



# Course guide

## 330606 - DMMIN - Mining Design and Modeling

Last modified: 25/04/2024

**Unit in charge:** Manresa School of Engineering  
**Teaching unit:** 750 - EMIT - Department of Mining, Industrial and ICT Engineering.  
**Degree:** MASTER'S DEGREE IN MINING ENGINEERING (Syllabus 2013). (Compulsory subject).  
**Academic year:** 2024    **ECTS Credits:** 5.0    **Languages:** Catalan, Spanish, English

### LECTURER

**Coordinating lecturer:** Sanmiquel Pera, Lluís

**Others:**

### PRIOR SKILLS

Previous knowledge of ploughing, referring to opencast and underground mining.

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**

1. (ENG) Coneixement adequat de la tecnologia d'explotació de recursos minerals.
2. (ENG) Coneixement de sistemes de control i automatismes.

**Transversal:**

3. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.
4. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

### TEACHING METHODOLOGY

The teaching methodology is fundamentally based on the use of a computer in order to be able to follow most of the activities that take place in the classroom. In fact, the explanations given by the teacher mainly refer to operations to be carried out using mining design and modelling software. For this reason, it is essential for students to be able to try out the different operations on the computer.

### LEARNING OBJECTIVES OF THE SUBJECT

Achieve adequate knowledge of mineral resource exploitation technology through mining and geological site modelling software such as VULCAN. The above knowledge will be achieved in open pit and underground mining, for both stratigraphic and non-stratigraphic deposits.

### STUDY LOAD

Type	Hours	Percentage
Hours medium group	45,0	36.00
Self study	80,0	64.00

**Total learning time:** 125 h



## CONTENTS

### title english

**Description:**

This content has the following parts:

- Data visualization.
- Cad tools for editing drawings.
- Triangulations: general aspects, surface triangulations and solid triangulations.

**Specific objectives:**

Upon completion of this content, the student will achieve the following knowledge:

- Aspects of the generic and basic part of the "VULCAN" software.

**Related activities:**

Clase magistral a través del ordenador en el que los alumnos en aula de informática van probando el mismo momento de las explicaciones o poco después, los conceptos dados por el profesor. Realización de ejercicios con el ordenador.

**Full-or-part-time:** 24h

Laboratory classes: 8h

Self study : 16h

### title english

**Description:**

This content has the following parts:

- Block construction.
- Block visualization.
- Block manipulation.
- Cubing of reserves from blocks.

**Specific objectives:**

Upon completion of this content, the student will achieve the following knowledge:

- All the aspects related to the generation, edition and manipulation of blocks through the software "VULCAN".

**Related activities:**

Master class through the computer in which the students in the computer room try out the concepts given by the teacher at the same time as the explanations or shortly after. Exercises with the computer.

**Full-or-part-time:** 21h

Laboratory classes: 7h

Self study : 14h



#### title english

**Description:**

This content has the following parts:

- Design and modelling of open-cast mining operations.
- Calculation of exploited reserves and/or exploitation in an open-cast mining operation.
- Calculation of exploitation costs.

**Specific objectives:**

Upon completion of this content, the student will achieve the following knowledge:

- Design, modelling, calculation of reserves and costs in open-cast mining operations through the software "VULCAN".

**Related activities:**

Master class through the computer in which the students in the computer room are trying out the same moment of the explanations or shortly after, the concepts given by the teacher. Carrying out exercises with the computer.

**Full-or-part-time:** 40h

Laboratory classes: 15h

Self study : 25h

#### title english

**Description:**

This content has the following parts:

- Design and modelling of underground mining operations.
- Calculation of exploited reserves and/or mining in an underground mine.
- Calculation of operating costs.
- Situation and location of control systems and automatisms for the sensorisation of a mine.

**Specific objectives:**

Upon completion of this content, the student will achieve the following knowledge:

- Design, modelling, calculation of reserves and costs in underground mining exploitations through the software "VULCAN", as well as knowledge about the best location of control systems and automatisms in the mine for their sensorization.

**Related activities:**

Master class through the computer in which the students in the computer room are trying out the same moment of the explanations or shortly after, the concepts given by the teacher. Carrying out exercises with the computer.

**Full-or-part-time:** 40h

Laboratory classes: 15h

Self study : 25h

## ACTIVITIES

### TITLE OF ACTIVITY 1: PRACTICE: DESIGN AND MODELLING OF AN OPEN-CAST MINING OPERATION

**Description:**

The aim is to design and model an open-cast mining operation on the basis of given data.

**Specific objectives:**

Practice with the "VULCAN" software and consolidate the knowledge that has been given about design and modelling of open-cast mines.

**Material:**

Computers and VULCAN software.

**Delivery:**

Prior to the full delivery of the internship, 2 deliverables must be submitted in order to monitor the progress of the students in the development of the internship. They represent 70% of the laboratory or practice mark.

