A_U03	Test, Project, Completion of laboratory classes
U4	Troubleshooting workflow issues and optimizing processes for better performance	STE2A_U03	Test, Project, Completion of laboratory classes
U5	Preparing technical reports and presentations on the design and outcomes of automated workflows	STE2A_U03	Test, Project, Completion of laboratory classes
Social competences – Student is ready to:			
K1	Participating in group projects focused on building and improving automated data processing pipelines	STE2A_K02	Test, Project, Completion of laboratory classes
K2	Sharing technical solutions and approaches within a team to enhance workflow development.	STE2A_K01, STE2A_K02	Test, Project, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	10
Laboratory classes	45
Preparation of project, presentation, essay, report	36
Preparation for classes	5
Contact hours	2
Examination or final test/colloquium	2
Realization of independently performed tasks	20
Student workload	**Hours** 120
Workload involving teacher	**Hours** 55

* 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, U3, W3, U4, U5, K1, K2	The course *Automated Workflows in Satellite Remote Sensing* covers the principles of building automated workflows and pipelines for remote sensing data processing. It emphasizes cloud computing platforms such as Google Earth Engine and CREODIAS, focusing on data ingestion, preprocessing, and analysis at scale. Students will learn methods for analyzing satellite data, including spectral indices, time series analysis, object detection, and classification, using Python-based tools for automation. The course involves hands-on sessions where students design and optimize automated workflows for multispectral/hyperspectral data, addressing real-world geospatial challenges. They will gain practical skills in troubleshooting workflow issues, preparing technical reports, and presenting the outcomes of automated data processing projects. Throughout the semester, students will engage in group projects to develop automated pipelines, collaborate to share technical solutions, and adapt to new technologies and methods in cloud computing. The course encourages innovation in building scalable solutions, culminating in a final project where each student will apply their knowledge to create an end-to-end automated workflow, leading to a comprehensive report and presentation.
Laboratory classes	W1, W2, U1, U2, U3, W3, U4, U5, K1, K2	

Machine Learning for space applications

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17922.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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: 30 Laboratory classes: 30	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 and understands the fundamental machine-learning techniques and their key applications	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, 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 machine learning workflow, covering data preparation, model selection, training, validation, and evaluation metrics.	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes
W3	The student knows and understands the specific applications of machine learning in space, including object classification, planetary feature recognition, and orbital mechanics.	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes
W4	The student knows and understands advanced machine learning techniques, including deep learning architectures (CNNs, RNNs, LSTMs) and their application to space imaging and time-series analysis.	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes
Skills – Student can:			
U1	The student is able to select, tune, and apply the appropriate machine-learning techniques and algorithms for space-specific applications.	STE2A_U01, STE2A_U03, STE2A_U04	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes
U2	Students can develop and train deep learning models for processing satellite imagery, telemetry data, and other types of space mission data.	STE2A_U01, STE2A_U03, STE2A_U04	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes
U3	The student is able to utilize reinforcement learning techniques for autonomous operations, such as path planning, navigation, and collision avoidance in space scenarios.	STE2A_U01, STE2A_U03, STE2A_U04	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes
U4	Student can deploy machine learning models to cloud and edge computing environments, optimizing for latency and bandwidth constraints in space systems.	STE2A_U01, STE2A_U03, STE2A_U04	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes
Social competences – Student is ready to:			
K1	The student is ready to work collaboratively on interdisciplinary projects involving machine learning and space technology, demonstrating a commitment to mission safety and reliability.	STE2A_K01, STE2A_K02, STE2A_K03	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
K2	Students are prepared for continual learning and adaptation to emerging trends and advancements in machine learning and artificial intelligence for space applications.	STE2A_K03	Activity during classes, Execution of exercises, Execution of laboratory classes, Oral answer, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	30
Preparation for classes	10
Realization of independently performed tasks	15
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 60

* 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, K2, W4, U2, U3, U4	The course covers key machine learning concepts for space applications, including supervised/unsupervised learning, deep learning for imaging, remote sensing, and time-series data. It explores reinforcement learning for autonomous systems, space exploration, and automation. Cloud/Edge AI, ethics, and emerging trends are also addressed
Laboratory classes	W1, W2, W3, U1, K1, K2, W4, U2, U3, U4	

Data engineering for space applications

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17996.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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: 30 Laboratory classes: 30	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 and understands the core concepts of data engineering, including data collection, storage, and management, within the context of space missions.	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, 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 various types of space data, such as multispectral, hyperspectral, radar, and telemetry data, along with their specific challenges and requirements.	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes
W3	The student knows and understands data quality and cleaning techniques tailored to handle the unique challenges of space data, including noise, anomalies, and data scarcity.	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes
W4	The student knows and understands the principles of data storage solutions, data warehousing, and distributed storage systems, focusing on scalable solutions for large-scale space data.	STE2A_W01, STE2A_W05, STE2A_W08, STE2A_W10	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes
Skills – Student can:			
U1	Students can design and implement scalable ETL pipelines for handling space mission data, including batch and real-time processing	STE2A_U01, STE2A_U03	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes
U2	The student is able to integrate and fuse multimodal data from various sources, such as satellites, sensors, and ground systems, for enhanced analysis and decision-making in space applications.	STE2A_U01, STE2A_U03, STE2A_U07	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes
U3	Student can apply data quality and cleaning techniques to ensure data consistency, accuracy, and reliability in spacecraft operations.	STE2A_U01, STE2A_U02, STE2A_U03	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U4	The student is able to utilize big data tools and technologies to process high-resolution satellite imagery and manage data from large satellite constellations.	STE2A_U01, STE2A_U03, STE2A_U04	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes
U5	Students can develop and implement real-time data streaming solutions for spacecraft telemetry, health monitoring, and anomaly detection.	STE2A_U01, STE2A_U03, STE2A_U04	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes
Social competences – Student is ready to:			
K1	The student is prepared for continuous learning and adaptation to new data engineering tools, cloud platforms, and emerging trends in space data management and processing.	STE2A_K01, STE2A_K03	Activity during classes, Participation in a discussion, Execution of laboratory classes, Involvement in teamwork, Oral answer, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	30
Preparation for classes	10
Realization of independently performed tasks	15
Contact hours	5
Student workload	**Hours** 90
Workload involving teacher	**Hours** 60

* 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, U4, U5, K1	The course covers data engineering fundamentals for space technologies, focusing on data types, challenges, quality, cleaning, and preprocessing. Topics include data acquisition, storage, pipeline design, ETL processes, integration, big data, streaming, geospatial data, visualization, cloud platforms, security, privacy, governance, and compliance.
Laboratory classes	W1, W2, W3, W4, U1, U2, U3, U4, U5, K1	

Satellite telecommunications and ground stations

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17924.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 2	Exam **Activities and hours** Lectures: 30 Laboratory classes: 15	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 buidling blocks of digital telecommunication chain	STE2A_W03	Execution of laboratory classes, Examination, Report, Oral answer
W2	the EM wave propagation effects as well as distortion and interference phenomena typical to satellite radio links	STE2A_W06	Examination, Oral answer

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	the modern modulation schemes and channel coding for digital communication	STE2A_W06	Execution of laboratory classes, Examination, Report, Oral answer
W4	the satellite antenna types and parameters	STE2A_W06	Examination, Oral answer
W5	the typical components used to build both ends of radio links	STE2A_W06	Examination, Oral answer
W6	application of satellite communication systems and practical examples	STE2A_W06	Oral answer
Skills – Student can:			
U1	select parameters of the system and calculate link budget	STE2A_U05	Execution of laboratory classes, Examination, Report, Oral answer
U2	design a simple satellite radio link based on off-the-shelf components	STE2A_U05	Examination, Oral answer
U3	operate a simple ground station	STE2A_U03	Execution of laboratory classes, Report
Social competences – Student is ready to:			
K1	explaining why satellite communications technology is inevitable in todays life	STE2A_K01	Examination, Oral answer

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	15
Preparation for classes	20
Examination or final test/colloquium	2
Contact hours	5
Preparation of project, presentation, essay, report	40
Other	20
Student workload	**Hours** 132
Workload involving teacher	**Hours** 45

