



1. General information

Course: ENVIRONMENTAL TECHNOLOGY

Type: CORE COURSE

Degree: 384 - MINING AND ENERGY ENGINEERING DEGREE

Center: 106 - SCHOOL OF MINING AND INDUSTRIAL ENGINEERING

Year: 3

Main language: Spanish

Use of additional languages: English

Web site:

Code: 19525

ECTS credits: 6

Academic year: 2022-23

Group(s): 51

Duration: C2

Second language: English

English Friendly: Y

Bilingual: Y

Lecturer: PABLO LEON HIGUERAS HIGUERAS - Group(s): 51				
Building/Office	Department	Phone number	Email	Office hours
EIMI Almadén, Ed. Storr, planta 1ª	INGENIERÍA GEOLÓGICA Y MINERA	926052709	pablo.higueras@uclm.es	To be designated at the begging of the course
Lecturer: SATURNINO LORENZO ALVAREZ - Group(s): 51				
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Edificio STORR, Planta Primera, Despacho 1.02	INGENIERÍA GEOLÓGICA Y MINERA	926264007 Ext 6017	saturnino.lorenzo@uclm.es	To be designated at the begging of the course

2. Pre-Requisites

In order to reach the designated objectives, previous knowledge in the following matters is required:

- General Chemistry
- Mineralogy and Petrology
- General and Applied Geology
- Geology of Ore Deposits

3. Justification in the curriculum, relation to other subjects and to the profession

The **Mining Environmental Technology** subject constitutes a subject that is inserted within the objectives of modern mining: it aims to make known the risks involved in mining without environmental control, and what are the measures that can be established to minimize the affectation to the environment, making it possible for us to speak of sustainable mining.

From this point of view, it is considered an important subject, which is directly related to the subjects with the highest mining load of the career:

- The basic subjects of the degree (**Mathematics, Physics, Chemistry**), suppose the foundations of this discipline, by allowing the identification, characterization and quantification of physical and chemical processes capable of modifying the environment.
- **Geology, basic and applied**, lays the foundations for a better understanding of the environment in which the mining activity will take place, and are important supports to differentiate between different materials that are likely to impact or be impacted by the presence of mining operations.
- The best knowledge of the **Mineral Deposits**, and of their **Mineralogy** and **Petrology**, allows the identification of specific risks for the environment, due to the nature of the material extracted.
- **Mining Technology** must be very aware of the risks that these activities pose to the environment, and on this basis, adapt as much as possible the exploitation methods to the considerations leading to the final objective of carrying out an activity compatible with respect for the environment and, where appropriate, with its subsequent recovery/rehabilitation.
- Similarly, the study of **mineral and rock treatment plants** must be based on knowledge of the environmental risks involved in their installation and design.
- At the same time, for an adequate development of the possibilities of mining Environmental Technology, they must have proper knowledge of the **Legislation** and **Land Management** issues that directly affect the sector, providing knowledge about the possible solutions for compliance with the corresponding regulations.
- Lastly, it should be pointed out that **Mining Research** must be aware of and bear in mind the problems inherent to this matter for the decision-making involved in the development of its activity, identifying before reaching the planning phases of a mining operation, the real possibilities that it may be carried out sustainably in sensitive areas.

4. Degree competences achieved in this course

Course competences	
Code	Description
A10	Technical and scientific capacity for the profession of Technical Mining Engineer and knowledge of the duties of consultancy, analysis, design, calculation, project, construction, maintenance, preservation and exploitation. To understand the multiple legal and technical restrictions which are to be considered in the Mining Engineering field and which are intended, according to what it was established in part 5 of the ministerial order CIN/306/2009 of 09-02-2009, the prospection and mining-geological research, all kind of geological exploitations including ground water, underground works, underground storage, treatment and processing plants, energy plants, metallurgical as well as iron and steel plants, building material plants, carbon and chemical, petrochemical, gas, waste treatment plants and effluents, explosive factories, and capacity to use verified methods and recognized technologies with the aim of getting the highest efficacy having environmental concern and protecting the health and security of workers and users of those facilities.
A11	
A14	Capacity to carry out studies on urban planning and zoning and environmental aspects related to the projects, plants and installations in their field.

