

Education/Learning Outcomes for the main field of study

(Assumed educational effects)

Faculty: Geoengineering, Mining, and Geology

Main field of study: geodesy and cartography

Education level: 1st, inżynier studies

Profile: general academic

Description of symbols/Legend

K – education/learning outcome for the main field of study

W – category of knowledge

U – category of skills

K (after an underscore) – category of social competences

OT –education/learning outcome for the education area in the field of technical sciences

01, 02, 03 and further – number of education/learning outcome

1 – first level studies

A – general academic profile

Education/ learning outcome for 1 st level studies in the main field of study (K)	DESCRIPTION OF THE MAIN-FIELD-OF-STUDY EDUCATION/LEARNING OTCOMES	Correlation with education/ learning outcomes for the education area in the field of technical sciences (OT)
On completion the 1st level studies in the field of geodesy and cartography a graduate:		
KNOWLEDGE		
K_W01	has general knowledge of point positioning within 3D, 2D and 1D space, the gravity field of the Earth, the vertical, map projection, methods of geodetic data acquisition; knows coordination systems on an ellipsoid (spheroid), sphere and plane	OT1A_W01 OT1A_W03
K_W02	has fundamental knowledge concerning: the structure, fields and functions of geodesy in engineering works, geodetic concepts, the essence of quantity surveys, realization and check measurements, methods of detailed surveys, methods for area and cubature calculating, coordinate calculus, and evaluation of measuring and calculation accuracy	OT1A_W06
K_W03	has fundamental knowledge of the numerical (digital) map structure; knows and understands methods of numerical mapping (digitizing), including basic and	OT1A_W02 OT1A_W05

	topographic maps and other digital thematic maps	
K_W04	is able to characterise the national spatial reference system and explain classification of control networks; is able to explain the principles of establishment of horizontal and vertical control networks and methods for low order point densification; is able to characterise the objectives, extent, technology and methods of planimetric, tacheometric and altimetric surveys; is able to describe the principles of cartographic documenting of measurement results as well as to depict the principles of the basic map revision and inventory of utilities	OT1A_W04 OT1A_W07
K_W05	knows and understands the basic concepts of mathematical statistics (the real value random variable and its distribution, selected probability distributions and their parameters, independence of random variables, covariance, correlation) and methods of statistical inference (the population and sampling population, fundamental point and interval estimators, statistical hypothesis testing-selected parametric and nonparametric tests) related to the one-dimensional random variable of real values	OT1A_W01 OT1A_W07
K_W06	has fundamental knowledge of the collation and adjustment of measurement results, analysis of measuring errors, estimation of measurement accuracy, adjustment of horizontal and vertical control networks	OT1A_W02 OT1A_W03
K_W07	is able to explain the principles of preparation of the layout of the vertical and horizontal detailed control networks with regard to survey (measuring) technology and the rules of the data collation and technical documentation preparation; is able to characterise the methods of coordinate transformation and to use them to calibrate analogue maps as well as to explain the roles of maps in legal issues and in designing	OT1A_W04 OT1A_W07
K_W08	has knowledge of engineering object displacement measurements, geodetic realization of inventory processes, alignment work (marking out) and quality measurements for building engineering	OT1A_W03 OT1A_W04
K_W09	has knowledge of the construction of electronic measuring instruments and is able to explain the principle of the distance and angle measurement and its accuracy evaluation	OT1A_W01 OT1A_W02 OT1A_W03
K_W10	has fundamental knowledge of data bases systems, the data base logic and physical structure design, differentiation and selection of data types suitable for the given reality description, data base management and its implementation in various information systems	OT1A_W01 OT1A_W03 OT1A_W07
K_W11	has elementary knowledge of widely comprehended mining engineering as one of the most important fields of technical and economic activity of a human being	OT1A_W02
K_W12	has knowledge of geodetic surveying carried out for the	OT1A_W03