* 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, W5, U1, U2, W6, W4, U3, K1	Lecture 1. Introduction. Ground and space segments. Communication links. Radio regulations. (2h) 2. Satellite orbits and their parameters – delay, attenuation, Doppler shift. Propagation and impairments. (2h) 3. Analog and digital transmission systems. Telecommunication chain. (2h) 4. Signal processing – coding and modulation. DVB-S/DVB-S2 characteristics. (4h) 5. Satellite link performance. Link budget. (2h) 6. Multiple access techniques. FDMA, TDMA, CDMA, SDMA. Fixed vs on-demand access. (2h) 7. Satellite networks. Inter-satellite links. (2h) 8. Earth stations. Communication subsystem. Tracking antennas. (4h) 9. Satellite communication payload. Transparent vs regenerative repeaters. Antennas and amplifiers. (2h) 10. Reliability of satellite communication systems. (2h) 11. Applications – broadcast, mobile communication, navigation systems. (4h) 12. Deep space communication. (2h) Laboratory 1. Using and interpreting TLE files (2h) 2. Calculating satellite link budget (3h) 3. Digital communication chain blocks – modulation and coding techniques (6h) 4. Operating a ground station (4h)
Laboratory classes	W2, W1, W3, W5, U1, U2, W4, U3	

Bioastronautics

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17934.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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: 15 Laboratory classes: 45	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	knowledge of development trends and the most important latest achievements in bioastronautics and, to a lesser extent, automation, robotics, mechanical engineering, electronics and computer science; theoretical and practical detailed knowledge of selected aspects of testing, modeling, design, production and operation of space systems and devices, as well as the materials and information processing methods used	STE2A_W01, STE2A_W02, STE2A_W03, STE2A_W04, STE2A_W05	Test, Report on completion of a practical placement, Work done within the framework of a practical placement, Preparation and conduct of scientific research, Confirmation of completion of practical placement programme

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	the ability to obtain information from literature, databases and other sources, integrate the information obtained, interpret and critically evaluate it, draw conclusions and formulate and justify opinions; ability to design space systems and devices for various applications, taking into account given functional and economic criteria and, if necessary, adapt existing or develop new design methods and CAD and CAE tools; the ability to propose improvements to existing design solutions and models of space components, devices and systems	STE2A_U02, STE2A_U04, STE2A_U05, STE2A_U06, STE2A_U07, STE2A_U08	Test, Report on completion of a practical placement, Work done within the framework of a practical placement, Preparation and conduct of scientific research, Confirmation of completion of practical placement programme
Social competences – Student is ready to:			
K1	Communication, Teamwork in international environment.	STE2A_K01, STE2A_K02, STE2A_K03	Test, Report on completion of a practical placement, Work done within the framework of a practical placement, Preparation and conduct of scientific research, Confirmation of completion of practical placement programme

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	45
Preparation for classes	40
Contact hours	5
Realization of independently performed tasks	40
Student workload	**Hours** 145
Workload involving teacher	**Hours** 60

* 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, K1	Classes will be conducted using many methods, including e-learning, using information available on the Internet. Additionally, manuals for practical exercises will be prepared, and lecture slides will be made available to students in the form of electronic flyers with the possibility of adding their own notes and comments. Practical classes (exercises) will take place in the habitat. Lectures will be graded based on attendance and exam. Exercises will be graded based on participation in practical classes with a pressure suit and properly completed reports. Project grades will be graded based on the assessment given by the instructors. Student attendance is mandatory. Exceptions are possible on the basis of justification. The final grade will be obtained as a result of attendance at lectures, correctly prepared reports and project assessment. The primary sources of knowledge will be scientific publications, handbooks (below), and space agency documentation and European Union guidelines. Carol Norberg “Human Spaceflight and Exploration” Gregory E. Chamitoff and Srinivas Rao Vadali “Human Spaceflight Operations: Lessons Learned from 60 Years in Space” Peter Eckart “The Lunar Base Handbook”
Laboratory classes	W1, U1, K1	

Space Biology and Astrobiology II

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.18000.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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	Exam **Activities and hours** Lectures: 15 Laboratory classes: 30 Project classes: 20	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	both temporary and permanent changes in the human body caused by prolonged exposure to microgravity and radiation on a space station, including potential health impacts.	STE2A_W04	Examination
W2	the risks and health effects for astronauts, considering gender, age and physiological conditions, as well as current research directions and critical topics for the future of space biology.	STE2A_W04	Examination

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	methods for searching for extraterrestrial life, including biosignatures and essential conditions for life’s origins, celestial bodies where the search for life is ongoing, enumerate theories on the origin of life on Earth, and the process of biological evolution.	STE2A_W04, STE2A_W11, STE2A_W13	Examination
W4	the use of extremophiles as analogues for potential extraterrestrial life, and their applications in experiments in space-like conditions, examples of biomanufacturing in space, such as cultivating microorganisms or plants for resource independence, eg. producing pharmaceuticals, food, or materials for long-term space missions.	STE2A_W03, STE2A_W04, STE2A_W13	Examination
W5	examples from the literature that cover recent and/or significant studies in Space Biology and Astrobiology.	STE2A_W04, STE2A_W13	Examination
Skills – Student can:			
U1	accurately design and test a biological experiment for simulated space conditions, and operate specialized instruments for simulating microgravity.	STE2A_U07, STE2A_U09	Report
U2	analyse the results and prepare reports that mimic a scientific journal publication.	STE2A_U08, STE2A_U09, STE2A_U10	Report
U3	read and present specialized literature in space biology and astrobiology with comprehension.	STE2A_U08, STE2A_U10	Report
Social competences – Student is ready to:			
K1	working independently and in a team to plan and develop research projects that are innovative, methodologically correct, and in line with current knowledge in the field.	STE2A_K02, STE2A_K03, STE2A_K04	Report
K2	read, understand and interpret scientific literature, and write scientific reports.	STE2A_K01, STE2A_K02, STE2A_K04, STE2A_K05	Report

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	30
Project classes	20
Preparation for classes	28
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	30
Contact hours	5

Student workload	**Hours** 130
Workload involving teacher	**Hours** 65

* 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, W3, W4, U2	Advanced Topics in Space Biology and Astrobiology: Human Biological Responses and Health Risks in Space, Life Detection and Evolutionary Processes, Space-Based Biomanufacturing and Organism Applications, Advanced Experimental Techniques, Current Research in Space Biology and Astrobiology.
Laboratory classes	W1, W2, U1, K1, W3, W4, U2, W5, U3, K2	
Project classes	W4, U1, K1, U2	

Human Spaceflight: Medical and Technological Challenges

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17998.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 2	Exam **Activities and hours** Lectures: 30 Laboratory classes: 30 Project classes: 20 Seminars: 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 will understand the fundamental techniques for performing ultrasound diagnostics, gastrointestinal diagnostics, and trauma assessment in space conditions.	STE2A_W04	Activity during classes, Examination, Test results

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	The student will understand the fundamentals of human nutrition and its critical role in supporting physiological health and performance during space missions, including adaptations to acute and chronic stress.	STE2A_W04	Examination, Test results
W3	The student will know the principles behind developing and utilising "in vitro" devices, such as Lab-On-a-Chip systems, to study the impact of space conditions on biological organisms, and will understand their application in creating personalised research models and treatments adapted for space health studies.	STE2A_W02, STE2A_W03, STE2A_W04	Examination, Engineering project
Skills – Student can:			
U1	The student will be able to perform fundamental ultrasound diagnostics, gastrointestinal diagnostics, and trauma assessment in space conditions.	STE2A_U11, STE2A_U12	Activity during classes, Examination, Test results
U2	The student will be able to analyse the impact of nutrition on mental health in space, understanding how specific dietary choices can support psychological well-being in isolated and stressful conditions	STE2A_U11, STE2A_U12	Activity during classes, Project, Examination, Test results, Presentation
U3	The student will be able to design the bioengineered "in-vitro" systems specifically adapted for space research, applying them to simulate complex human biology under space conditions.	STE2A_U11, STE2A_U12	Activity during classes, Project, Examination, Engineering project, Test results, Presentation
Social competences – Student is ready to:			
K1	The student will be prepared to work effectively in interdisciplinary teams, collaborating with professionals from diverse fields to address the complex challenges of space medicine and biomedical engineering.	STE2A_K01, STE2A_K02	Activity during classes, Project, Engineering project, Test results, Presentation
K2	The student will be ready to approach problem-solving in high-stress, resource-limited environments, demonstrating resilience and adaptability essential for work in both space and other demanding settings.	STE2A_K01, STE2A_K02	Activity during classes, Project, Engineering project, Test results, Presentation
K3	The student will be committed to upholding high standards of responsibility and ethical conduct, understanding the critical importance of accurate diagnostics and effective healthcare solutions in situations where lives depend on precise, timely decisions.	STE2A_K01, STE2A_K02	Activity during classes, Project, Engineering project, Test results, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Laboratory classes	30

Project classes	20
Preparation for classes	23
Examination or final test/colloquium	2
Contact hours	5
Preparation of project, presentation, essay, report	20
Realization of independently performed tasks	10
Seminars	10
Student workload	**Hours** 150
Workload involving teacher	**Hours** 90

