

**(B) Course information in English**

**General course information:**

<b>Course title:</b>	Tunnels & Underground Works	<b>Course code:</b>	CE09-G02
<b>Credits:</b>	6	<b>Work load (hours):</b>	121
<b>Course level:</b>	Undergraduate <input checked="" type="checkbox"/>	Graduate <input type="checkbox"/>	
<b>Course type:</b>	Mandatory <input checked="" type="checkbox"/>	Selective <input type="checkbox"/>	
<b>Course category:</b>	Basic <input type="checkbox"/>	Orientation <input checked="" type="checkbox"/>	
<b>Semester:</b>	10 <sup>th</sup>	<b>Hours per week:</b>	4
<b>Course objectives (capabilities pursued and learning results):</b>			
Comprehension of tunnel designing principles. Introduction to the principles of soil-structure interaction modelling. Evaluation of geotechnical conditions and selection of design parameters. Preliminary tunnel design using geotechnical methods. Tunnel analysis and design with numerical methods.			
<b>Prerequisites:</b>			
Soil Mechanics I & II Foundations & Retaining Structures Rock Mechanics Computational Geotechnical Engineering			

**Instructor's data:**

<b>Name:</b>	Emilios Comodromos
<b>Level:</b>	Professor
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<b>Other tutors:</b>	

**Specific course information:**

Week No.	Course contents	Hours	
		Course attendance	Preparation
1	Tunnel types, description of construction methods in soil and rocky formations.	4	
2	Evaluation of in-situ geological and geotechnical conditions. Requisite site tests and measurements and laboratory tests to define design parameters of soil materials and domain topology.	4	
3	Initial stress field definition. Anticipated kinematic and stress field due to excavation. Plastified zones and general pathology.	4	
4	Tunnel stability. Typical shapes of instability. Reaction curves of surrounding rock mass in relation to excavation step. Linear elastic and elastoplastic approach.	4	2
5	Elastoplastic response curves of surrounding rock mass in relation to excavation size and immediate support measures.	4	6
6	Description of primary support measures. Variation associated with placement convenience, partial and full activation time and installation cost.	4	2
7	Preliminary design of primary support measures, according to custom geotechnical rating systems (Bieniawski rock mass rating system application).	4	4
8	Preliminary design of primary support measures, according to custom geotechnical rating systems (Q rock mass rating system application).	4	4
9	Dependence of primary support measures' selection and implementation sequence on construction method.	4	2
10	Preliminary tunnel design example. Definition of strength parameters and deformation modules, application of geotechnical rating systems, adequacy control using pressure-convergence curves.	4	8
11	Application of numerical methods in tunnel designing. Reference to simplified numerical approaches.	4	2
12	Finite Element Method application to simulate tunnel construction as a multistage problem, with variable boundaries and capability of primary	4	6

	support activation and deactivation.		
13	Modification of constitutive materials' stiffness during various stages. Interaction of surrounding rock mass and final lining elements. Simulation, analysis, solution framework allowing for load combinations, final design.	4	4
14	Representative examples of tunneling.	4	2

<b>Additional hours for:</b>			
<b>Class project</b>	<b>Examinations</b>	<b>Preparation for examinations</b>	<b>Educational visit</b>
	3	14	6

**Suggested literature:**

Bouvard-Lecoanet, A, Colombet, G. et Esteulle, F. (1988). *Ouvrages Souterrains – Conception – Realisation – Entretien*. Presses Ponts et Chaussées, Paris.

Hoek, E., Kaiser, P.K. and Bawden, W.F. (1995). *Support of Underground Excavations in Hard Rock*. A. A. Balkema, Brookfield, VT 05036, USA.

Wyllie, D. C. (1992). *Foundation on Rock*. Chapman & Hall, London, pp. 333.

Panet, M., (1995). *Calcul des Tunnels par la méthode convergence-confinement*. Département Edition de l'Association Amicale des Ingénieurs Anciens Elèves, Paris: Press de l'Ecole Nationale des Ponts et Chaussées.

<b>Teaching method</b> ( <i>select and describe if necessary - weight</i> ):		
Teaching	<input checked="" type="checkbox"/>	50%
Seminars	<input checked="" type="checkbox"/>	10%
Demonstrations	<input checked="" type="checkbox"/>	10%
Laboratory	<input type="checkbox"/>	.....%
Exercises	<input checked="" type="checkbox"/>	20%
Visits at facilities	<input checked="" type="checkbox"/>	10%
Other ( <i>describe</i> ): .....	<input type="checkbox"/>	.....%
Total		100%

<b>Evaluation method</b> ( <i>select</i> ) - <b>weight</b> :				
	<i>written</i>	<i>%</i>	<i>Oral</i>	<i>%</i>
Homework	<input type="checkbox"/>		<input type="checkbox"/>	
Class project	<input checked="" type="checkbox"/>	50	<input type="checkbox"/>	
Interim examination	<input type="checkbox"/>		<input type="checkbox"/>	
Final examinations	<input type="checkbox"/>		<input checked="" type="checkbox"/>	50
Other ( <i>describe</i> ): .....	<input type="checkbox"/>		<input type="checkbox"/>	