	road and railroad building engineering, bridge constructions, territorial development networks, and streams and water reservoirs	OT1A_W04
K_W13	has the basic theoretical grounding in: photogrammetric modelling on the basis of digital and analogue photographs taken by means of metric and nonmetric cameras; using the ground, aerial and satellite imageries for topographic and non-topographic purposes; using the earth observation satellite systems, laser scanning, and radar imageries to acquire spatial information on the environment	OT1A_W04 OT1A_W06
K_W14	knows fundamental concepts related to geographic information systems; is able to explain the real world representation models and differentiate methods of spatial data digital recording; is able to characterise methods for modelling of spatial events and objects and methods of spatial analyses in the GIS environment	OT1A_W01 OT1A_W03 OT1A_W05
K_W15	has fundamental knowledge of the horizontal and vertical network adjustment, and the error analysis of connecting points and the most extreme values; is able to differentiate observation models and to employ interpolation and approximation methods	OT1A_W03 OT1A_W04 OT1A_W07
K_W16	has knowledge of the theory of the artificial Earth satellite motion and satellite orbits; knows methods for satellite observation including the gravity field examination methods; is able to characterise the global positioning systems such as GPS, GLONASS, Galileo and static and dynamic measurement technologies including the principles of real-time measurements (DGPS and RTK) and permanent measurements (GNSS) using EUREF and IGS networks	OT1A_W01 OT1A_W03 OT1A_W05
K_W17	has knowledge of technical and legal factors connected with geodetic service works for investments, and especially of legal documentation preparation, geodetic study necessary for investment projects, and the principles of excluding and acquiring the rural and forest lands for investments	OT1A_W03 OT1A_W04
K_W18	is able to differentiate and describe architectures and construction standards of spatial information systems; is able to characterise the country spatial data infrastructure and list and depict the network geospatial services such as Inspire and OGC; knows the examples of construction and practical implementation of geo-information systems in the public administration and enterprises	OT1A_W04 OT1A_W08
K_W19	distinguishes basic concepts related to underground and surface mining, mining geology, mining surveying and geodetic measuring methods used for running the horizontal and vertical underground workings; is able to depict realisation measurements carried out during surface and underground mining and tunnel building	OT1A_W03 OT1A_W05

K_W20	has fundamental knowledge of theories concerning the spatial planning and development and methods for investigation of the condition and changes of spatial development and models supporting planning decisions; knows planning development documents defining the manner of the development and has fundamental knowledge necessary to understand them	OT1A_W02 OT1A_W08
K_W21	has fundamental knowledge necessary to understand social, legal and other non-technical factors of engineering activities connected with environment protection	OT1A_W02 OT1A_W07 OT1A_W08
K_W22	has knowledge of mathematical and thematic cartography and spatial data bases in geodetic and cartographic resources	OT1A_W03 OT1A_W04
K_W23	has fundamental knowledge of the management and maintenance of the cadastre, the legal acts concerning preparation and management of land and building registration as the main component of the Land Information Systems, the technical and legal factors connected with: delimitation and division of a real estate, land redistribution and exchange and valuation of a real property	OT1A_W04 OT1A_W06
K_W24	has knowledge of application of the deformation monitoring techniques in mining engineering and building engineering, the state-of-the-art techniques of deformation monitoring and its result analysis, measuring automation, trends in development of monitoring techniques, and the selection of basic methods for monitoring of different engineering objects	OT1A_W02 OT1A_W03 OT1A_W04 OT1A_W05 OT1A_W07
K_W25	has elementary knowledge necessary to resolve basic geodetic tasks on the physical surface of the Earth referred to the surface of the ellipsoid, sphere and geoid (quasi geoid); has fundamental knowledge of trends in development in geodetic and satellite measuring techniques	OT1A_W01 OT1A_W03 OT1A_W05
K_W26	has knowledge of legal factors connected with mining areas protection, discrimination between direct and indirect deformations resulting from the surface and underground mining activities and their influence on the ground and underground infrastructure necessary for: <ul style="list-style-type: none"> - classification of mining areas according to the types of hazards, - quantitative and qualitative description of the surface and rock mass deformations, - prediction of the effects of the exploitation planned – prediction of deformations, - application of the mining and building protection in mining areas in order to minimise the mining influence on the land development and underground infrastructure 	OT1A_W03 OT1A_W05 OT1A_W07 OT1A_W08