A16	To carry out in the mining engineering field, according to the acquired knowledge established in section 5 of order CIN/306/2009 (9-02-2009), measurements, layout plans, maps and plans, calculations, assessment, risk analysis, experts' reports, studies and reports, work plans, environmental and social studies, restoration plans, quality control systems, prevention systems, analysis and assessment of metallic, ceramic, refractory, synthetic and other materials and properties, ground characterization and rocky mountain ranges and similar works.
A17	To know, understand and apply the necessary legislation in the professional field of the Technical Mining Engineer.
C13	Capacity to apply study methodologies and evaluation of environmental impact, in general, sustainability and waste treatment.
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.
CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
CT00	To promote respect and promotion of Human Rights as well as global access principles and design for everybody according to the 10th final order of the Law 51/2003 of December 2nd, about equal opportunities, non-discrimination and universal accessibility for people with disabilities.
CT01	To master a foreign language, B1 level following the Common European Framework of Reference for Languages.
CT02	To be acquainted with Information and Communication Technology ICT
CT03	Capacity for written and oral communication skills.
CT04	Capacity to accept ethical and deontological professional responsibility.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

To know and understand legislation aspects of environmental concern

To know and understand the different kinds of mining installations which may act as focal point in environmental degradation process

To know, understand and apply environmental assessment processes to mining activities

Critical and reasoning capacity

Capacity to understand maps and outlines related to environmental impact issues.

Capacity to express yourself correctly both in spoken and in written form.

Capacity to integrate mining and geological data as well as environmental data

To know and understand the natural environment and its possible alterations, related to land and landscape modifications, and the air, water, soils and living beings.

To know and understand the dynamics of mining activities liable to the generation of environmental impact issues.

To know and understand the natural dynamics which might affect or contribute to the pollution surrounding mining areas

6. Units / Contents

Unit 1: Introduction: the environmental impact of mining

Unit 2: Mining and atmosphere

Unit 3: Mining and hydrosphere

Unit 4: Mining and soil 1: general characteristics of soils

Unit 5: Mining and soil 2: Reasons and dynamics of soil contamination

Unit 6: Mining and soil 3: analysis of soil contamination: Environmental Geochemistry

Unit 7: Mining and living beings: biogeochemistry

Unit 8: Restoration and Remediation 1: the terrain

Unit 9: Restoration and Remediation 2: water

Unit 10: Restoration and Remediation 3: Soils and ground water

Unit 11: Environmental risk assessment

Unit 12: Mining & Society Green / sustainable mining

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	A11 A14 A16	1.2	30	Y	N	Participatory master class, with the use of audiovisual media, blackboard, videos, etc. Use of the Virtual Campus Moodle Platform as a support for teacher-student communication and obtaining information for the preparation of notes, preparation of classes by the student, and issuance of documents.
							A maximum of three groups of students are established, who must propose and solve a case study or project, through field and laboratory work, under the direct supervision of the teacher or teachers of the subject. The projects/cases consist of the approach of a study of the impact