* 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, K1, K2, K3, W2, U2, W3, U3	During the "Human Spaceflight: Medical and Technological Challenges" course, students will explore the complex medical and technological aspects of human health in space. The first module, Diagnostics and Emergency Medical Procedures, will focus on fundamental techniques for ultrasound diagnostics, gastrointestinal diagnostics, and trauma assessment tailored to the unique conditions of space. The second module, Nutrition and Its Impact on an Astronaut’s Mental Health and Endocrine System, will introduce students to the critical role of nutrition in supporting both physiological and mental health during space missions. The final module, Design and Development of Miniaturized Biomedical Systems for In-Space Health Monitoring and Biological Research, will equip students with the skills to develop and implement advanced biomedical systems for life-science research in space.
Laboratory classes	W1, U1, K1, K2, K3, W2, U2, W3, U3	
Seminars	W1, U1, K1, K2, K3, W2, U2, W3, U3	
Project classes	W3, U3, K1, K2, K3	

Space resources and robotics (summer school)

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17914.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Elective
Form of study Full-time studies	**Block** Core 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 2	Completing the classes **Activities and hours** Lectures: 9 Project classes: 9 Fieldwork: 6 Seminars: 6	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 understands the geological history of Earth including its stratospheric scheme and understands the conditions of the space environment.	STE2A_W01, STE2A_W02	Execution of a project, Involvement in teamwork
W2	The student knows about space exploration using robots and environmental constraints on exploration of different bodies e.g. the Moon or Mars.	STE2A_W02, STE2A_W03, STE2A_W07	Execution of a project, Involvement in teamwork

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	The student knows about current research in the field of space robotics.	STE2A_W01	Execution of a project, Involvement in teamwork
Skills – Student can:			
U1	The student can detect simple geological objects in the field: types of rocks, their orientation in space, the relative age of rocks, and processes that resulted in their formation.	STE2A_U03	Execution of a project, Involvement in teamwork
U2	The student can design a model of a space manipulator and prepare a conceptual design of a space robot controller as well as a modular and autonomous space robot.	STE2A_U04	Execution of a project, Involvement in teamwork
U3	The student can communicate effectively in multinational teams.	STE2A_U08	Execution of a project, Involvement in teamwork
Social competences – Student is ready to:			
K1	The student is ready to take advantage of English being the lingua franca of education and science.	STE2A_K02	Execution of a project, Involvement in teamwork
K2	The student is aware of cultural differences in industry and academia and is ready to reconcile them while sharing knowledge.	STE2A_K01, STE2A_K02	Execution of a project, Involvement in teamwork
K3	The student is aware of the impact of the technologies on the societies.	STE2A_K03	Execution of a project, Involvement in teamwork

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	9
Project classes	9
Fieldwork	6
Seminars	6
Realization of independently performed tasks	13
Contact hours	5
Preparation for classes	13
Preparation of project, presentation, essay, report	12
Examination or final test/colloquium	2
Student workload	**Hours** 75

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
Lectures	W1, W2, U1, K1, W3, U2, K3, U3, K2	The learning outcomes are achieved through lectures, workshops, and seminars on space geology, space exploration, space robotics, and intercultural communication in multilingual and multinational teams. Students learn about the newest technologies applied in the space sector research during educational trips, tours, and sessions with research clubs. Students also work in teams on projects which they then need to consult with the teachers and present to other students and the teachers.
Project classes	W1, W2, U1, K1, W3, U2, K3, U3, K2	
Seminars	W1, W2, U1, K1, W3, U2, K3, U3, K2	
Fieldwork	W1, W2, U1, K1, W3, U3, K2, K3	

Planetary bodies exploration

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2K.17915.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Elective
Form of study Full-time studies	**Block** Core Modules
Profile General academic	**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: 15 Laboratory classes: 15	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 need for space exploration	STE2A_W07, STE2A_W14, STE2A_W15	Participation in a discussion, Examination
W2	Space bodies environment	STE2A_W07, STE2A_W14, STE2A_W15	Participation in a discussion, Examination
W3	Methods for resources identifications	STE2A_W07, STE2A_W14, STE2A_W15	Participation in a discussion, Examination

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W4	Technological readiness level and mission phases	STE2A_W02, STE2A_W07, STE2A_W14, STE2A_W15	Participation in a discussion, Examination
W5	Methods for mechatronic systems development dedicated to planetary bodies environment	STE2A_W07, STE2A_W14, STE2A_W15	Participation in a discussion, Examination, Report
W6	Geotechnical properties of soil and its interactions with devices	STE2A_W07, STE2A_W14, STE2A_W15	Participation in a discussion, Examination, Report
Skills – Student can:			
U1	Determine the basic characteristics of devices dedicated for space exploration	STE2A_U04	Participation in a discussion, Project, Report
U2	Discuss the properties of soil (regolith) existing in planetary environment	STE2A_U04, STE2A_U06	Participation in a discussion, Report
Social competences – Student is ready to:			
K1	Promoting the idea of the need for exploration and exploitation mineral resources in space	STE2A_K01, STE2A_K02	Participation in a discussion, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Laboratory classes	15
Preparation for classes	10
Preparation of project, presentation, essay, report	20
Realization of independently performed tasks	14
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 81
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
Lectures	W1, W2, W3, W4, W5, W6, U2	Classes within the module are conducted in the form of lectures and laboratory. As part of classes the following issues will be discussed: - potential location of mineral resources in space - components of planetary infrastructures and its development process - technologies for obtaining mineral resources from planetary bodies
Laboratory classes	W2, W5, W6, U1, U2, K1	

General Relativity and Space Applications

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi2S.18001.24

Lecture languages
English

Mandatoriness
Elective

Block
Major 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 2	Completing the classes **Activities and hours** Lectures: 15 Project classes: 15	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 foundational principles of general relativity, including metrics, curvature, and the geometric viewpoint.	STE2A_W11	Activity during classes, Participation in a discussion, Execution of exercises
W2	the Einstein Field Equations and their implications for spacetime curvature and gravitation.	STE2A_W11	Activity during classes, Participation in a discussion, Execution of exercises

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	the construction leading from general relativity to cosmology, to compact objects in astrophysics and their gravitational wave signatures.	STE2A_W11	Activity during classes, Participation in a discussion, Execution of exercises
W4	the principles and instruments for the measurement of gravitational effects and observation of gravitational waves, with special attention to space-based technology	STE2A_W01, STE2A_W11	Activity during classes, Participation in a discussion, Case study
Skills – Student can:			
U1	apply tensor calculus to analyze curvature, geodesics, and conservation laws in curved spacetime. They can calculate Christoffel symbols and solve geodesic equations in simple spacetime geometries.	STE2A_U10	Activity during classes, Participation in a discussion, Execution of exercises
U2	interpret gravity and gravitational wave phenomena, linking them to astrophysical sources and to advanced instrumentation used in scientific missions	STE2A_U10	Activity during classes, Participation in a discussion, Case study
Social competences – Student is ready to:			
K1	contributing to complex discussions on gravitational phenomena as part of projects that may involve space agencies, industry partners, or academic research groups.	STE2A_K01, STE2A_K02, STE2A_K03	Activity during classes, Participation in a discussion
K2	engaging in applied research by interpreting scientific literature, bridging knowledge between general relativity theory and practical applications.	STE2A_K03, STE2A_K04, STE2A_K05	Activity during classes, Participation in a discussion, Case study

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Project classes	15
Realization of independently performed tasks	40
Contact hours	5
Preparation for classes	10
Student workload	**Hours** 85
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
Lectures	W1, U1, K1, K2, W2, W3, U2, W4	The General Relativity course will focus on the geometrical point of view, introducing tensors, conservation laws, the stress-energy tensor and Christoffel symbols. The Equivalence Principle, parallel transport, Lie transport, Killing vectors, tensor densities and geodesics will be illustrated. The curvature of space and Einstein's field equation will be introduced. Gravitational radiation will be studied using linearized gravity, which will also allow discussion of the static limit. An introduction to relativistic cosmology, compact spherical source physics and black holes will be provided. The course covers the advanced space instruments fundamental to gravitational and relativistic measurements, including gravitational wave detectors (LISA), atomic clocks (ACES), drag-free systems (GRACE, LISA-PATHFINDER), probes testing frame dragging (GPB) and others, highlighting their role in detecting spacetime phenomena.
Project classes	W1, U1, K1, K2, W2, W3, U2, W4	

Students Club II

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi2O.17912.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
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 2	Completing the classes **Activities and hours** Participation in a student research club: 0	2