K_W27	has knowledge related to thematic cartography, cartographic representation methods, compilation, editing and generalization of maps	OT1A_W03 OT1A_W04
K_W28	has elementary knowledge, knows instruments and has imagination necessary to recognise and record spatial objects on a plane using the following: axonometric, Mong's, attributed, and central perspective (vertical perspective) projections	OT1A_W01 OT1A_W07
K_W29	has fundamental knowledge of the structure of the Earth as the interior planet of the Solar System; knows basic endogenetic and exogenetic processes influencing the topographic profile (relief) of the Earth surface and formation of strata and other rock bodies in the lithosphere; understands how geological processes influence the lithosphere interior structure and the formation of mineral resource deposits; knows how the basic types and kinds of the lithosphere rocks come into existence, can be altered, (metamorphosed) or damaged (wasted); knows processes leading to significant or rapid deformations of the lithosphere surface strata and the forms of spatial distribution of rocks within the lithosphere; knows the outline of the Earth history from its formation to the present day and the division of this history into formal units (geological time periods)	OT1A_W01 OT1A_W08
K_W30	has fundamental knowledge of the origin, occurrence and flow of groundwater	OT1A_W03
K_W31	has mastered the fundamentals of soil and rock mechanics including spatial modelling of geological formations, numerical (digital) modelling of groundwater flow and soil consolidation processes, calculation of the slope stability and determination of soil filter stability	OT1A_W01 OT1A_W03
K_W32	is able to read, interpret and make simple geological maps, cross-sections and lithological sections; is able to use a geological compass; is able, mainly on the base of the macroscopic features, to recognise and characterise the basic magmatic, sedimentary and metamorphic rocks and their component minerals	OT1A_W01 OT1A_W06
K_W33	has fundamental knowledge related to civil engineering embracing the principles of road, railroad and engineering object planning	OT1A_W03 OT1A_W07
K_W34	has fundamental knowledge of geodetic, geological and mining law necessary to perform regulated professions in the field of geodesy	OT1A_W08 OT1A_W10
K_W35	has fundamental knowledge of complex numbers, polynomials, matrix algebra and its use to solve the systems of linear equations, analytical geometry on a plane and in space, and conic sections	OT1A_W01 OT1A_W07
K_W36	has fundamental knowledge of the properties of mathematical functions (trigonometric, power, exponential, logarithmic, cyclometric functions and their	OT1A_W01 OT1A_W07

	inverses), the differential and indefinite integral calculus of the single variable functions necessary to understand mathematical problems in engineering sciences; has fundamental knowledge of the definite and improper integrals, differential calculus of multi variable functions, double and triple integrals, numerical and power series necessary to understand mathematical problems in engineering sciences	
K_W37	knows basic methods of ethics; has fundamental knowledge necessary to understand the ethical factors of social functions of communication in engineering activity	OT1A_W07 OT1A_W08
K_W38	has well-ordered knowledge of computer architecture especially of the hardware layer; has fundamental knowledge of the principles of operational use, exploitation and safety of computer networks	OT1A_W02 OT1A_W03
K_W39	has fundamental knowledge of the free market economy mechanisms and the function of enterprises within different market structures	OT1A_W08
K_W40	has fundamental knowledge related to selected sporting activity (sports)	
K_W41	has knowledge of the physiography of the Earth surface and the Earth interior structure; has knowledge of the research methodology employed in tectonics, physical and dynamic phenomena occurring within the Earth as well as geophysical methods for their discovery and investigation	OT1A_W01
K_W42	has fundamental knowledge of classical mechanics, wave motion and phenomenological thermodynamics; has fundamental knowledge of the classical electrodynamics (electrostatics, electrical current, magnetostatics, electromagnetic induction, electromagnetic waves, optics); has fundamental knowledge of the special theory of relativity, as well as of the selected problems of physics i.e. quantum physics, physics of the solid-state, physics of the atomic nucleus, and astrophysics	OT1A_W01
K_W43	has knowledge of fundamentals of the labour law, employee's and employer's responsibilities and duties resulting from Occupational Safety and Health regulations, rules of the bodies of supervision modus operandi and inspection of Occupational Safety and Health conditions, accidents, occupational diseases, noxious, hazardous, and arduous agents in work environment (measurements and assessment)	OT1A_W04 OT1A_W07
SKILLS		
K_U01	is able to carry out field planimetric and altimetric surveys using simple and electronic geodetic equipment (instruments), construct an analogue map on the basis of geodetic measurements and calculations, determine Cartesian coordinates of points, determine an area and cubature, and evaluate the accuracy of measurements and	OT1A_U15_