Problem solving and/or case studies [ON-SITE]	project-based learning	A11 A14 A16	0.8	20	Y	N	on the environment by mining activities in the locality, which implies participating jointly with the teacher or teachers in the appropriate approach to the work, its practical development in the field and in the laboratory, the analysis of the results obtained and the obtaining of conclusions that serve to establish the risks involved in the affectation analyzed. In case of non-compliance in person, it would be replaced for recovery purposes by a knowledge test.
Writing of reports or projects [OFF-SITE]	Case Studies	A11 A14 A16	2	50	Y	Y	Preparation by the student of summaries of the class topics, and of an extension work of some of the topics of the subject program or of practical application (case study). Use of the Virtual Campus Moodle Platform as support for teacher-student communication and obtaining information for the preparation of documents. Use of the INTERNET for complementary documentation. In case of non-performance, it is replaced for evaluation purposes by a knowledge test.
Study and Exam Preparation [OFF-SITE]	Self-study	A11 A14 A16	1.6	40	N	-	Study activities and complementary training. Use of INTERNET and NNTT for access to documentation. Analysis of the information collected.
Individual tutoring sessions [ON-SITE]	Other Methodologies		0.1	2.5	N	-	Personal tutorials aimed at solving doubts or problems raised by the student individually. Usage as a support of the Virtual Campus Moodle Platform for student-teacher communication.
Group tutoring sessions [ON-SITE]	Other Methodologies	A11 A14 A16	0.1	2.5	N	-	Group tutorials, for the resolution of doubts or problems of the work groups aimed at resolution of Projects. Usage of the Virtual Campus Moodle Platform as support for communication.
Final test [ON-SITE]	Assessment tests	A10 A11 A14 A16	0.2	5	Y	Y	Theoretical and practical tests of evaluation of applied knowledge: test of examination and oral presentation of the results obtained in the Projects carried out.
Total:			6	150			
Total credits of in-class work: 2.4			Total class time hours: 60				
Total credits of out of class work: 3.6			Total hours of out of class work: 90				

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System			
Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Oral presentations assessment	30.00%	30.00%	Oral and group presentation of the results of the Project carried out by each group.
Practicum and practical activities reports assessment	35.00%	35.00%	Preparation by each group of the report corresponding to the Project carried out. The contents and the quality of the edition will be valued.
Final test	35.00%	35.00%	Written exam test, on the subject matter of the subject program.
Total:	100.00%	100.00%	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The evaluation of the indicated items will be based on the following criteria:

- Final test: It will be a knowledge test, including expository and test questions on the information transmitted by the teacher in the class topics available on the Virtual Campus and during the theoretical classes. The adequacy of the knowledge to what is taught will be valued, as well as, very positively, the original substantiated contributions of the student.

- Oral presentation of topics: corresponds to the oral presentation of the results of the projects carried out by groups of students. The quality of the presentation will be assessed in general, and individually, the fluency and clarity of the presentation of each component of the group.
- Preparation of internship reports: Corresponds to the written report of the internship projects carried out in groups. It will be assessed globally for the group, and the quality of the writing, graphics and illustrations, as well as that of the conclusions obtained, will be taken into account in the assessment.
- Elaboration of theoretical works: Corresponds to the assessment of the summaries of the topics, and of an extension work on an aspect of the taught syllabus, or a specific case study. The summaries must be of a maximum length of 2 pages, and must contain a summary prepared by the student on aspects related to the topic in question. Extension works or case studies must have an extension between 20 and 30 pages. In both cases, the conciseness, the writing, the accompaniment of appropriate illustrations, and the evaluative personal contributions by the student will be valued.

Non-continuous evaluation:

It includes a knowledge test, although the results obtained in the other items that have been carried out and/or delivered in the ordinary call will also be valued. In the event that these student contributions could not be assessed because they had not been delivered to the teacher previously, the assessment of the note will be for a maximum of 6 points.

Specifications for the resit/retake exam:

It includes a knowledge test, although the results obtained in the other items that have been made and/or delivered in the ordinary call will also be valued. In the event that these student contributions could not be assessed because they had not been delivered to the teacher previously, the assessment of the note will be for a maximum of 6 points.