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	Fundamentals of Space Technology: Understand key concepts in space technology, including satellite systems, lunar transport, astrobiology, and space mission planning.	STE2A_W01, STE2A_W03, STE2A_W14, STE2A_W15	Work done within the framework of a practical placement
W2	Project Methodology: Familiarize with the stages of project development, from initial planning to execution and evaluation, in a space-oriented context.	STE2A_W03, STE2A_W14, STE2A_W15	Work done within the framework of a practical placement
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Develop the ability to identify and address technical challenges using knowledge of engineering, physics, and other related fields.	STE2A_U01, STE2A_U02	Work done within the framework of a practical placement
U2	Enhance skills in working effectively within interdisciplinary teams, communicating with peers, and dividing tasks based on each member's expertise.	STE2A_U07, STE2A_U08	Work done within the framework of a practical placement
U3	Conduct research, critically analyze information, and apply findings to make informed decisions within project activities.	STE2A_U08	Work done within the framework of a practical placement
Social competences – Student is ready to:			
K1	Demonstrate initiative and responsibility for one’s own learning by exploring project-related resources and continuously improving knowledge and skills.	STE2A_K02	Work done within the framework of a practical placement
K2	Encourage innovation by approaching complex space-related problems with creativity, considering new perspectives, and proposing original solutions.	STE2A_K01	Work done within the framework of a practical placement

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Preparation for classes	10
Realization of independently performed tasks	35
Preparation of project, presentation, essay, report	10
Contact hours	5
Student workload	**Hours** 60

* 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, W2, U1, K1, U2, U3, K2	This course builds on the foundation laid in "Students Club I," where students were introduced to various club projects and areas of focus. In "Students Club II," students will take an active role, gaining hands-on experience by directly contributing to a project they selected from those offered by AGH University’s student clubs.

Diploma Thesis

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi4K.01412.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 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	The student expands their knowledge in the area related to the topic of their thesis.	STE2A_W01, STE2A_W03, STE2A_W10, STE2A_W12	Diploma thesis
W2	Demonstrates critical and analytical thinking in the field of space studies.	STE2A_W02, STE2A_W03, STE2A_W07, STE2A_W09, STE2A_W10, STE2A_W13	Diploma thesis
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	The student develops skills in independently solving issues related to their thesis project.	STE2A_U01, STE2A_U02, STE2A_U07, STE2A_U09, STE2A_U10	Diploma thesis
Social competences – Student is ready to:			
K1	A conviction about the necessity of carrying out and promoting scientific and technical work within society.	STE2A_K01, STE2A_K03, STE2A_K04, STE2A_K05	Diploma thesis

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Contact hours	120
Preparation of project, presentation, essay, report	280
Realization of independently performed tasks	200
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, W2, U1, 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.

Space engineering III

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi4O.17928.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
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 3	Completing the classes **Activities and hours** Seminars: 15	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	How to explain complex technical concepts in a way that is accessible to both experts and non-specialists.	STE2A_W01	Activity during classes, Report on completion of a practical placement, Presentation
W2	How to logically arrange material to effectively introduce the audience to the topic, present the problem, methods, results, and conclusions.	STE2A_W01	Activity during classes, Report on completion of a practical placement, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	How to present both successes and encountered challenges or limitations, as well as pointing out potential applications or possibilities for improvement of the results.	STE2A_W01, STE2A_W03	Activity during classes, Report on completion of a practical placement, Presentation
Skills – Student can:			
U1	Prepare and deliver information clearly and convincingly, using appropriate visual aids.	STE2A_U01	Activity during classes, Presentation
U2	Engage in dialogue with the audience, respond to questions, clarify answers, and involve listeners in the discussion.	STE2A_U01, STE2A_U03	Activity during classes, Presentation
Social competences – Student is ready to:			
K1	Public speaking, managing stage fright, and staying calm in stressful situations, which allows for more confident and professional presentation of results.	STE2A_K01, STE2A_K03	Activity during classes, Presentation
K2	Take initiative and responsibility for personal learning by actively exploring project-related resources and consistently enhancing knowledge and skills.	STE2A_K01, STE2A_K03	Activity during classes, Report on completion of a practical placement, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Seminars	15
Preparation of project, presentation, essay, report	10
Contact hours	5
Student workload	**Hours** 30
Workload involving teacher	**Hours** 15

* 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, W2, W3, U1, U2, K1, K2	This course is an integral part of Students Club III and focuses on advancing students' practical skills in space engineering. Students will participate in hands-on project work and regular seminars, where they will present results from one of six specialized tracks selected during the Students Club III course. Each student joins a project team associated with a scientific club at AGH University, collaborating on real-world challenges in the space sector and working toward specific project objectives. Through periodic seminars, students share their progress, receive feedback, and refine their work based on insights from peers and instructors. Students may choose one of the following project teams: SpaceTeam AGH: This team focuses on developing a transport system for lunar regolith, tackling the challenges of lunar resource handling. AstroBio AGH: Dedicated to astrobiology, this team explores the possibilities for life in extraterrestrial environments and conducts space biology experiments. SatLAB AGH: Specializing in nanosatellite design and construction, SatLAB AGH is working on Poland's first student-built observational satellite, with a mission to monitor environmental changes in Poland using visible and near-infrared imaging. AGH LunarTech: Focused on developing technologies for lunar missions, this team collaborates with industry professionals to prepare students for practical applications in the space sector. AGH SpaceSystems: This team engages in a variety of space technology projects, including rockets, Mars rovers, planetary landers, and stratospheric balloon gondolas, providing experience across multiple space-related technologies. Cosmodrill: A team focused on promoting advancements in space technology, emphasizing the latest techniques and innovations relevant to the space industry. In Space Engineering III, students will gain invaluable experience in project-based learning, enhance their presentation and teamwork skills, and build foundational expertise in tackling the challenges and exploring innovations in space engineering.

Students Club III

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi4O.17929.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
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	2

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	Fundamentals of Space Technology: Understand key concepts in space technology, including satellite systems, lunar transport, astrobiology, and space mission planning.	STE2A_W01, STE2A_W03, STE2A_W14, STE2A_W15	Execution of a project
W2	Project Methodology: Familiarize with the stages of project development, from initial planning to execution and evaluation, in a space-oriented context.	STE2A_W03, STE2A_W14, STE2A_W15	Execution of a project
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Develop the ability to identify and address technical challenges using knowledge of engineering, physics, and other related fields.	STE2A_U01, STE2A_U02	Execution of a project
U2	Enhance skills in working effectively within interdisciplinary teams, communicating with peers, and dividing tasks based on each member's expertise.	STE2A_U01, STE2A_U02, STE2A_U03, STE2A_U04, STE2A_U05, STE2A_U06, STE2A_U07	Execution of a project
U3	Conduct research, critically analyze information, and apply findings to make informed decisions within project activities.	STE2A_U08	Execution of a project
Social competences – Student is ready to:			
K1	Demonstrate initiative and responsibility for one’s own learning by exploring project-related resources and continuously improving knowledge and skills.	STE2A_K02	Execution of a project
K2	Encourage innovation by approaching complex space-related problems with creativity, considering new perspectives, and proposing original solutions.	STE2A_K01	Execution of a project

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Preparation for classes	10
Preparation of project, presentation, essay, report	10
Realization of independently performed tasks	35
Contact hours	5
Student workload	**Hours** 60

* 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, W2, U1, K1, U2, U3, K2	"Students Club III" is the culminating course in the series, where students take on leadership roles, applying their accumulated knowledge while guiding and mentoring new members. Building on the practical skills and project experience gained in "Students Club II," students in "Students Club III" will not only advance their selected projects but also play a crucial role in knowledge transfer to the "Students Club I" participants, who are in the same semester and at the beginning of their journey. In "Students Club III," students will deepen their technical and teamwork skills through direct involvement in one of six specialized project tracks. They will collaborate with their project teams on advanced tasks while dedicating time to mentor first-level students, sharing insights and offering guidance on project development. The experience provides third-level students with valuable leadership and teaching skills, preparing them for future roles in both technical and managerial aspects of the field. Available student club teams include: SpaceTeam AGH: Developing a lunar regolith transport system and mentoring new members in practical problem-solving related to lunar exploration. AstroBio AGH: Expanding astrobiology knowledge while introducing first-year students to research principles in the search for life beyond Earth. SatLAB AGH: Continuing to refine nanosatellite projects and sharing knowledge with newcomers on the fundamentals of satellite design and data analysis, especially in monitoring environmental changes. AGH LunarTech: Advancing lunar mission planning, with a focus on guiding beginners through basic principles of lunar technology and collaborative projects with the space sector. AGH SpaceSystems: Leading projects on rockets, Mars rovers, and planetary landers, while introducing "Students Club I" members to the fundamentals of space technology. Cosmodrill: Promoting the latest in space technology development and helping new students grasp emerging trends and practical applications in the field. This course is ideal for students looking to consolidate their technical expertise while gaining mentoring and leadership experience, contributing to a collaborative, knowledge-sharing environment essential for the space technology community.

