

Major learning outcomes	Description of learning outcomes	Reference to major learning outcomes
KNOWLEDGE		
1) general knowledge (not directly related to engineering)		
K_W01	Selects and is able to use mathematical and physical methods for describing and analysing physical processes and systems essential for solving technical problems including: nonlinear differential equations, partial differential equations, harmonic analysis, mathematical theory of signal analysis and visualisation	Has extended and in-depth knowledge of mathematics, physics, chemistry and other field-related areas useful for formulating and solving simple problems associated with the scope of his or her field of study T2A_W01
K_W02	Knows achievements, challenges and limitations of selected advanced physical and physiochemical problems applied in modern technologies	Has well-established theoretical basic knowledge of selected issues related to the scope of his or her field of study T2A_W04
		Has knowledge of development trends and the most crucial new achievements in the area of science and scientific disciplines relevant to his or her field of study and related fields T2A_W05
K_W03	Knows computer simulation systems of many bodies, continuums, static systems and systems based on quantum and mechanical models	Has extended and in-depth knowledge of mathematics, physics, chemistry and other field-related areas useful for formulating and solving simple problems associated with the scope of his or her field of study T2A_W01
		Has well-established theoretical general knowledge of key issues related to the scope of his or her field of study T2A_W03
		Has well-established theoretical basic knowledge of selected issues related to the scope of his or her field of study T2A_W04
2) basic engineering knowledge		
K_W04	Has extended knowledge of characterisation and manufacture of technological and construction materials and their potential uses in modern technologies	Has detailed knowledge of fields of studies associated with his or her field of study T2A_W02
		Has well-established theoretical general knowledge of key issues related to the scope of his or her field of study T2A_W03
		Has well-established theoretical basic knowledge of selected issues related to the scope of his or her field of study T2A_W04
K_W05	Has detailed knowledge of selected branches of electronics, control and optics and automatic control enabling him or her to understand operation and construction of selected complex measurement and research systems	Has detailed knowledge of fields of studies associated with his or her field of study T2A_W02
		Has well-established theoretical general knowledge of key issues related to the scope of his or her field of study T2A_W03
		Has well-established theoretical basic

		knowledge of selected issues related to the scope of his or her field of study T2A_W04
		Has basic knowledge of the lifespan of devices, facilities and technical systems T2A_W06
K_W06	Knows the process of constructing selected complex multi-functional mechanical, electronic and optical devices and their combinations	Has well-established theoretical general knowledge of key issues related to the scope of his or her field of study T2A_W03
		Has well-established theoretical basic knowledge of selected issues related to the scope of his or her field of study T2A_W04
		Has basic knowledge of the lifespan of devices, facilities and technical systems T2A_W06
		Knows basic methods, techniques, tools and materials used to solve complex engineering problems related to his or her field of study T2A_W07
3) knowledge closely related to solving engineering tasks		
K_W07	Has knowledge of selected experimental quantum engineering methods and their practical applications	Has well-established theoretical general knowledge of key issues related to the scope of his or her field of study T2A_W03
K_W08	Has well-established detailed knowledge of selected problems related to analysing the properties of functional materials at the macro-, micro- and nanoscale	Has well-established theoretical basic knowledge of selected issues related to the scope of his or her field of study T2A_W04
K_W09	Knows and understands processes of designing and creating molecular functional systems	Has well-established theoretical basic knowledge of selected issues related to the scope of his or her field of study T2A_W04
K_W10	Knows the current state of knowledge, research and development in the area of nanotechnology, condensed matter physics, surface physics, electronics, quantum science, bioelectronics, spintronics, nonlinear and material optics; has knowledge of technology transfer	Has well-established theoretical general knowledge of key issues related to the scope of his or her field of study T2A_W03
		Has knowledge of development trends and the most crucial new achievements in the area of science and scientific disciplines relevant to his or her field of study and related fields T2A_W05
K_W11	Has detailed knowledge of a technique of microwave and optical radiation synthesis and a method of spectral and time analysis	Has well-established theoretical basic knowledge of selected issues related to the scope of his or her field of study T2A_W04
		Knows basic methods, techniques, tools and materials used to solve complex engineering problems related to his or her field of study T2A_W07
K_W12	Knows and understands basic terminology relating to copyright and intellectual property resources management	Has knowledge essential for understanding social, economic, legal and nontechnical aspects of engineering and their application in engineering practice T2A_W08
		Has basic knowledge concerning management, including quality management, and running a business T2A_W09
		Knows and understands basic terminology and principles related to industrial and intellectual property protection and recognises the need to

