

## SUBJECT TEACHING GUIDE

M1640 - Design and implementation of underground works

Master's Degree in mining engineering

Academic year 2022-2023

1. IDENTIFYING DATA					
Degree	Master's Degree in mining engineering			Type and Year	Compulsory. Year 1
Faculty	School of Mines and Energy Engineering				
Discipline	MINING				
Course unit title and code	M1640 - Design and implementation of underground works				
Number of ECTS credits allocated	3	Term	Semester based (2)		
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. TRANSPORTES Y TECNOLOGIA DE PROYECTOS Y PROCESOS				
Name of lecturer	RUBEN PEREZ ALVAREZ				
E-mail	ruben.perez@unican.es				
Office	E.P. de Ingeniería de Minas y Energía. Planta: + 2. DESPACHO (228)				
Other lecturers					

### 3.1 LEARNING OUTCOMES

- Once the subject has been passed, the student will have specific knowledge about the project, construction and execution of tunnels and underground works. Hence, the student will be able to design and execute underground works projects.

### 4. OBJECTIVES

The objectives of this subject are knowing the project, design, construction and execution of tunnels and underground works.

## 6. COURSE ORGANIZATION

### CONTENTS

1	<p>CHAPTER I: UNDERGROUND WORKS. Introduction. Types and characteristics. General aspects.</p> <p>CHAPTER 2: INVESTIGATION OF ROCK MASS. Introduction. Conditioning aspects. Geology and Geotechnics of the rock mass.</p> <p>CHAPTER 3: GEOMECHANIC CLASSIFICATIONS. Introduction. Aims of geomechanic classifications. Bieniawski Classification. Barton Classification. Correlation between classifications.</p> <p>CHAPTER 4: CLASSIFICATION OF TERRAIN ACCORDING TO ITS EXCAVABILITY. Introduction. Characteristics of rock masses that condition their excavability.</p>
2	<p>CHAPTER 5. EXECUTION PROJECT OF A TUNNEL. Introduction. Tunnel layout. Cross Sections.</p> <p>CHAPTER 6. TUNNEL MOUTHS. Introduction. Correction of instabilities. Special supports. Location and progress. Stages.</p> <p>CHAPTER 7. MECHANICAL EXCAVATION OF TUNNELS. Introductions. Road Headers. Hydraulic Excavators.</p> <p>CHAPTER 8. TUNNEL BORING MACHINES. Hard Rocks T.B.M.: Field of application, main parts and excavation systems. Soft Grounds T.B.M.: Field of application, main parts and excavation systems.</p>

3	<p>CHAPTER 9. TUNELLING BY DRILL AND BLAST METHODS.          Introduction.          Blasting calculation.          Firing systems: electric and non-electric blasting.          Drilling patterns.          Firing sequences.</p> <p>CHAPTER 10. TUNELLING METHODS.          Introduction.          Belgian Tunelling Method.          German Tunelling Method.          Bernold Tunelling Method.          New Astrian Tunelling Method Method.</p> <p>CHAPTER 11: SUPPORT OF TUNNELS.          Introduction.          Support Types.          Support Design.</p> <p>CHAPTER 12. TUNNEL VENTILATION.          Introduction.          Calculation of requirements during construction works.          Calculation of requirements for operation.</p> <p>CHAPTER 13: UNDERGROUND WORKS.          Introduction.          False tunnels.          Trenchless technology.          Underground storage facilities.          Rehabilitation of mining sites.</p>
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## 7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Final Exam	Written exam	Yes	Yes	60,00
Group Essay	Work	No	Yes	15,00
Individual Essay	Work	No	Yes	15,00
Individual resolution of exercises	Others	No	Yes	10,00
<b>TOTAL</b>				<b>100,00</b>
<b>Observations</b>				
<p>In order to pass, the student will be required to obtain a minimum score of 4.5/10 in the Final Exam of Contents, and an average score of 5/10 in the whole subject. If this requirements is not satisfied, the final score will be obtained as the weighted average of the different items of evaluation, until a maximum of 4.9. Any passed item would be kept for the extraordinary evaluation.</p> <p>The final exam will be on-site. However, if Health and Educational Authorities suspended in-class activities, it will be developed with Moodle, and monitored through Teams.</p>				
<b>Observations for part-time students</b>				
<p>Part-time students will be evaluated according to the Normative of University of Cantabria. Part-time students will be evaluated following the Normative of University of Cantabria. In addition to the requirement of passing the Final Exam of Contents, and given the characteristics of the activities proposed for the continuous evaluation, part time students will be subject to them as the rest of students.</p>				

## 8. BIBLIOGRAPHY AND TEACHING MATERIALS

### BASIC

Manual de voladuras en túneles. López Jimeno, C., López Jimeno, E. y García Bermúdez, P. Madrid: U.D. Proyectos-ETSIIM (UPM). 2010.

Manual de Túneles y obras subterráneas. Editor: Carlos López Jimeno

Colección IngeoTúneles. López Jimeno, C. Madrid: Varias Editoriales.

Excavación mecánica de túneles. Cornejo Álvarez, L. Rueda. 1988.

Apuntes facilitados por los profesores.