	calculations	
K_U02	is able to use information and communication techniques appropriate to perform tasks typical of engineering activities and in order to achieve such the purposes; is able to make use of calculation sheets, word processors and to prepare a multimedia presentation	OT1A_U02 OT1A_U05 OT1A_U07
K_U03	is able to compile numerical (digital) maps such as basic, topographic and other thematic ones and develop a digital terrain model (DTM); is able to use computer tools to assist map designing	OT1A_U07 OT1A_U16
K_U04	is able to use the information about detailed control networks and make description of the position of a mark; is able to carry out planimetric and altimetric surveys connected with establishment of a control network and measurements of terrain details (in order to adjust a basic map and make a numerical one); is able to measure by means of an underground system locator and collate and process the data of the geodetic measurements	OT1A_U08 OT1A_U15
K_U05	is able to calculate record books, make survey sheets, complete technical documentation; is able to map a manuscript of a planimetric map and ground relief; is able to plot longitudinal profiles and cross-cuts; is able to calibrate analogous maps and to compile numerical maps on the basis of tacheometric surveys using geodetic software	OT1A_U15 OT1A_U16
K_U06	is able to carry out a statistical analysis of a finite set of real numbers related to statistical description and estimation of the distribution basic parameters, formation and revision of the parametric and nonparametric hypothesis, revision of the independence and correlation of two population characteristics	OT1A_U07 OT1A_U09 OT1A_U15
K_U07	is able to develop and make an application in programming environment using a procedural and object-oriented approach; has basic abilities related to data bases and data exchange formats applied to geoinformatics and programming algorithms	OT1A_U05 OT1A_U07 OT1A_U09
K_U08	is able to select measurement methods appropriate to the predicted accuracy and assess the error distribution of geodetic surveys	OT1A_U03 OT1A_U08
K_U09	is able to realise the measurements of angles by direction and in sets; is able to establish networks of the transfer of coordinates for inaccessible points; is able to use the RTK GPS technique for topographic surveys; is able to transform coordinates using Helmert and affine method and convert coordinates of different systems into each other's ones using geodetic programs	OT1A_U08 OT1A_U15
K_U10	is able to design detailed vertical control of the IV class and detailed horizontal control of the III class on topographic maps of 1:100000 scale and analyse accuracy of the designed networks using computer programs; is	OT1A_U15 OT1A_U16

	able to carry out eccentric measurements for points of the geodetic control network; is able to carry out calculations connected with the parcel division and develop a digital terrain model (DTM) using the computer program	
K_U11	is able to realise geodetic service works for investments at the stage of their design, realisation, post execution measurements and measurements of displacements during the construction process and after its end	OT1A_U08 OT1A_U09 OT1A_U12
K_U12	is able to operate geodetic electronic instruments and carry out procedures for checking the precision of the geodetic measuring instruments in accordance with the geodetic standards	OT1A_U07 OT1A_U08 OT1A_U15 OT1A_U16
K_U13	is able to design the logical and physical architecture of data bases, enter the data using forms, output the data using queries, make reports, manage the database stored locally (on a PC) and on a server; knows fundamentals of PHP, HTML and SQL	OT1A_U01 OT1A_U07
K_U14	is able to organise geodetic surveys, collate and process their results for the road and railroad building engineering, bridge constructions, territorial development networks, and streams and water reservoirs	OT1A_U08 OT1A_U09 OT1A_U12
K_U15	is able to determine coordinates, compile an orthophotomap and develop a digital terrain model (DTM) on the basis of the metric photographs; is able to model the terrain surface and objects; is able to carry out laser scanning in stable and free station points as well as collate and process its results; is able to collate and process the results of radar imageries and multispectral satellite images	OT1A_U16
K_U16	is able to design and manage thematic spatial data bases and accomplish GIS projects aimed at solving given problems including the formation of action procedures in the formal language and then their realisation with the use of the geographic information system software; is able to visualise and interpret the results of spatial analyses	OT1A_U07 OT1A_U08
K_U17	is able to adjust horizontal and vertical networks applying various methods along with the detailed error analysis of connecting points and evaluation of the accuracy of field surveys	OT1A_U03 OT1A_U07 OT1A_U08
K_U18	is able to carry out field surveys of the geodetic network by means of GPS technique, collate and process the results of measurements using the standard firms' software	OT1A_U01 OT1A_U07
K_U19	is able to organise and make decisions in geodetic works connected with technical and legal documentations related to preparation of investment projects and the principles of excluding and acquiring the rural and forest lands for investments	OT1A_U08 OT1A_U09 OT1A_U12
K_U20	is able to prepare and perform advanced spatial analyses using the language of the map algebra; is able to use GIS	OT1A_U03 OT1A_U08