		manage intellectual property resources; is able to use patent information resources T2A_W10
K_W13	Knows the general principles of the manner of functioning of individual entrepreneurship that uses knowledge of technical physics	Knows general principles of creating and developing forms of individual entrepreneurship using knowledge of scientific branches and disciplines relevant to his or her field of study T2A_W11

SKILLS

1) general skills (not directly related to engineering)

K_U01	Is able to use mathematical knowledge she or he has acquired to describe and create models of processes and physical and technical systems, algorithmise selected metrological tasks and control and monitor devices of physical experiment	Is able to integrate knowledge in the area of scientific branches and disciplines relevant to his or her field of study and use a systems approach considering nontechnical aspects, when formulating and solving engineering tasks T2A_U10
K_U02	Is able to extract information on physical and technical aspects from the literature and databases, carry out its critical analysis, integrate and formulate opinions on physical, technical and economic aspects	Is able to extract information from the literature, databases and other properly selected sources, also in English or another foreign language of international communication in the area of his or her field of study; is able to integrate obtained information, interpret it, draw conclusions and formulate and justify his or her opinions thoroughly T2A_U01
K_U03	Is able to prepare and deliver a scientific report, an oral presentation and/or a well-documented treatise in Polish and in a foreign language regarding specific problems related to technical physics	Is able to extract information from the literature, databases and other properly selected sources, also in English or another foreign language of international communication in the area of his or her field of study; is able to integrate obtained information, interpret it, draw conclusions and formulate and justify his or her opinions thoroughly T2A_U01
		Is able to prepare a scientific treatise in Polish and a short scientific report in a foreign language of international communication for the scientific branches and disciplines relevant to his or her field of study, presenting the results of his or her own scientific research T2A_U03
		Is able to prepare and deliver an oral presentation in Polish and a foreign language concerning detailed issues related to his or her field of study T2A_U04
		Has language skills related to scientific branches and disciplines relevant to his or her field of study, in accordance with requirements set for level B2+ Common European Framework of Reference for Languages T2A_U06

K_U04	Is able to plan and arrange self-education process	Is able to plan and implement self-education process T2A_U05
2) basic engineering skills		
K_U05	Is able to formulate a complex physical and/or technical problem in a structured way, propose the algorithm and strategy of solving it	Is able to use information and communication technologies to carry out engineering tasks T2A_U07
		Is able to plan and carry out experiments, including computer measurements and simulations, interpret results he or she has obtained and draw conclusions T2A_U08
		Is able to use analytical, simulation and experimental methods to formulate and solve engineering problems T2A_U09
		Is able to integrate knowledge in the area of scientific branches and disciplines relevant to his or her field of study and use a systems approach considering nontechnical aspects, when formulating and solving engineering tasks T2A_U10
		Is able to formulate and test hypotheses related to engineering problems and simple research problems T2A_U11
		Is able to evaluate usefulness and usability of new technological achievements relevant to his or her field of engineering T2A_U12
		Is able to identify and formulate a specification of complex engineering tasks relevant to his or her field of study, including nontypical ones, considering nontechnical aspects T2A_U17
K_U06	Is able to prepare documentation of research progress and/or a technical device in the area of selected problems of mechanics, electrical engineering, electronics, optics and photonics	Is able to use information and communication technologies to carry out engineering tasks T2A_U07
		Is able to identify and formulate a specification of complex engineering tasks relevant to his or her field of study, including nontypical ones, considering nontechnical aspects T2A_U17
K_U07	Is able to analyse concepts of selected rapidly developing new areas of physics, assess their innovativeness and technical feasibility	Is able to evaluate usefulness and usability of new technological achievements relevant to his or her field of engineering T2A_U12
K_U08	Is able to communicate using various information and communication technologies in professional and other contexts; is able to prepare training materials, also using modern information technologies	Is able to use information and communication technologies to carry out engineering tasks T2A_U07
K_U09	Has knowledge of a foreign language that enables him or her to deliver a seminar communiqué, participate in a discussion, read and understand	Is able to prepare and deliver an oral presentation in Polish and a foreign language concerning detailed issues related to his or her field of study T2A_U04