Diploma Seminar

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi4K.01432.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Core 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 3	Completing the classes **Activities and hours** Seminars: 15	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	Knowledge acquired in relation to the chosen thesis topic.	STE2A_W01, STE2A_W02, STE2A_W03, STE2A_W04, STE2A_W05, STE2A_W06, STE2A_W07, STE2A_W11	Review of a thesis, Diploma thesis preparation
W2	Demonstrates critical and analytical thinking in the field of space studies.	STE2A_W02, STE2A_W03, STE2A_W04, STE2A_W07, STE2A_W09, STE2A_W10	Review of a thesis, Diploma thesis preparation
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Prepare and deliver an oral presentation in English on specific topics in the field of technical sciences related to the execution of a project or research task.	STE2A_U02, STE2A_U08	Review of a thesis, Diploma thesis preparation
Social competences – Student is ready to:			
K1	Continuous education, which is achieved through the preparation of a master's thesis	STE2A_K01, STE2A_K02, STE2A_K03	Review of a thesis, Diploma thesis preparation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Seminars	15
Preparation for classes	10
Contact hours	5
Student workload	**Hours** 30
Workload involving teacher	**Hours** 15

* 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, W2, U1, K1	The diploma seminar prepares students for the completion of their master's thesis, which includes elements of a scientific issue. During the classes, students will be provided with knowledge on how to present the obtained results, how to prepare conclusions, and how to present the outcomes.

Science communication

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi4HS.17930.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Humanities and Social Sciences 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** Lectures: 15 Auditorium classes: 15	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 will understand the principles of clear, accessible science communication, including methods for tailoring messages to diverse and underrepresented audiences.	STE2A_W01, STE2A_W13	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	Students will acquire in-depth knowledge of global and local sustainability issues, such as climate change, biodiversity loss, and sustainable resource management, along with their socio-cultural dimensions.	STE2A_W01	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation
W3	Students will learn how different cultural, indigenous, and local knowledge systems contribute to scientific understanding, particularly in relation to environmental and sustainability challenges.	STE2A_W01, STE2A_W12, STE2A_W13	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation
Skills – Student can:			
U1	Students will be able to craft science messages that are clear, engaging, and appropriate for different audiences, considering factors such as cultural background, education level, and language.	STE2A_U01, STE2A_U09, STE2A_U10	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation
U2	Students will develop skills in using various media formats (e.g., infographics, videos, social media, podcasts) to communicate scientific concepts, ensuring that these formats are accessible to diverse populations.	STE2A_U01, STE2A_U10	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation
U3	Students will be able to evaluate the credibility and inclusivity of scientific sources, media representations, and public discourse on sustainability, identifying biases and gaps in representation.	STE2A_U01, STE2A_U09, STE2A_U10	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation
Social competences – Student is ready to:			
K1	Students will develop cultural sensitivity and empathy, enabling them to respectfully engage with diverse communities, understand their needs, and integrate their perspectives into science communication.	STE2A_K01, STE2A_K02, STE2A_K03, STE2A_K04, STE2A_K05	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation
K2	Students will adopt a strong commitment to promoting diversity, equity, and inclusion within the scientific community and in public communication, advocating for the representation of marginalized voices in science discussions.	STE2A_K01, STE2A_K02, STE2A_K03	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation
K3	Students will be able to foster a collaborative environment for science communication, encouraging dialogue and co-creation with various stakeholders, from local communities to global policymakers, with a focus on sustainable development.	STE2A_K01, STE2A_K02, STE2A_K03, STE2A_K04, STE2A_K05	Participation in a discussion, Execution of exercises, Execution of a project, Project, Involvement in teamwork, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Auditorium classes	15
Preparation for classes	30
Preparation of project, presentation, essay, report	15
Contact hours	5
Examination or final test/colloquium	2
Student workload	**Hours** 82
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

Lectures	W1, W2, W3, U1, U2, U3, K1, K2, K3	1. Foundations of Science Communication - The role of science communication in society - Principles of clear and effective communication of complex scientific information - The importance of audience analysis: understanding diverse audiences - Techniques for simplifying scientific jargon without compromising accuracy 2. Diversity and Inclusion in Science Communication - Addressing underrepresentation in science: Gender, race, ethnicity, and socio-economic factors - Inclusive communication: How to make science accessible to all audiences 3. Sustainability and Global Challenges in Science Communication - Global vs. local perspectives on sustainability issues - Role of science communication in promoting sustainability practices 4. Communication principles - How to get and retain peoples' attention - Steering the conversation - Dealing with difficult audience members - How to inspire and spark interest in science - Case studies and good practice 5. Ethical Issues and Responsibilities in Science Communication - Communicating risk and uncertainty, especially in public health and environmental contexts - Ethical communication of sustainability science: Considering economic and social equity - Balancing scientific accuracy with public understanding and action 6. Public Engagement and Science Outreach - Engaging diverse audiences through public outreach events, citizen science, and participatory science - Building two-way communication between scientists and the public - Evaluating public perception of science and sustainability issues - Strategies for effective science communication in policymaking and community decision-making
Auditorium classes	W1, W2, W3, U1, U2, U3, K1, K2, K3	

Space hackaton

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi4HS.17931.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Elective
Form of study Full-time studies	**Block** Humanities and Social Sciences 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** Lectures: 6 Auditorium classes: 30	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	A student who has passed the module knows the Lean Canvas and KTHIRL® methodology in the context of developing technological innovation.	STE2A_W01, STE2A_W12	Presentation
W2	A student who has passed the module knows the concepts of: Start up, pivot, business model, business plan	STE2A_W01, STE2A_W12	Presentation

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	A student who has passed the module understands the components of successful development of technological innovation in accordance with the KTHIRL® methodology.	STE2A_W01, STE2A_W12	Presentation
Skills – Student can:			
U1	A student who has passed the module is able to work effectively in a team under time pressure.	STE2A_U08, STE2A_U09, STE2A_U10	Presentation, Participation in scientific research, conferences, additional internships and training courses
U2	A student who has passed the module is able to effectively conduct desk research on a given technological and business issue.	STE2A_U08, STE2A_U09, STE2A_U10	Presentation, Participation in scientific research, conferences, additional internships and training courses
U3	A student who has passed the module is able to give a pitch deck presentation.	STE2A_U08, STE2A_U09, STE2A_U10	Presentation, Participation in scientific research, conferences, additional internships and training courses
U4	A student who has passed the module is able to prepare a pitch deck investor presentation.	STE2A_U08, STE2A_U09, STE2A_U10	Presentation, Participation in scientific research, conferences, additional internships and training courses
Social competences – Student is ready to:			
K1	A student who has completed the module is aware of the current challenges related to the development of innovations in the Space industry.	STE2A_K01, STE2A_K03, STE2A_K04, STE2A_K05	Presentation, Participation in scientific research, conferences, additional internships and training courses

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	6
Auditorium classes	30
Contact hours	5
Preparation for classes	20
Preparation of project, presentation, essay, report	8
Realization of independently performed tasks	6

Student workload	Hours 75
Workload involving teacher	Hours 36

* 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	The classes will be divided into two parts: a lecture and a workshop in the form of a hackathon. The lecture part will familiarize students with the basics of the Lean Canvas methodology and the method of assessing the development of KTHIRL® innovations. The workshop part will consist of performing short tasks in a team under time pressure.
Auditorium classes	U1, U2, U3, U4, K1	

Interpersonal skills

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi4HS.17932.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Elective
Form of study Full-time studies	**Block** Humanities and Social Sciences 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** Lectures: 15 Auditorium classes: 20	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 and understands how interpersonal skills contribute to innovation, problem-solving, and teamwork in space technology field	STE2A_W01	Oral answer
Skills – Student can:			
U1	The student is able to communicate effectively within interdisciplinary teams, adapt their style for diverse audiences, and actively contribute through listening and feedback	STE2A_U09, STE2A_U10	Execution of exercises

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Social competences – Student is ready to:			
K1	The student is ready to contribute to and lead teams in interdisciplinary projects, demonstrating the competence to manage team dynamics and foster motivation in space-industry settings	STE2A_K02, STE2A_K04, STE2A_K05	Execution of exercises, Oral answer
K2	The student is ready to apply conflict resolution strategies in interdisciplinary teams, effectively managing disagreements to maintain collaboration and productivity in space technology projects	STE2A_K01, STE2A_K04, STE2A_K05	Execution of exercises, Oral answer

