ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

63000273 - Advanced Rock Engineering

DEGREE PROGRAMME

06AK - Master Universitario En Mineria Sostenible

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	63000273 - Advanced Rock Engineering
No of credits	4 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	06AK - Master Universitario en Mineria Sostenible
Centre	06 - Escuela Técnica Superior De Ingenieros De Minas Y Energía
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Ricardo Lain Huerta (Subject coordinator)	216	ricardo.lain@upm.es	Sin horario.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

2.2. Research assistants

Name and surname	Email	Faculty member in charge
Gomez Mateos, Santiago	santiago.gomez@upm.es	Lain Huerta, Ricardo

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- ? Good English skills (Minimum: CEF Level B1) Basic knowledge of Rock Mechanics and Mining Methods

4. Skills and learning outcomes *

4.1. Skills to be learned

CG1 - Know and apply knowledge of basic sciences and technologies to the practice of Mining Technology

CG2 - Possess the ability to design, analyze, calculate, project, build, maintain, preserve, exploit, develop, implement, manage and improve products, systems and processes in the different areas of Mining Technologies, using analytical, computational or appropriate experimental settings, including the advisory role in these fields

CG6 - Possess learning skills that allow them to continue studying throughout life for their proper professional development

CG7 - Incorporate new technologies and mining technology engineering tools into your professional activities

F25 - Geotechnical studies applied to mining, construction and civil works

F30 - Geotechnical studies applied to mining, construction and civil works

4.2. Learning outcomes

RA20 - Select the more appropriate mining method.

RA21 - Select the more appropriate excavation method

RA22 - Design (dimension) mine voids.

RA26 - Estimate the stress distribution from mine exploitation.

RA23 - Design support elements for mines and tunnels.

RA28 - Estimate the Surface deformation and affections from underground mines.

RA27 - Estimate the surface deformation and affections from underground works.

RA29 - Estimate advance rate of roadheaders and TBM

RA24 - Stress calculation in mine pillars through numerical modeling.

RA25 - Stress calculation in tunnels through numerical modeling.

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The subject begins with an analysis of the origin of natural stresses in the rock masses. It continues with the study in detail of the behaviour of the slopes, where the bases of the calculation are laid to define the safety coefficient and the support elements. The open pit part ends with the definition of the levels of slope monitoring and instrumentation.
Next, the course enters the Rock Mechanics section dedicated to underground mining and underground works. The distribution of stresses around circular and elliptical holes with elastic behaviour is studied. The methodology for determining the stresses in the mine pillars is explained. The calculation procedures to determine the safety factor of a tunnel support are explained. The course continues with the stability analysis of underground chamber roof and the dimensioning of pillars. The last part of the course is devoted to the study of the advance of tunnels by

mechanical means. Specifically, the procedures to estimate the advance rate of road headers and tunnel boring machines TBM are studied. Also the mechanical properties of rocks that influence the rate of advance and cutters consumption are analysed. Finally, rock mechanics laboratory tests are studied, specifically those applied to road headers and TBM.

5.2. Syllabus

1. Natural stress assessment
2. Stress distribution around circular tunnels. Support elements
3. Slope stability
4. Stress distribution in mine pillars.
5. Numerical models applied to open pit and underground mines
6. Roadheaders
7. TBM
8. Rock properties related with the advance rate and cutting tools wearing of roadheaders and TBM
9. Laboratory tests

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Presentation of the subject** Duration: 01:00 Lecture **TOPIC 1** Duration: 01:00 Lecture **TOPIC 1** Duration: 01:00 Problem-solving class **TOPIC 2** Duration: 01:00 Lecture			
2	**TOPIC 2** Duration: 02:00 Lecture **TOPIC 2** Duration: 02:00 Problem-solving class			
3	**TOPIC 2** Duration: 03:00 Problem-solving class **TOPIC 3** Duration: 01:00 Lecture			
4	**TOPIC 3** Duration: 04:00 Problem-solving class			
5	**TOPIC 3** Duration: 01:00 Problem-solving class **TOPIC 4** Duration: 01:00 Lecture **TOPIC 4** Duration: 02:00 Problem-solving class			

6	**TOPIC 5** Duration: 01:00 Lecture **TOPIC 5** Duration: 03:00 Problem-solving class			
7	**TOPIC 6** Duration: 01:00 Lecture **TOPIC 6** Duration: 01:00 Problem-solving class **TOPIC 7** Duration: 01:00 Lecture **TOPIC 7** Duration: 01:00 Problem-solving class			
8	**TOPIC 7** Duration: 02:00 Problem-solving class **TOPIC 8** Duration: 01:00 Lecture **TOPIC 8** Duration: 01:00 Problem-solving class			
9	**TOPIC 8** Duration: 01:00 Problem-solving class **TOPIC 9** Duration: 01:00 Lecture **TOPIC 9** Duration: 01:00 Laboratory assignments	**Topics 1 to 9** Duration: 01:00 Additional activities		**Topics 1 to 9** Written test Progressive assessment Presential Duration: 01:00
10	**TOPIC 9** Duration: 03:00 Laboratory assignments			**Topics 1 to 9** Written test Global examination Presential Duration: 01:00
11				
12				
13				
14				

15				
16				
17				

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
9	Topics 1 to 9	Written test	Face-to-face	01:00	100%	5 / 10	CG1 CG2 CG6 CG7 F25 F30

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
10	Topics 1 to 9	Written test	Face-to-face	01:00	100%	5 / 10	CG1 CG2 CG6 CG7 F25 F30

7.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

7.2. Assessment criteria

The grade of Advanced Rock Engineering will be composed of 30% corresponding to the grade obtained in the theorical part, 60 % of the grade obtained in the practical part. and 10 % corresponding to the sum of deliverable issues. Deliverable problems are the personal work of each student.

To qualify for approval, the following three requirements are required:

- Average grade of 5 or higher

- A minimum of 4 points out of 10 in the theorical part

- A minimum of 4 points out of 10 in the practical part

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
HOEK, E. (2000)	Web resource	Rock Engineering. Course notes http://www.rocscience.com
HOEK, E. & BRADY, J.W. (1977)	Bibliography	Rock slope engineering. Institution of Mining and Metallurgy
Hoek, E.; Bray, J.(2004).	Bibliography	Rock Slope Engineering; D.C. Wyllie, Ch.W. Mah Editors; Span Press, New York, N.Y.;
HOEK, E. & BROWN, E.T. (1980).	Bibliography	Underground excavations in rock. Institution of Mining and Metallurgy, Londres
BIENIAWSKI, Z.T. (1989)	Bibliography	Engineering rock mass classifications. John Wiley and Sons, Nueva York
BIENIAWSKI, Z.T. (1987)	Bibliography	Strata control in mineral engineering. A.A. Balkema, Rotterdam.

BROWN, E.T. & BRADY, J.W. (1985).	Bibliography	Rock Mechanics for underground mining. George Allen & Unwin, Nueva York
HUDSON, J.A. (1993).	Bibliography	Comprehensive rock engineering. Pergamon, Londres.
E. HOEK (2007)	Web resource	Hoek's Corner. Practical Rock Engineering
Moodle platform: subject: Advanced Rock Engineering	Web resource	
Rock Mechanics Laboratory	Equipment	