	tools to resolve selected planimetric problems and to analyse phenomena and processes within space independently of the type of the hardware and software platform	
K_U21	is able to develop technical documentation in the analogue and digital form and interpret them correctly; is able to properly select measuring techniques for the performance of specified field tasks	OT1A_U09 OT1A_U12
K_U22	is able to use the GIS tools to examine the concentration and density of development and for analysis of the condition and changing process of the land development, for accessibility analyses and for the assessment of the land capacity for development; is able to find and interpret the establishment of a development project facts	OT1A_U09
K_U23	is able to use information and communication techniques for tasks related to Environmental Protection subject; is able to choose and apply the proper method and tools, including those available in the GIS software, for management of the environment quality	OT1A_U02 OT1A_U05 OT1A_U03 OT1A_U07 OT1A_U15
K_U24	is able to perform tasks connected with the use of the data included in spatial databases and with the visualisation of maps	OT1A_U08 OT1A_U09 OT1A_U12
K_U25	is able to develop technical documentation of geodetic and legal procedures and realisation of the field works concerning updating the documentation of land registration, delimitation of a real estate, division of the rural and urban parcels, and appraisal of the real property	OT1A_U14 OT1A_U15
K_U26	is able to practically select methods and use techniques for monitoring the deformations in mining and building engineering	OT1A_U08 OT1A_U11 OT1A_U14 OT1A_U15
K_U27	is able to resolve basic tasks related to geodetic triangle and calculate coordinates and azimuths on the ellipsoid; is able to carry out time calculations (timing) and astronomic azimuth determination; is able to calculate components of the deflection of the plumb line and apply the calculation results for solving geodetic problems	OT1A_U07 OT1A_U08 OT1A_U10
K_U28	is able to prepare the layout of the horizontal and vertical geodetic networks and adjust them	OT1A_U07 OT1A_U081 OT1A_U0
K_U29	is able, on the basis of geodetic measurements, to determine the type and size of the deformations of the surface and interpret and classify the mining area under an appropriate category; is able, on the basis of mining and geological factors, to make the alternative deformation prediction related to minimization of the deformation influence on the surface and underground infrastructure and to interpret possible damage to the infrastructures	OT1A_U07 OT1A_U08 OT1A_U10 OT1A_U13 OT1A_U14 OT1A_U15
K_U30	is able to use the method of cartographic representation to	OT1A_U08

	construct thematic maps; is able to compile and compose the map content	OT1A_U09 OT1A_U12
K_U31	employs the studied methods for three-dimensional reality projection on the plane made by hand with drawing instruments and using the AutoCAD system (elementary functions); is able to read geometric forms and obtain information from technical drawings	OT1A_U02 OT1A_U16 OT1A_U14
K_U32	is able to make simple geological maps, geological cross-sections and lithological sections	OT1A_U07
K_U33	is able to apply laboratory methods for the determination of fundamental hydrogeological parameters of rocks	OT1A_U07
K_U34	is able to apply obtained knowledge to solve problems connected with geotechnical protection against the failure of earthen structures and hydraulic constructions	OT1A_U03 OT1A_U08 OT1A_U09
K_U35	is able to correctly use the technical documentation of building structures	OT1A_U01 OT1A_U07
K_U36	is able to prepare the project of selected elements of the transportation infrastructure objects i.e. location plan, cross-sections and elements of the pavement and drainage	OT1A_U01 OT1A_U07
K_U37	is able to obtain the information from data bases of legal systems, legal literature and other sources; is able to study the obtained information concerning contemporary regulations of geodetic and mining law, draw conclusions, formulate and justify opinions	OT1A_U01 OT1A_U11
K_U38	is able to properly and effectively apply the knowledge of linear algebra and analytical geometry to the qualitative and quantitative analysis of mathematical problems connected with the studied engineering discipline	OT1A_U09 OT1A_U10
K_U39	is able to properly and effectively apply the knowledge of the differential and integral calculus of the single-variable functions to the qualitative and quantitative analysis of mathematical problems connected with the studied engineering discipline; is able to properly and effectively apply the knowledge of the differential and integral calculus of the multi-variable functions and numerical and power series to the qualitative and quantitative analysis of mathematical problems connected with the studied engineering discipline	OT1A_U09 OT1A_U10
K_U40	is able to make use of various sources of information in a foreign language, especially professional literature; is able to integrate obtained information and apply it to deepen the specialization knowledge and to improve their own language skills; comprehends spoken and written formulations on general, scientific and technological topics connected with the scientific disciplines and fields of study related to the studied discipline; has language skills sufficient to relatively correctly express themselves (verbally and in writing), formulate and justify opinions, explain their own standpoint, present advantages and disadvantages of different technical solutions, discuss and	OT1A_U01 OT1A_U02 OT1A_U03 OT1A_U04