	specialist texts related to technical physics	Has language skills related to scientific branches and disciplines relevant to his or her field of study, in accordance with requirements set for level B2+ Common European Framework of Reference for Languages T2A_U06
K_U10	Is able to carry out economic analysis of undertaken engineering activities and use correctly at least one method of assessing their labour intensity	Is able to carry out initial economic analysis of undertaken engineering activities T2A_U14
K_U11	Is prepared for working in design and research team as well as industrial environment	Is prepared for working in an industrial environment and knows safety rules related to that work T2A_U13
3) skills closely related to solving engineering tasks		
K_U12	Is able to identify a complex physical and/or technical problem, propose a scheme of its analysis and/or its solution detailing its various physical and technical aspects, determine the degree of their complexity and assess their feasibility	Is able to identify and formulate a specification of complex engineering tasks relevant to his or her field of study, including nontypical ones, considering nontechnical aspects T2A_U17
		Is able to - according to provided specification and considering nontechnical aspects - design a complex device, facility, system or process relevant to his or her field of study and implement the project, at least partly, using appropriate methods, techniques and tools, using specifically adapted tools or developing new ones T2A_U19
K_U13	Is able to select advanced and new materials which have appropriate physicochemical and structure properties for standard and nonstandard laboratory and engineering uses	Is able to identify and formulate a specification of complex engineering tasks relevant to his or her field of study, including nontypical ones, considering nontechnical aspects T2A_U17
K_U14	Is able to plan and carry out research that aims at characterising functional materials, selected quantum processes in atom, molecular and condensed phase systems; is able to analyse and record research results	Is able to use information and communication technologies to carry out engineering tasks T2A_U07
		Is able to use analytical, simulation and experimental methods to formulate and solve engineering problems T2A_U09
		Is able to identify and formulate a specification of complex engineering tasks relevant to his or her field of study, including nontypical ones, considering nontechnical aspects T2A_U17
		Is able to evaluate usefulness of methods and tools for solving a engineering problem relevant to his or her field of study, perceive their limitations; is able to – using new methods conceptually – solve complex engineering problems relevant to his or her field of study, including nontypical tasks and tasks with a research component T2A_U18
		Is able to - according to provided specification and considering nontechnical aspects - design a complex device, facility, system or process

		relevant to his or her field of study and implement the project, at least partly, using appropriate methods, techniques and tools, using specifically adapted tools or developing new ones T2A_U19
K_U15	Is able to create databases supporting engineering activities in the area of technical physics	Is able to communicate using various techniques in professional and other contexts also in English or another foreign language of international communication related to his or her field of study T2A_U02
K_U16	Is able to prepare a technical specification of research systems based on phenomena in various branches of physics	Is able to carry out critical analysis of the way in which existing technical solutions, especially devices, facilities, systems, processes and services function, and evaluate them, particularly in relation to his or her field of study T2A_U15
		Is able to identify and formulate a specification of complex engineering tasks relevant to his or her field of study, including nontypical ones, considering nontechnical aspects T2A_U17
		Is able to evaluate usefulness of methods and tools for solving an engineering problem relevant to his or her field of study, perceive their limitations; is able to – using new methods conceptually – solve complex engineering problems relevant to his or her field of study, including nontypical tasks and tasks with a research component T2A_U18
K_U17	Is able to operate advanced experimental infrastructure equipment: spectroscopical, mechatronic, electronic, cryogenic, ultra-high vacuum, laser, high-frequency, radiological devices and that of a chemical laboratory; is able to properly define requirements concerning the infrastructure in technical language and in accordance with health and safety rules	Is able to plan and carry out experiments, including computer measurements and simulations, interpret results he or she has obtained and draw conclusions T2A_U08
		Is prepared for working in an industrial environment and knows safety rules related to that work T2A_U13
K_U18	Is able to configure complex measurement and technical systems from functional modules and components and develop control software using standard devices and modules	Is able to communicate using various techniques in professional and other contexts also in English or another foreign language of international communication related to his or her field of study T2A_U02
		Is able to integrate knowledge in the area of scientific branches and disciplines relevant to his or her field of study and use a systems approach considering nontechnical aspects, when formulating and solving engineering tasks T2A_U10
		Is able to - according to provided specification and considering nontechnical aspects - design a complex device, facility, system or process

