

**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:** English**Use of additional languages:** Spanish for resolution of particular questions.**Web site:****Code:** 19525**ECTS credits:** 6**Academic year:** 2020-21**Group(s):** 52 51 54**Duration:** C2**Second language:** Spanish**English Friendly:** Y**Bilingual:** Y**Lecturer:** PABLO LEON HIGUERAS HIGUERAS - Group(s): 52 51 54

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2. Pre-Requisites

To adequately achieve the planned objectives, prior training is required in the following aspects:

- 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 subject of Environmental Mining Technology is inserted within the objectives of modern mining: it aims to publicize the risks involved in mining without environmental control, and what are the measures that can be established to minimize the impact on environment, with the aim of introducing the concept of sustainable mining.

From this point of view, it is considered a matter of importance, which is directly related to the subjects with the highest mining load of this career:

- The basic subjects of the degree (Mathematics, Physics, Chemistry) support the basis of this discipline, by allowing to identify, characterize and quantify physical and chemical processes capable of modifying the environment.
- Basic and applied Geology support the basis to better understand the environment in which mining activity will take place, and to differentiate between different materials likely to impact or be impacted by the presence of mining operations.
- The best knowledge of the Ore Deposits, and their Mineralogy and Petrology, allow identifying specific risks for the environment, due to the nature of the material extracted.
- Mining technology must bear in mind the risks that these activities pose to the environment, and on this basis, adapt as far as possible the methods of exploitation to the procedures 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 environmental risks involved in its installation and design.
- In turn, for a proper development of the possibilities of mining Environmental Technology, they must properly know the issues of Legislation and Territory Management that directly affect the sector, providing knowledge on possible solutions for compliance of the corresponding regulations.
- Finally, Mining Research must know and keep in mind the problems of this matter for decision-making involved in the development of its activity, identifying the real possibilities of that it can be carried out in a sustainable way in sensitive areas, before reaching the planning stages of a mining operation.

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.
A11	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.
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 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

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

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: Living beings: biogeochemistry

Unit 8: Restoration and Remediation 1: the terrain

Unit 9: Restoration and Remediation 2: water

Unit 9.1 Acid Mine Drainage

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

Unit 11: Environmental risk assessment

Unit 12: Mining & Society & 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, using audiovisual media, blackboard, videos, etc. Using the Campus Moodle platform Virtual as a support for teacher-student communication and obtaining information for making notes, preparation of classes by the student, and issuance of documents.
Problem solving and/or case studies [ON-SITE]	project-based learning	A11 A14 A16	0.8	20	Y	N	A maximum of three groups of students are established, who must raise 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 on the approach to a study of environmental impact by activities by mining companies in the town area, which implies participating together with the teacher or teachers in the approach adequate work, its practical development in the field

							and laboratory, the analysis of the results obtained and the obtaining of conclusions serving to establish the risks involved in the affectation analyzed. In case of non-attendance of student, it would be replaced for recovery purposes by a knowledge test related with practical aspects.
Writing of reports or projects [OFF-SITE]	Reading and Analysis of Reviews and Articles	A11 A14 A16	2	50	Y	Y	Issuing by the student of summaries of the class topics, and of a work of extension about any or some of the topic(s) of the program of the subject or practical application (case study). Use of the "Campus Virtual" Moodle Platform as a support for teacher-student communication and obtaining information for the preparation of documents. Using the INTERNET to obtain complementary documentation.
Study and Exam Preparation [OFF-SITE]	Self-study	A11 A14 A16	1.6	40	N	-	Complementary study and training activities. Usage of INTERNET and NNTT for access to documentation.
Individual tutoring sessions [ON-SITE]	Other Methodologies		0.1	2.5	N	-	Individual personal tutoring for resolution of doubts, questions and concerns raised by the student. Usage of "Campus Virtual" platform for communication support.
Group tutoring sessions [ON-SITE]	Other Methodologies	A11 A14 A16	0.1	2.5	N	-	Group tutoring, for resolution of doubts, problems or concerns of the working groups, aimed at solving Projects. Usage of "Campus Virtual" platform for communication support.
Final test [ON-SITE]	Assessment tests	A10 A11 A14 A16	0.2	5	Y	Y	Theoretical and practical tests for applied knowledge assessment: exam and oral presentation of the results obtained in the Projects developed by each group.
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
Assessment of active participation	10.00%	0.00%	Regular class attendance with participatory achievement will be valued.
Oral presentations assessment	10.00%	10.00%	Oral and group presentation of the results of the Project carried out by each group.
Practicum and practical activities reports assessment	20.00%	10.00%	Preparation by each group of the report corresponding to the Project carried out. The content and quality of the edition will be valued.
Final test	40.00%	50.00%	Written exam, based on the knowledge object of the program.
Theoretical papers assessment	20.00%	30.00%	Evaluation of the quality of the theoretical or theoretical-practical work carried out individually by the students: summaries of the topics of the program, and extension work or case study.
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 final knowledge exam, including expository and test questions about the information transmitted by the teacher in the class topics available on Virtual Campus and during the theoretical classes. The adequacy of the knowledge to the taught will be assessed, as well as, very positively, the original supported 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 in general, and individually, the ease and clarity of the exposition of each component of the group, will all be assessed.
- Preparation of practice reports: Corresponds to the written report of the practice projects carried out in a group. It will be valued globally for the group, and the quality of the writing, graphics and illustrations will be taken into account, as well as the conclusions obtained.
- Preparation of theoretical works: Corresponds to the assessment of the summaries of the topics, and 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 subject in question. Extension works or case studies must be between 20 and 30 pages long. 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 will only include 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 contributions of the student could not be valued for not having been delivered to the teacher, the evaluation of the grade will be for a maximum of 6 points.

Specifications for the resit/retake exam:

It will only include 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 contributions of the student could not be valued for not having been delivered to the teacher previously, the evaluation of the grade will be for a maximum of 6 points.

Specifications for the second resit / retake exam:

The special call for second resit / retake exam be assessed on the basis of a knowledge test, according to the same criteria that are expressed for ordinary calls.

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][Reading and Analysis of Reviews and Articles]	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): 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 ¿ 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][Reading and Analysis of Reviews and Articles]	.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][Reading and Analysis of Reviews and Articles]	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
J.E. Romero	Medio ambiente y minería. http://www.ecoportall.net/Temas_Especiales/Mineria/medio_ambiente_y_mineria	Ecoportal			2009	
Bernd G. Lottermoser	Mine Wastes: Characterization, Treatment and Environmental Impacts	Springer		3540486305	2007	
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	Important book for this subject.
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%20mineria.pdf	ESCET-URJC				
J. Oyarzún y R. Oyarzun	Minería Sostenible: Principios y Prácticas. http://www.aulados.net/GEMM/Libros_Manuales/index_libros.html	Aulados			2011	Deveopment of the Sustainable Mining concept.
Karlheinz Spitz, John Trudinger	Environment: From Ore to Metal.	CRC Press		9780415465106	2018	