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Auditorium classes	20
Preparation for classes	10
Preparation of project, presentation, essay, report	15
Realization of independently performed tasks	18
Contact hours	5
Student workload	**Hours** 83
Workload involving teacher	**Hours** 35

* 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	This course develops communication and teamwork skills for the space industry. Students learn verbal and non-verbal communication, adaptive team interactions, active listening, and feedback. Topics include conflict resolution, leadership, emotional intelligence, and managing teams in high-pressure, interdisciplinary settings.
Auditorium classes	U1, K1, K2	

English for Engineering

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi80000JO.17882.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foreign Language
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 0	Completing the classes **Activities and hours** Foreign language classes: 28	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	The student knows basic technical vocabulary in mechanical engineering, strength of materials, fluid mechanics, programming, control theory, electronics, mechatronics, etc.	STE2A_U01_0	Activity during classes, Participation in a discussion, Test
U2	The student knows the structure of scientific publications, reports and documentation, and conference presentations	STE2A_U01_0	Activity during classes, Test, Report
U3	The student knows the basic vocabulary used in professional communication	STE2A_U01_0	Activity during classes, Test

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U4	The student is able to write a report/publication using specialist engineering vocabulary	STE2A_U01_0	Activity during classes, Test, Report
U5	The student is able to prepare and deliver a technical presentation in English	STE2A_U01_0	Activity during classes, Test, Presentation
U6	The student is able to speak and give an opinion on a presented topic at a formal professional meeting	STE2A_U01_0	Activity during classes, Participation in a discussion, Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Foreign language classes	28
Preparation for classes	15
Preparation of project, presentation, essay, report	5
Realization of independently performed tasks	5
Examination or final test/colloquium	2
Contact hours	5
Student workload	**Hours** 60
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

Foreign language classes	U1, U2, U3, U4, U5, U6	During the course, students will have the opportunity to explore specialised vocabulary in various fields of engineering. The first module is on Aeronautical Engineering Vocabulary, where parts of aircraft, spacecraft and their functions will be discussed, as well as aerodynamics and flight mechanics terminology. The next subject block is Mechanical Engineering Vocabulary, where students will learn about tools, machines and mechanical components, as well as explore terminology in fluid mechanics and thermodynamics. The third module, on Materials Engineering Vocabulary, will introduce different types of materials such as metals, polymers, composites and ceramics, along with their properties such as tensile strength, elasticity and conductivity. The course also covers Mechatronics, technical writing, safety and standards compliance, environmental aspects in Engineering and practical dialogues related to engineering communication. Each of these modules will provide students with the knowledge necessary to successfully navigate the field of engineering and understand the specialised language used in the field.

Mathematics in engineering calculations

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi80000P.17883.24

Lecture languages
English

Mandatoriness
Obligatory

Block
Foundation 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 0	Completing the classes **Activities and hours** Lectures: 42 Auditorium 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	fundaments of algebra, including the properties of real and complex numbers.	STE2A_W05_0	Test, Oral answer
W2	fundamentals of differential and integral calculus of functions of one variable.	STE2A_W05_0	Test, Oral answer
W3	basic operations on tensors and their applications.	STE2A_W05_0	Test, Oral answer
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	apply calculus to the solution of mathematical and engineering problems. She/he can examine the convergence of sequences and series and determine their limits, differentiate and integrate functions of single variable.	STE2A_U01_0	Activity during classes, Test
U2	can perform basic operations on matrices. She/he can solve systems of linear equations, find the eigenvalues and eigenvectors of matrices.	STE2A_U01_0	Activity during classes, Test
U3	can perform algebraic operations on tensors.	STE2A_U01_0	Activity during classes, Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	42
Auditorium classes	42
Preparation for classes	30
Examination or final test/colloquium	2
Contact hours	4
Student workload	**Hours** 120
Workload involving teacher	**Hours** 84

* 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, W3, U3	Differential and integral calculus of functions of single variable. Fundamentals of linear algebra. Fundamentals of tensors and tensor calculus.
Auditorium classes	W1, W2, U1, U2, W3, U3	

Physics 1

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi80000P.03161.24

Lecture languages
English

Mandatoriness
Obligatory

Block
Foundation 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 0	Exam **Activities and hours** Lectures: 30 Auditorium classes: 30	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	Fundamentals of classical physics and selected topics of modern physics.	STE2A_W03_0	Examination
W2	Newtonian and Lagrangian mechanics, fundamentals of thermodynamics, solar physics and cosmology.	STE2A_W04_0	Examination
Skills – Student can:			
U1	Critically analyze and solve engineering projects utilizing her/his knowledge and available resources.	STE2A_U02_0	Activity during classes, Test

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U2	Solve problems in Newtonian, Lagrangian mechanics, thermodynamics, solar physics and cosmology.	STE2A_U02_0	Activity during classes, Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	30
Auditorium classes	30
Preparation for classes	15
Realization of independently performed tasks	20
Examination or final test/colloquium	2
Contact hours	3
Student workload	**Hours** 100
Workload involving teacher	**Hours** 60

* 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, W2, U2	1. Measurement, measurement uncertainty, the International System of Units. 2. Coordinate systems, motion in 3-dimensions, Newtonian mechanics. 3. Force, linear momentum, torque, angular momentum, equations of motion, work, energy. 4. Conservation laws, motion in gravitational field, Kepler's laws, variable mass motion, two-body system, collisions. 5. System of particles, center of mass, rigid body angular motion, tensor of inertia, equilibrium, elasticity. 6. Generalized equations of motion, principle of least action. 7. Thermodynamical equilibrium, temperature, ideal gas, kinetic theory of ideal gas, equipartition of energy, heat and work, the first law of thermodynamics, changes of thermodynamic state of ideal gas, specific heat capacity, heat conduction, diffusion, Fick's law, entropy, the second law of thermodynamics, engines and refrigerators, statistical view of entropy, reversible and irreversible processes. 8. Solar physics, Solar atmosphere, surface and interior, Solar energy, proton-proton cycle, evolution of stars, cosmology and evolution of universe, Hubble's law.
Auditorium classes	W1, U1, W2, U2	

Chemistry

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi80000P.01361.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 0	Completing the classes **Activities and hours** Lectures: 10 Auditorium classes: 10 Laboratory classes: 10 Project classes: 10	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 has structured knowledge of chemistry necessary to understand and interpret basic chemical phenomena in the context of issues in the field of materials and mechanical engineering.	STE2A_W01_0	Test, Test results
W2	The student knows the basic concepts and laws of chemistry, elements of nuclear chemistry, and the structure of the atom in terms of quantum mechanics.	STE2A_W01_0	Execution of laboratory classes, Test, Project, Test results

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	The student is able to determine the type of chemical bond based on the properties of the elements that form it, as well as show the relationship between the type of bond in a given material and the influence on its physicochemical properties.	STE2A_U06	Test, Project, Test results
U2	The student is able to propose the use of basic physicochemical phenomena to create, for example, intelligent materials, build reactors, store energy, etc.	STE2A_U06	Project
U3	The student is able to show the relationship between the electronic configuration of atoms and the structure of the periodic table and the basic physicochemical properties of the elements.	STE2A_U06	Execution of laboratory classes, Test, Report, Test results
U4	The student is able to perform chemical calculations using basic chemical laws and concepts, distinguishes basic types of chemical reactions and is able to write down their course using reaction equations in molecular and ionic form	STE2A_U06	Execution of laboratory classes, Test, Project, Report, Test results
U5	The student is able to perform basic laboratory operations and, by carrying out appropriate chemical reactions, is able to detect the most important cations and anions in inorganic compounds.	STE2A_U06	Execution of laboratory classes, Report

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	10
Auditorium classes	10
Laboratory classes	10
Project classes	10
Preparation of project, presentation, essay, report	15
Preparation for classes	20
Examination or final test/colloquium	2
Student workload	**Hours** 77
Workload involving teacher	**Hours** 40