	present general and scientific as well as technical topics (e.g. prepare and give oral presentation concerning project and research tasks, realised or in progress); is able to use a foreign language to communicate within the international professional environment with regard to inter-culture knowledge and the formal and informal type of language	
K_U41	is able to make a study on the ordered problem related to the economy of mineral resource markets	OT1A_U01
K_U42	has basic abilities related to the sports discipline they chose as the optional course; is able to lead a pro-health lifestyle along with the sports activity chosen for their lifetime and form attitudes promoting the lifetime physical activity	
K_U43	is able to carry out the tectonic interpretation of the morphology of the Earth surface and geological interpretation of geophysical measuring results	OT1A_U08
K_U44	is able to correctly and efficiently use the studied physical principles, laws and rules for quantity and quality analysis of physical problems related to engineering ones; is able to: a) plan and carry out measurements safely, b) collate and process measurement results, c) estimate the uncertainties of measured values of parameters investigated	OT1A_U08 OT1A_U09
K_U45	is able to develop the documentation of the industrial accident and occupational disease; knows the principles of measurements taking at the work place such as dust, noise, mechanical vibrations, microclimate, lighting and chemical factor examinations	OT1A_U11
K_U46	is able to work in the task team in an enterprise or public administration and also to organise such the team work; is able to make use of the project documentation and materials from the geodetic resource; is able to select methods and tools appropriate for realisation of geodetic tasks in accordance with the current, obligatory rules and acquire the observation data; is able to use the geodetic-cartographic documentation to realise an engineering project and develop such the documentation for the geodetic resource	OT1A_U07 OT1A_U12 OT1A_U14 OT1A_U15
SOCIAL COMPETENCES		
K_K01	understands the necessity and knows the possibilities of the lifelong education (permanent learning) (second and third level studies, postgraduate courses, refresher courses, additional trainings) and the professional, personal and social competence development (upgrading)	OT1A_K01
K_K02	realises the significance of and understands non-technical aspects and consequences of the mining engineer activity including its influence on the natural environment and the related responsibility for decisions	OT1A_K02
K_K03	realises the significance of the professional behaviour as	OT1A_K05

	well as the obedience to ethical rules and the respect for various opinions and cultures	
K_K04	realises the responsibility for their individual work and is disposed to obey the rules of working in a team and be responsible for tasks performed by the team	OT1A_K04 OT1A_K07
K_K05	knows general rules of the establishment and development of the individual enterprise types using the knowledge related to the studied scientific discipline	OT1A_K06
K_K06	is able to think and act in an entrepreneurial way	OT1A_K06
K_K07	realizes the social role of the university of technology graduates and especially understands the need to formulate information and opinions concerning achievements in mining engineering and other aspects of a mining engineer activity and share them with the society, among other means, through mass media; makes efforts to share the information and opinions in an understandable way	OT1A_K07
K_K08	promotes the social and cultural significance of sport and physical activities and cultivates their own interests in the field of physical culture	
K_K09	is able to practically select methods and use techniques for monitoring the deformations in mining and building engineering	