Specifications for the second resit / retake exam:

The special call for retake will be assessed on the basis of a knowledge test, in accordance with the same criteria that are expressed for ordinary calls, although the results obtained in the other items that have been made and/or delivered in the ordinary call will also be valued. In the event that these student contributions could not be assessed because they had not been delivered to the teacher previously, the assessment of the note will be for a maximum of 6 points.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Problem solving and/or case studies [PRESENCIAL][project-based learning]	20
Writing of reports or projects [AUTÓNOMA][Case Studies]	20
Study and Exam Preparation [AUTÓNOMA][Self-study]	10
Group tutoring sessions [PRESENCIAL][Other Methodologies]	2.5
Final test [PRESENCIAL][Assessment tests]	5
Unit 1 (de 12): Introduction: the environmental impact of mining	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Problem solving and/or case studies [PRESENCIAL][project-based learning]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	1.5
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 2 (de 12): Mining and atmosphere	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Problem solving and/or case studies [PRESENCIAL][project-based learning]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	1.5
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 3 (de 12): Mining and hydrosphere	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][project-based learning]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	2
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 4 (de 12): Mining and soil 1: general characteristics of soils	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][project-based learning]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	2
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 5 (de 12): Mining and soil 2: Reasons and dynamics of soil contamination	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][project-based learning]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	3
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 6 (de 12): Mining and soil 3: analysis of soil contamination: Environmental Geochemistry	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][project-based learning]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	3
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 7 (de 12): Mining and living beings: biogeochemistry	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][project-based learning]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	3
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2

Unit 8 (de 12): Restoration and Remediation 1: the terrain	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][project-based learning]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	3
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 9 (de 12): Restoration and Remediation 2: water	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][project-based learning]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	3
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 10 (de 12): Restoration and Remediation 3: Soils and ground water	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][project-based learning]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	3
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.2
Unit 11 (de 12): Environmental risk assessment	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][project-based learning]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	3
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	.3
Unit 12 (de 12): Mining & Society Green / sustainable mining	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][project-based learning]	2
Writing of reports or projects [AUTÓNOMA][Case Studies]	.2
Group tutoring sessions [PRESENCIAL][Other Methodologies]	2
Global activity	
Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	30
Study and Exam Preparation [AUTÓNOMA][Self-study]	38
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	2.3
Writing of reports or projects [AUTÓNOMA][Case Studies]	20.2
Final test [PRESENCIAL][Assessment tests]	5
Problem solving and/or case studies [PRESENCIAL][project-based learning]	50
Group tutoring sessions [PRESENCIAL][Other Methodologies]	4.5
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Bernd G. Lottermoser	Mine Wastes: Characterization, Treatment and Environmental Impacts	Springer		3540486305	2007	
J.E. Romero	Medio ambiente y minería. http://www.ecoportall.net/Temas_Especiales/Mineria/medio_ambiente_y_mineria	Ecoportal			2009	
Fred G. Bell, Laurance J. Donnelly	Mining and its Impact on the Environment	CRC Press			2019	
R. Oyarzun, P. Higuera y J. Lillo	Minería Ambiental: Una Introducción a los Impactos y su Remediación. http://www.aulados.net/GEMM/Libros_Manuales/index_libros.html	Aulados			2011	Libro fundamental para el seguimiento del Curso.
Jose M. Azue	Environmental Impacts of Mining Activities: Emphasis on Mitigation and Remedial Measures (Environmental Science and Engineering)	Springer		978-3-642-59891-3	1999	
A. Toro, J.I. García de los Ríos-Cobo, O. Fadón, R. Cabrera y P. Acebes	Impactos ambientales en minería metálica. https://www.interempresas.net/Mineria/Articulos/265811-Impactos-ambientales-en-mineria-metalica.html	SIEMCALSA				
Paul L. Younger, S.A. Banwart, Robert S. Hedin	Mine Water: Hydrology, Pollution, Remediation	Springer Science & Business Media		978-94-010-0610-1	2002	
Javier Lillo Ramos	Impacto de la minería en el medio natural. http://www.escet.urjc.es/~jlillo/Efectos%20ambientales%20minería.pdf	ESCET-URJC				
J. Oyarzún y R. Oyarzun	Minería Sostenible: Principios y Prácticas.	Aulados			2011	Desarrollo del concepto de Minería Sostenible.