		relevant to his or her field of study and implement the project, at least partly, using appropriate methods, techniques and tools, using specifically adapted tools or developing new ones T2A_U19
K_U19	When carrying out measurements, he or she is able to refer to standards of measurements and use quality management procedures	Is able to integrate knowledge in the area of scientific branches and disciplines relevant to his or her field of study and use a systems approach considering nontechnical aspects, when formulating and solving engineering tasks T2A_U10
K_U20	Is able to identify and assess the importance of basis factors disturbing a measurement, propose and take relevant measures using appropriate equipment, algorithms and software	Is able to carry out critical analysis of the way in which existing technical solutions, especially devices, facilities, systems, processes and services function, and evaluate them, particularly in relation to his or her field of study T2A_U15
		Is able to propose improvements (rationalisations) of existing technical solutions T2A_U16
		Is able to evaluate usefulness of methods and tools for solving a engineering problem relevant to his or her field of study, perceive their limitations; is able to – using new methods conceptually – solve complex engineering problems relevant to his or her field of study, including nontypical tasks and tasks with a research component T2A_U18
K_U21	Is able to adapt achievements in physics described in the literature for technical uses	Is able to evaluate usefulness and usability of new technological achievements relevant to his or her field of engineering T2A_U12
		Is able to propose improvements (rationalisations) of existing technical solutions T2A_U16
		Is able to - according to provided specification and considering nontechnical aspects - design a complex device, facility, system or process relevant to his or her field of study and implement the project, at least partly, using appropriate methods, techniques and tools, using specifically adapted tools or developing new ones T2A_U19
K_U22	Is able to discern the social, economic and legal aspects when formulating and solving engineering problems	Is able to integrate knowledge in the area of scientific branches and disciplines relevant to his or her field of study and use a systems approach considering nontechnical aspects, when formulating and solving engineering tasks T2A_U10
		Is able to carry out initial economic analysis of undertaken engineering activities T2A_U14
ATTITUDES		
K_K01	Is able to work responsibly on a multi-	Is able to cooperate and work in a team,

	aspect task assigned to him or her both on his or her own and as part of a team	assuming various roles T2A_K03
K_K02	Is able to think and act in a creative and entrepreneurial manner when carrying out an engineering/organisational task	Is able to think and act in a creative and entrepreneurial manner T2A_K06
K_K03	Follows the rules of professional ethics, is responsible for the reliability of results obtained in his or her work and their interpretation, and the assessment of work done by and outside a team	Is able to properly identify and settle dilemmas related to the job he or she does T2A_K05
K_K04	Understands the need of and knows opportunities for continuous self-improvement – raising his or her professional, personal and social competences	Understands the need of life-long learning; is able to inspire and organise other people's learning process T2A_K01
K_K05	Is aware of the need of taking care of his or her health and physical fitness through sports, recreational or rehabilitation activities and organising his or her active rest; is responsible for his or her own safety at work and that of his or her team	Understands the need of life-long learning; is able to inspire and organise other people's learning process T2A_K01
		Is able to cooperate and work in a team, assuming various roles T2A_K03
K_K06	Is aware of the importance of and understands nontechnical aspects and results of engineering, including its environmental impact, and responsibility for the decisions taken in relation to this	Is aware of the importance of and understands nontechnical aspects and results of engineering, including its environmental impact, and responsibility for the decisions taken in relation to this T2A_K02
K_K07	Is able to identify priorities correctly in order to carry out a task defined by him or her or others; is aware of the importance of behaving in a professional manner	Is able to identify priorities correctly in order to carry out a task defined by him or her or others T2A_K04
K_K08	is aware of the social role of technical university graduates, and especially understands the need of informing the society about new developments, information and opinions in the field of technical physics and other aspects of engineering	Is aware of the social role of technical university graduates, and especially understands the need of informing the society (especially through mass-media) about new developments, information and opinions in the field of technology and other aspects of engineering; attempts to present the information and opinions in a commonly understandable way, justifying various points of view T2A_K07