* 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	W2, U3, W1, U1, U2, U4, U5	Scope of lectures and exercises: - Basic chemical laws - Basic chemical concepts (atomic number, mass number, atomic and molecular mass, unified atomic mass unit (u), molar mass, mole of a substance, Avogadro's constant, chemical element, isotope, atom, chemical compound, molecule, derivation of empirical and molecular formulas of compounds, stoichiometric calculations) - The quantum mechanical model of atoms (Heisenberg's indeterminacy principle, wave-particle duality, Schrödinger equation, wave function, quantum numbers, orbital, spin, spin-orbital, atomic nucleus, alpha and beta particles, nuclear reactions, the effect of radiation on the structure and properties of materials) - Electronic configuration of an atom and the periodic table (electron shells and subshells, Pauli exclusion principle, Hund’s rule, electronic configurations of atoms, the relationship between electronic configuration and chemical properties, valency of elements in compounds, variability of physical and chemical properties within groups and periods) - Chemical bonding (the reason for the formation of chemical bonds, types of chemical bonds, molecular orbitals, electronic configuration of homo- and heteroatomic molecules, hybridization, molecular shape, bond type and the properties of chemical compounds) - States of matter (plasma, gas state, liquid state, solid state, structure and properties of solids, phase transitions) - Chemical kinetics and equilibrium (thermodynamic causes of chemical reactions, kinetic equation, reaction rate, rate constant, the dependence of reaction rate on reactant concentration, activation energy, catalysis and catalysts, the effect of temperature on reaction rate, equilibrium constant, the effect of reactant concentration and state parameters on chemical equilibrium, Le Chatelier’s principle, calculation of reaction rates and rate constants, calculation of equilibrium constants, calculation of equilibrium concentrations, prediction of the direction of equilibrium shift) - Formulating and balancing reactions, including oxidation and reduction reactions, and stoichiometric calculations related to chemical reactions, reaction yield - Solution chemistry (electrolytes and nonelectrolytes, electrolytic dissociation, weak and strong electrolytes, degree and constant of dissociation, methods of expressing solution concentrations, conversion between different concentration units) - Acids, bases, salts (definitions of acids and bases, salts, acid salts, basic salts, the ionic product of water, pH, writing dissociation equations for strong and weak electrolytes, pH calculations in strong and weak electrolyte solutions, ionic equilibria) - Electrochemistry (oxidation state, redox reactions, standard potentials, electrochemical series, prediction of the direction of redox reactions, electrochemical cells, electrochemical cell potential, electrolysis, electrochemical corrosion)
Auditorium classes	W2, U3, W1, U2, U4, U5	
Project classes	W2, U3, W1, U1, U2, U4, U5	
Laboratory classes	U4, U5, W1, U3	

Introduction to mechanics of the materials

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi80000P.17884.24

Lecture languages
English

Mandatoriness
Obligatory

Block
Foundation 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 0	Exam **Activities and hours** Lectures: 18 Laboratory classes: 20 Project classes: 30	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	Students will have a basic knowledge of the properties of metallic, polymeric, ceramic and composite materials.	STE2A_W01_0, STE2A_W03_0, STE2A_W04_0	Activity during classes, Execution of a project, Test, Examination, Test results
W2	The student has a basic knowledge of the influence of service conditions on the mechanical response of materials	STE2A_W01_0, STE2A_W03_0	Activity during classes, Test, Examination, Test results

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W3	The student has a basic knowledge of modelling the physico-chemical properties of materials	STE2A_W01_0, STE2A_W03_0, STE2A_W04_0	Activity during classes, Test, Examination, Test results
W4	Students will be able to select the material and manufacturing method of the component according to the defined operating conditions.	STE2A_W01_0, STE2A_W03_0, STE2A_W04_0	Activity during classes, Test, Examination, Test results
W5	Students will be able to apply adequate testing tools for materials to determine their basic properties	STE2A_W01_0, STE2A_W03_0, STE2A_W04_0	Activity during classes, Test, Examination, Test results
W6	The student is able to define the analyses that can be carried out to determine the strength properties of the designed structures	STE2A_W01_0, STE2A_W03_0, STE2A_W04_0	Activity during classes, Test, Examination, Test results
Skills – Student can:			
U1	Students will be able to select the material and manufacturing method of the component according to the defined operating conditions.	STE2A_U01_0, STE2A_U02_0	Activity during classes, Report, Test results, Presentation
U2	Students will be able to apply adequate testing tools for materials to determine their basic properties	STE2A_U02_0, STE2A_U04_0	Activity during classes, Report, Test results, Presentation

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	18
Laboratory classes	20
Project classes	30
Preparation for classes	25
Contact hours	5
Examination or final test/colloquium	2
Student workload	**Hours** 100
Workload involving teacher	**Hours** 68

* 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, W5, U1, U2, W2, W4, W3, W6	During the "Introduction to Material Mechanics" course, students will have the opportunity to deepen their understanding of various materials, including metals, polymers, and composites. The first part of the course will cover the fundamentals of material strength and key terminology, such as stress, strain, and failure hypotheses. Students will learn how to conduct static load analyses and understand how dynamic loads affect the mechanical response of different materials. The second thematic block will focus on characterizing metals, polymers, and composite materials. Basic properties such as elasticity, plasticity, viscoelasticity, and viscoplasticity will be introduced. A key element of this block will be stress analysis in structural components, along with an introduction to Finite Element Method (FEM) analysis. Students will learn how to conduct experimental tests essential for properly defining FEM analyses, such as tensile, compression, multiaxial, dynamic, relaxation, and creep tests. The final part of the course will be dedicated to the degradation and durability of materials. Various cases of structural damage will be discussed as case studies. Additionally, students will have the chance to learn about materials operating in extreme conditions, as well as current challenges and future perspectives in the field of material mechanics. This segment of the course will provide students with practical knowledge essential for understanding and designing materials under real engineering conditions.
Laboratory classes	W1, W5, U1, U2, W2, W4, W3, W6	
Project classes	W1, W5, U1, U2, W2, W4, W3, W6	

Mechanical Structures I

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi80000P.17885.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 0	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	The student knows and understands the structure and operation of mechanical devices used in space.	STE2A_W04_0	Test
Skills – Student can:			
U1	The student is able to present technical documentation of mechanical devices with particular emphasis on the specifics of work in outer space conditions.	STE2A_U01_0, STE2A_U02_0	Test

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	14
Laboratory classes	28
Contact hours	5
Preparation for classes	10
Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	20
Student workload	**Hours** 79
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, U1	Basic Theory of Machines and Mechanisms, Basics of mechanics, Basics of physics, Fundamentals of material strength.
Laboratory classes	W1, U1	

Basics of electronics

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi80000P.17886.24

Lecture languages
English

Mandatoriness
Obligatory

Block
Foundation 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 0	Completing the classes **Activities and hours** Laboratory classes: 24 Project classes: 10 Discussion seminars: 20	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 has basic knowledge about operation principles of semiconductor electronic devices	STE2A_W02_0	Activity during classes, Participation in a discussion, Oral answer
W2	Student knows and understands general methodology of basic analog and digital electronic circuits as well as some practice related to measurements of functional parameters of them	STE2A_W05	Activity during classes, Participation in a discussion, Oral answer

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Skills – Student can:			
U1	Student can acquire relevant information form technical literature and databases including electronic component datasheets. He/she can integrate acquired data and interpret them, draw appropriate conclusions and justify opinions/expectations concerning electronic circuits/systems	STE2A_U01_0	Report, Engineering project, Completion of laboratory classes
U2	Student is able to analyse and design simple electronic circuits/systems as well as can design the measurement setup for functional verification and important parameter estimation	STE2A_U02, STE2A_U03	Report, Engineering project, Completion of laboratory classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Laboratory classes	24
Project classes	10
Discussion seminars	20
Preparation for classes	20
Preparation of project, presentation, essay, report	34
Contact hours	4
Student workload	**Hours** 112
Workload involving teacher	**Hours** 54

* 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, W2, U2	Fundamental electric concepts: voltage,currtent. Ohm law and Kirchhof laws. DC and AC steady state circuits Resistors, capacitors, inductior coils. Diodes BJT and MOSFETs. Relays and switches. Methods and techniques of circuit analysus. Simulation tools (SPICE). Analog filters - approximation, synthesis. Fundamentals of digital electronics. Logic gates combinatorial circuits synthesis. Flip-flops ad registers. Introduction to microprocessors and mirocontrollers. Signal processinf - sampling, quantization DACs and ADCs. Modulation and frequency transation. Transmission lines and antenas Feedback fundamentals - supply regulators motor drivers. Feedback stability PLL as sophisticated nonlinear feedback example. Oscillators and frequency synthetiseers. Electronic sensors of temperature/pressure. Accelerometers. Developement vectors of contemporary electronics- technology, hardware-software embedded systems Communication standards. Fundamentals of satelite communications and GPS Lab classes will additionally make student familiar with rapid prototyping using solderless protoboards and universal PCBs
Project classes	U2	
Laboratory classes	U1, U2	

