

## COURSE DESCRIPTION CARD

Faculty of Civil Engineering and Environmental Sciences									
Field of study								Degree level and programme type	
Specialization/ diploma path								Study profile	Academic profile
Course name	Underground structures							Course code	IS-FCEE-00044W
								Course type	Erasmus
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	winter
	30			30				No. of ECTS credits	4
Entry requirements	General building engineering, Soil mechanics, Foundation, Concrete structures, Metal structures								
Course objectives	Obtaining a basic knowledge for the design and construction of underground structures: tunnels and underground cubature objects made in the excavation. Knowledge in the scope of design, dimensioning and detailing of pedestrian underpass and pipe jacking.								
Course content	<p><u>Lecture:</u> Basic concepts and definitions, classification of tunnels. Classifications of rock mass and types of excavation protection. Principles of forming the tunnel cross section, longitudinal section and tunnel plan. Classification of tunnel construction methods. Types of protection the excavation during the implementation of underground structures depending on soil and water conditions and ground load. Opencast methods for tunnel construction. Drilling methods: shield methods, TBM and NATM. Special methods of tunnel construction. Trenchless technologies for the construction of underground installations. Selected projects.</p> <p><u>Project:</u> Loads on the ceiling and walls of shallow tunnels. Design of the underground passage in the open excavation. Design of installation execution using the pipe jacking method.</p>								
Teaching methods	problem lecture, informative lecture, project method								
Assessment method	lecture – written tests, project – evaluation of the projects, presentation of projects, written test								
Symbol of learning outcome	Learning outcomes							Reference to the learning outcomes for the field of study	
LO1	Student knows and understands the principles of constructing and dimensioning elements of underground structures							K_B2_W02	
LO2	Student knows and understands construction and material solutions used in underground construction							K_B2_W05	
LO3	Student knows and understands standard rules as well as regulations and guidelines for the design of underground structures and their elements.							K_B2_W07	

L04	Student can make a critical analysis and assessment of the functioning of technical solutions used in underground construction	K_B2_U02	
L05	Student can design a complex structure systems in underground facilities.	K_B2_U04	
L06	Student is ready to critically assess his knowledge in the field of engineering and technical sciences used in solving cognitive and practical problems.	K_B2_K01	
<b>Symbol of learning outcome</b>	<b>Methods of assessing the learning outcomes</b>	<b>Type of tuition during which the outcome is assessed</b>	
L01	Written test, preparation and presentation of the project	L, P	
L02	Written test, preparation and presentation of the project	L, P	
L03	Preparation and presentation of the project	P	
L04	Written test, preparation and presentation of the project	L, P	
L05	Preparation and presentation of the project	P	
L06	Presentation of the project	P	
<b>Student workload (in hours)</b>		<b>No. of hours</b>	
<b>Calculation</b>	lecture attendance	30	
	participation in project class	30	
	participation in student-teacher sessions related to the classes/seminar/project	5	
	implementation of project tasks	20	
	preparation for and participation in exams/tests	25	
	preparation for presentation the project	10	
<b>Quantitative indicators</b>		<b>HOURS</b>	<b>No. of ECTS credits</b>
<b>Student workload – activities that require direct teacher participation</b>		69	2,7
<b>Student workload – practical activities</b>		65	2,6
<b>Basic references</b>	1. Chapman D., Metje N., Stark A.: Introduction to tunnel construction. Spon Press, London&NewYork 2010. 3. Kolybas D.: Tunelling and tunnel mechanics. A rational approach to tunnelling. Springer, Berlin 2005. 3. Ou Ch. Yu: Deep excavation. Theory and practice. Taylor & Francis, London&New York 2006. 4. Puller M.: Deep excavation. A practical manual. Thomas Telford books. London 1998.		
<b>Supplementary references</b>	1. Clayton Ch. R.I., Woods R.I., Bond A.J., Militsky J.: Earth pressure and earth-retaining structures. CRC Press, London&New York 2013. 2. NATM The Austrian Practice of Conventional Tunneling. Austrian Society for Geomechanics, Salzburg 2010.		
<b>Organisational unit conducting the course</b>	<b>Department of Geotechnics and Structural Mechanics</b>	<b>Date of issuing the programme</b>	
<b>Author of the programme</b>	<b>Assoc. Prof. Katarzyna Zabielska-Adamska, PhD, DSc, Eng</b>	<b>07.04.2020</b>	

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar