Course guide
330419 - TCA - Applied Surveying and Cartography

Last modified: 06/07/2023

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN MINING ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2021). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Sanmiquel Pera, Lluis

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. (ENG) Elaboració de cartografia temàtica.

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
3. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
4. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

The course is distributed as follows:
30 hours of large group:
15 hours of lectures in the classroom.
11 hours in the classroom in which more applied aspects and problem solving are developed.
4 hours of partial exams.
30 hours of small group:
4 hours of field work of the practical part.
12 hours in the computer classroom to carry out the laboratory work of the practical part of the course.
14 hours per course in the computer classroom to carry out problems requiring the use of computers.

LEARNING OBJECTIVES OF THE SUBJECT

Study of the cartographic systems most commonly used in mining. Study of mining concessions, their demarcation and demarcation and demarcation in relation to both the old mining laws and the current one. Resolution of the problems of mining workings intrusions. Spatial dimensioning of a deposit. Providing knowledge of the instruments and methods used in topographic surveys of the interior of mines and tunnels. Liaison of underground topographic workings with those of the exterior. Acquisition of adequate training for the preparation of plans for underground workings in mines and tunnels, as well as for the execution of all types of mine and tunnel breaks. Study of the phenomena of land subsidence due to mining.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours medium group	60,0	40.00

Total learning time: 150 h

CONTENTS

Content title 1: Underground topography

Description:
This content deals with:
- Specific working conditions in underground workings.
- Orientation of underground workings.
- Underground planimetry and altimetry.

Specific objectives:
Upon completion of this content, the student will achieve the following knowledge:
- Specific working conditions in underground workings.
- Methods of orientation of underground workings: Fundamentals. Requirements. Field and cabinet work. Advantages and disadvantages of the different methods.
- Planimetric survey of an underground workings: Rationale. Parking method. Reduction of directional error. Off-vertex station. Basic and detail network. Field and cabinet works.
- Altimetric survey of an underground workings: Measurement of the depth of boreholes for inclined and vertical boreholes. Underground levelling. Field and cabinet work.
- Mine plans: Longitudinal profiles. Transverse profiling methods Cubing of underground workings.
- Practical field and office work for the orientation of a hypothetical mine, as well as the planimetric and altimetric survey of part of it.
- Preparation of thematic cartography on underground mining.

Related activities:
Master class on basic concepts and small group problem classes where the knowledge presented is applied.

Full-or-part-time: 47h
Theory classes: 8h
Laboratory classes: 9h
Self study : 30h

Title of content 2: Mining Breakthroughs and tunnelling

Description:
In this content we work:
- Mining breakthrough
- Tunnel surveys.

Specific objectives:
Upon completion of this content, the student will achieve the following knowledge:
- Mine breakthrough: Fundamentals. Field and cabinet work for the calculation of mine breakage. Setting out the direction and slope of a mine gallery. Setting out curves. Elements of a circumferential arc. Setting out curves with equal tangents. Layout of transition curves. Clotoïdes. Guidance of shafts.
- Surveying for tunnels: Field and office work. Calculation of tunnel length and direction. Tunnel slope calculation. Tunnel layout.
- Carrying out the necessary calculations in the computer room, from the field measurements taken in the practical sessions, for the design of a communication ramp between a gallery of a hypothetical mine and a certain place on the surface.

Related activities:
Master class on basic concepts and small group problem classes where the knowledge presented is applied.

Full-or-part-time: 40h
Theory classes: 6h
Laboratory classes: 7h
Self study : 27h

Content title 3: Mining cartography and geodesy

Description:
In this content we work on:
- Mining records and resources.
- Topography and cartography in mining.
- Geodesy.

Specific objectives:
Upon completion of this content, the student will have the following knowledge:
- Records and mining resources: concept, classes, description, grant,...
- Need for topography and cartography in mining according to current mining legislation.
- Geodesy: Foundation. Geodetic coordinates. Spanish Geodetic Network. Catalan Geodetic Network. Spanish and Catalan geodetic leveling. Old geodetic system, ED50 and ETRS89 Corrections to be applied to reduce distances measured with electronic meter on the ellipsoid.
- Mining cartography: UTM and Lambert cartographic system. Transformations from map coordinates to geodesics and vice versa. Transformations of cartographic coordinates from the UTM system to Lambert and vice versa.
- Application for a mining concession with UTM and geodetic map coordinates of a specific geographical area.

Related activities:
Master class on basic concepts and small group classes on problems where the knowledge presented is applied.

Full-or-part-time: 33h
Theory classes: 9h
Laboratory classes: 9h
Self study : 15h

Content title 4: Magnetic orientation and mining planning

Description:
In this content we work on:
- Magnetic orientation.
- Mining determinations and demarcations.
- Mining intrusions.

Specific objectives:
Upon completion of this content, the student will have the following knowledge:
- The magnetic declination and its variations. Calculation of the magnetic declination: From topographic map information, from specific software and from topographic measurements.
- Mining determinations and demarcations: foundation, field work and cabinet that must be carried out.
- Mining intrusions: Concept. type Field and cabinet work that must be carried out to determine its existence and its extent in terms of surface area and volume.
- Field and office topographic work practices for the determination of the presumed existence of a mining intrusion and quantification of the same, if this is the case.