Essentials of software development and systems engineering

Course description sheet

Basic information

Field of study Space Technologies	**Didactic cycle** 2024/2025
Major All	**Course code** WTKSTES.IIi80000P.17997.24
Organisational unit Faculty of Space Technologies	**Lecture languages** English
Study level Second-cycle (engineer) programme	**Mandatoriness** Obligatory
Form of study Full-time studies	**Block** Foundation 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 0	Exam **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	Key principles of the Software Development Life Cycle (SDLC) and Agile methodologies, including Scrum, feature-centric teams, and software design principles.	STE2A_W06_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
W2	Core concepts in data management, including relational and NoSQL databases, data processing pipelines, and ETL (Extract, Transform, Load) processes.	STE2A_W06_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes
W3	Modern software technologies such as virtualization, containerization, cloud computing, and DevOps practices for efficient development, deployment, and scaling.	STE2A_W06_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes
W4	Basic programming concepts and constructs, including syntax, data structures, control flow, and libraries, with a focus on Python for space applications.	STE2A_W06_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes
Skills – Student can:			
U1	Use Python programming, version control (Git), and scripting skills to address problems and automate tasks relevant to space engineering.	STE2A_U03_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes
U2	Apply software architecture principles and design patterns to develop modular, scalable, and reliable systems.	STE2A_U03_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes
U3	Deploy and manage virtualization and containerization tools to create isolated environments and scalable applications.	STE2A_U03_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes
U4	Apply Agile methodologies, including Scrum and feature-centric team practices, to manage software development lifecycles effectively and collaborate in team-based projects	STE2A_U03_0	Activity during classes, Execution of laboratory classes, Examination, Completion of laboratory classes
U5	Effectively manage and perform scripting in modern operating systems to automate system tasks and configurations.	STE2A_U03_0	Activity during classes, Execution of laboratory classes, Examination, 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
Examination or final test/colloquium	2
Realization of independently performed tasks	20
Contact hours	5
Student workload	**Hours** 111
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	U2, W4, U1, U5, W1, U4, W2, W3, U3	1. Introduction to Software Development in Space Applications 2. Python Programming Essentials for Space Engineers 3. Operating Systems Essentials for Developers 4. Linux Systems: Administration and Shell Scripting 5. Windows Systems Administration and PowerShell Basics 6. Version Control with Git 7. Agile Development and Software Lifecycle 8. Software Architecture Fundamentals 9. Data Management Essentials 10. Data Processing Pipelines 11. Software Quality, Testing, and Clean Code Practices 12. Virtualization and Containerization 13. Container Orchestration and Deployment 14. Cloud and Edge Computing Fundamentals 15. DevOps and CI/CD Pipelines 16. Ethical, Safety, and Compliance Considerations
Laboratory classes	U2, W4, U1, U5, W1, U4, W2, W3, U3	

Engineering Project

Course description sheet

Basic information

Field of study
Space Technologies

Major
All

Organisational unit
Faculty of Space Technologies

Study level
Second-cycle (engineer) programme

Form of study
Full-time studies

Profile
General academic

Didactic cycle
2024/2025

Course code
WTKSTES.IIi80000P.17888.24

Lecture languages
English

Mandatoriness
Obligatory

Block
Foundation 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 0	Completing the classes **Activities and hours** Project classes: 28 Lectures: 7	2

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 basic knowledge of the interdisciplinary approach to product design.	STE2A_W02_0, STE2A_W04_0	Project, Oral answer
W2	Has fundamental knowledge of the mechatronic product lifecycle, from concept and design to development, testing, and potential product integration.	STE2A_W02_0, STE2A_W04_0	Project, Oral answer
Skills – Student can:			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
U1	Is able to create a conceptual design of a mechatronic device along with its specifications.	STE2A_U01_0, STE2A_U02_0	Project
U2	Can use algorithms to implement within interdisciplinary projects.	STE2A_U02_0	Project

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Project classes	28
Lectures	7
Preparation for classes	20
Contact hours	5
Student workload	**Hours** 60
Workload involving teacher	**Hours** 35

* 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	This course focuses on developing practical skills and interdisciplinary knowledge through a team-based mechatronics project. Students will synthesize foundational knowledge in computer science, electronics, and mechanics to design and create a functional mechatronic prototype. This course aims to teach the essentials of interdisciplinary product design and the lifecycle of mechatronic products, emphasizing teamwork and problem-solving skills.
Project classes	W1, U1, U2, W2	

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

Field of study: Space Technologies

Enrollment rules for the next semester

It is governed by the Regulations of Studies at the AGH University of Science and Technology in Kraków (available at: https://www.cok.agh.edu.pl/regulamin-studiow-agh/regulamin-studiow-agh-tekst). Students who do not exceed the allowable deficit of ECTS points are granted enrollment for the next semester.

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

According to the AGH University of Science and Technology regulations, a student may advance to the next semester with a credit deficit not exceeding 15 ECTS points. A formal request for this must be submitted to the Dean.

ECTS credits debt ceiling

15

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)

Monitoring semesters

2

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

The situations entitling students to apply for an individualized organization of studies and the possibilities for individualization are specified by the AGH Study Regulations. A student, with the Dean's consent, has the right to pursue studies according to an individualized study plan. Pursuing such studies cannot lead to changes in the scope of program learning outcomes or mandatory course modules. The rules for conducting such studies are determined by the Dean based on a written application from the student. The application should specify the scope of individualization and provide justification.

Implementation of practical placements including monitoring system and completion rules

The study program does not include mandatory professional internships.

Although a diploma internship is not mandatory as part of the second-cycle studies, students have the option to apply for such an internship with the dean's approval. Internships can be undertaken individually at companies or research laboratories aligned with the student’s diploma work. Examples of key companies in Poland offering relevant opportunities include Astronika (mechanical devices for space missions), KP Labs (AI and onboard systems for satellites), Creotech Instruments (satellite systems and instruments), and SpaceForest (suborbital rockets and space technologies).

Alternatively, students may gain hands-on experience by participating in AGH student scientific clubs, such as AGH Space Systems or AGH Rover Team, contributing to research projects or preparing for international competitions. This flexibility allows students to develop practical skills and industry connections, enhancing their career prospects in the space sector.

Rules of elective modules taking

The rules for selecting individual course modules are specified in the Syllabus.

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

During the recruitment process for the second-cycle studies in Space Technologies, students declare their preferred educational path by selecting their order according to their interests. The available paths are:

- Upstream (technologies related to the design and operation of spacecraft)
- Downstream (analysis of space data and signal processing)
- Biomedical (the impact of space on human health and life support technologies).

The results of the recruitment exam are the basis for creating a ranking that determines the allocation of students to their chosen paths. The Vice Dean for Education makes the decision to launch a given path, with a minimum of 12 students required for each.

Within two weeks of the announcement of the allocation lists, students have the opportunity to submit a request to change their decision regarding the choice of educational path. The decision on the change is made depending on the availability of places in the respective groups.

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

Diploma awarding is conducted in accordance with the Regulations of Studies at the AGH University of Science and Technology in Kraków.

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

The overall result of completing the studies is calculated during the session of the Examination Committee, held during the so-called defense of the diploma thesis. It is a weighted average calculated as follows:
Final Result (OD) = 0.6 * average grade obtained during the course of studies + 0.3 * final grade for the diploma thesis + 0.1 * grade from the diploma examination.

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

Full-time second-cycle studies begin in:

- Winter semester (October) for graduates of first-cycle studies who do not have the professional title of engineer.
- Summer semester (February) for graduates of first-cycle studies who have the professional title of engineer.

A graduate of the second-cycle Space Technologies program will possess advanced interdisciplinary skills tailored to the demands of the modern space sector. Building on their first-cycle education, students gain expertise in key areas such as spacecraft design, mission planning, satellite systems, and the integration of cutting-edge technologies like artificial intelligence and robotics in space applications.

Graduates are well-prepared to pursue careers in the rapidly expanding space industry, taking on roles in satellite development, mission analysis, and space system operations. They are also equipped to work in R&D positions at leading aerospace companies, research institutions, and government agencies. Companies specializing in earth observation, navigation systems, or advanced manufacturing processes are among the many potential employers.

This program also provides a strong foundation for doctoral studies, enabling graduates to contribute to innovative research projects in fields such as space exploration, planetary sciences, and space-related technologies. With its emphasis on hands-on experience, collaboration, and cutting-edge problem-solving, the Space Technologies program ensures that graduates are highly valued across both the private and public sectors in the global space economy.

Mentor of the field of study: dr hab. inż. Leszek Siwik, prof. AGH

View full description of the field of study

Study programme determined by Resolution No. 118/2024 of the AGH UST Senate of 27th November 2024