**Full-or-part-time:** 18h

Laboratory classes: 6h

Self study: 12h

### ACTIVITY TITLE 4: INDIVIDUAL ASSESSMENT PROBLEM TEST 2

**Description:**

Individual performance in a computer classroom of 1 or more exercises of all the contents of the subject covering all the specific learning objectives of the indicated contents. Correction by the teaching staff.

**Specific objectives:**

To evaluate the knowledge acquired by the students with respect to the more practical contents of the subject.

**Material:**

Approach of one or several problems to be solved with computer using the software "VULCAN".

**Delivery:**

Resolution of the problems by the student. It represents a part of the evaluation (60% of the exam marks).

**Full-or-part-time:** 16h

Practical classes: 2h

Self study: 14h

### TITLE OF ACTIVITY 2: ECONOMIC STUDY IN AN UNDERGROUND MINING OPERATION THAT HAS BEEN DESIGNED AND MODELLED WITH VULCAN

**Description:**

The aim is to carry out an economic study of an underground mining operation based on a design given to the students.

**Specific objectives:**

Practice with the Vulcan software and consolidate your knowledge of underground mine design and modelling.

**Material:**

Computers and Vulcan software.

**Delivery:**

Prior to the full delivery of the internship, 1 deliverable must be submitted for the purpose of monitoring the progress of the students in the development of the internship. It represents 30% of the laboratory or practical note.

**Full-or-part-time:** 6h

Laboratory classes: 2h

Self study: 4h



### ACTIVITY TITLE 3: INDIVIDUAL ASSESSMENT THEORY TEST 1

**Description:**

Individual performance of a theoretical exam in which there may be a combination of test questions, explanatory questions, and calculation of some data with a high conceptual content.

**Specific objectives:**

To evaluate the knowledge acquired by the students with respect to the more theoretical contents of the subject.

**Material:**

The approach of test questions, explanatory questions, and calculations of some data.

**Delivery:**

Delivery of the answers to the questions raised. It represents 40% of the exam marks.

**Full-or-part-time:** 12h

Laboratory classes: 2h

Self study: 10h

## GRADING SYSTEM

The final grade is calculated with the following formula:

$$N_{\text{final}} = 0,75 \cdot (N_{\text{exTeo}} \cdot 0,35 + N_{\text{exProbl}} \cdot 0,65) + 0,10 \cdot \text{Computer practicals} + 0,15 \cdot \text{Subject related work}.$$

$N_{\text{final}}$ : final grade.

$N_{\text{exTeo}}$  = Theory exam grade

$N_{\text{exProbl}}$  = Qualification of problems to be solved by means of Vulcan.

Below are the 5 evaluation systems established by the MUEM's verification report, with the total weighting % for the systems used in this subject:.

Partial and/or global tests, or synthesis tests: 75%.

Laboratory and/or computer practicals: 10%.

Reports:

Oral presentations:

Work related to the subject: 15%.

## EXAMINATION RULES.

A series of skills and qualities are required that are generic and applicable to any activity in the university academic environment, such as: spirit of sacrifice, neatness, capacity for synthesis, teamwork, respect for the rest of the classmates and the professor, perseverance, etc.



## BIBLIOGRAPHY

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### Basic:

- Maptek. VULCAN [on line]. Sulte: Maptek, 2017- [Consultation: 21/12/2020]. Available on: <http://www.maptek.com/cl/productos/vulcan/>.
- Pla Ortiz de Urbina, F. Fundamentos de laboreo de minas. Madrid: Escuela Técnica Superior de Ingenieros de Minas, 1994. ISBN 8485616059.
- Hustrulid, W. A.; Kuchta, M.; Martin, R. Open pit mine planning & design [on line]. 3rd ed. London: CRC Press, 2013 [Consultation: 24/05/2022]. Available on: <https://www.taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/b15068/open-pit-mine-planning-design-two-volume-set-cd-rom-pack>. ISBN 9781466575127.
- Read, J.; Stacey, P., eds. Guidelines for open pit slope design [on line]. Collingwood: CSIRO Publishing, 2009 [Consultation: 17/01/2023]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=615213>. ISBN 9780415874410.
- Sturgul, J. R. Mine design: examples using simulation. Littleton: Society for Mining, Metallurgy, and Exploration, 2000. ISBN 0873351819.
- Bustillo, M.; López, C. Manual de evaluación y diseño de explotaciones mineras. Madrid: Entorno Gráfico, 1997. ISBN 8492170824.

### Complementary:

- Hustrulid, W. A.; Bullock, R. L., eds. Underground mining methods: engineering fundamentals and international case studies. Littleton: Society for Mining, Metallurgy and Exploration, 2001. ISBN 0873351932.
- Gertsch, R. E.; Bullock, R. L., eds. Techniques in underground mining: selections from underground mining methods handbook. Littleton: Society for Mining, Metallurgy and Exploration, 1998. ISBN 0873351630.