Related activities:
Master class on basic concepts and small group classes on problems where the knowledge presented is applied.

Full-or-part-time: 20h
Theory classes: 3h
Laboratory classes: 5h
Self study : 12h

Content Title 5: Mining subsidence

Description:
In this content we work on:
- Study and control of mining subsidence.

Specific objectives:
Upon completion of this content, the student will achieve the following knowledge:
- Determination of the zone of influence and importance of a mining subsidence. Theoretical layout method and actual layout method: Geometric levelling, Trigonometric levelling, Global Positioning System (GPS), SAR interferometry.
- Duration of movements. Damage. Sudden sinking. Determination of pressure and inland ground movements: Measurement of deformations by topographic methods and Measurement of deformations by strain gauges.
- Development of thematic mapping of mine subsidence.

Related activities:
Master class on basic concepts.

Full-or-part-time: 10h
Theory classes: 4h
Self study : 6h

ACTIVITIES

Title of activity 1: Practice: Field work for the design of a communication ramp between a point of a gallery located in a hypothetical mine with a point located on the outside

Description:
Practice that is carried out outside and next to the school premises with teams of 3-4 people. Each team has a total station at the indicated place where the experimental part is carried out, and as directed learning, it is planned that the student will do a previous reading of the approach of the practice. The teacher gives the relevant indications and clarifications so that the students are clear about the objectives to be achieved and the procedures to be developed.

Specific objectives:
Carrying out a series of topographic works with a total station in a hypothetical mine. These works consist of applying the exterior and interior topographic methods that need to be applied to lower the orientation and cartographic system of the surface in the interior of a mine or underground workings with maximum precision. With these works it will be possible to calculate the cartographic coordinates of a point called "Q" where a ramp will have to arrive that will have to be designed from a point "E" of the surface.
Measurement with a system of 2 GPS receivers of a point located as close as possible to the hypothetical shaft, as well as the point "Y" where the ramp from the exterior to the interior of the mine must start.

Material:
Total stations and system of 2 GPS receivers.

Delivery:
It represents 10% of the laboratory or practical grade.

Full-or-part-time: 8h
Laboratory classes: 4h
Self study: 4h

Title of activity 2: Practical: Cabinet work for the design of a communication ramp between a point in a gallery located in a hypothetical mine and a point outside.

Description:
This activity is carried out entirely in the CAD classroom. Each team of 3-4 people has 2-3 computers to solve as much as possible of what has to be done in activity 1. The teacher guides the steps to be taken in the process of calculating the field measurements taken in the field work of activity 1. He/she also clarifies any doubts that may arise.

Specific objectives:
Completion of the desk-based part of activity 1.

Material:
Computers.

Delivery:
It represents 30% of the laboratory or practical grade.
Delivery of a bound work with memory, calculations and plans of everything that has been raised in activity 1, at the end of the four-month period.

Full-or-part-time: 22h
Laboratory classes: 11h
Self study: 11h

Title of activity 3: Individual assessment test 1

Description:
Individual performance in the classroom of an exercise from topics 1 to 6 covering all the specific learning objectives of the topics indicated. Correction by the teacher.

Material:
Theoretical questions and problems.

Delivery:
The student answers the theoretical questions and solves the problems. It represents a part of the evaluation of the exams or tests part, specifically 50%.

Full-or-part-time: 10h
Practical classes: 2h
Self study: 8h

name english

Description:
Individual exam or test in the classroom on topics 7 to 12, covering all the specific learning objectives of the topics indicated. Correction by the teaching staff.

Specific objectives:
To assess the knowledge acquired by the students on topics 7-12.

Material:
Theoretical questions and problems.

Delivery:
The student answers the theoretical questions and solves the problems. It represents a part of the evaluation of the exams or tests part, specifically 50%.

Full-or-part-time: 10h
Practical classes: 2h
Self study: 8h

GRADING SYSTEM

The final qualification is calculated with the following formula:

Nfinal= 0,6·(Nex1·0.5 + Nex2·0.5)+ 0,2·ATPMIE + 0,2·ASPAPTIDRIIE

Nfinal: final grade.

Nex1= Partial test or exam 1. Subjects 1 to 6.
Nex2= Partial test or exam 2. Subjects 7 to 12.

Below you can see the 3 evaluation systems established by the GERMR verification report with the total % of weighting for the systems used in this subject:

Written or oral tests to control individual knowledge (Nex1 + Nex2): 60%.
Evaluation of practical work by means of deliverable reports (ATPMIE): 20%.
Attendance at practical sessions, personal attitude, individual work, individual or team reports on the activities carried out (ASPAPTIDRIIE): 20%.

EXAMINATION RULES.

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

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- Martín Asín, Fernando. Geodesia y cartografía matemática. 3ª ed. Madrid: Fernando Martín Asín, 1990. ISBN 843980248X.
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