UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: ADVANCED MATHEMATICS
Code: 19509
Type: CORE COURSE
ECTS credits: 6
Degree: 384 - MINING AND ENERGY ENGINEERING DEGREE
Academic year: 2023-24
Center: 106 - SCHOOL OF MINING AND INDUSTRIAL ENGINEERING
Group(s): 51
Year: 1
Duration: C2
Main language: Spanish
Second language:
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **PEDRO JOSE MORENO GARCIA** - Group(s): **51**

Building/Office	Department	Phone number	Email	Office hours
Elhuyar / Matemáticas	MATEMÁTICAS	6049	PedroJose.Moreno@uclm.es	

Lecturer: **DOROTEO VERASTEGUI RAYO** - Group(s): **51**

Building/Office	Department	Phone number	Email	Office hours
Elhuyar / Matemáticas	MATEMÁTICAS	926052122	doroteo.verastegui@uclm.es	It will be published at the beginning of each semester.

2. Pre-Requisites

In order for students to achieve the proposed learning objectives, they must possess knowledge and skills that are assumed to be guaranteed in their training prior to university entrance:
- Knowledge: basic geometry and trigonometry, basic mathematical operations (powers, logarithms, fractions), polynomials, matrices, derivation, integration and representation of functions.
- Basic skills in the handling of instruments: elementary handling of computers (operating system).

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

The Mining Engineer is the professional who uses the knowledge of physical and mathematical sciences and engineering techniques to develop his professional activity in aspects such as the search for mining resources, the exploitation of mines, the extraction of elements of economic interest from their original minerals, the control, instrumentation and automation of processes and equipment, as well as the design, construction, operation and maintenance of extractive industrial processes, etc. This training allows him/her to participate successfully in the different branches that make up mining engineering, to adapt to changes in technologies in these areas and, if necessary, to generate them, thus responding to the needs that arise in the productive and service branches to achieve the welfare of the society to which he/she owes.

Within the MATHEMATICAL knowledge necessary to carry out all of the above, the methods developed in the subject MATHEMATICS have proven to be the most appropriate for the modern treatment of many disciplines included in the Syllabus. Disciplines that, in the end, will allow the engineer to face the problems that will arise throughout the exercise of the profession.

Therefore, it is necessary to take this subject because it is an essential part of the basic training of a future engineer. Its purpose is to provide students with the basic MATHEMATICAL resources necessary to follow other specific subjects of their degree, so that the student will have enough MATHEMATICAL ability and skills to solve problems related to engineering and to MATHEMATICS itself. In addition, this subject helps to enhance the capacity for abstraction, rigor, analysis and synthesis that are typical of MATHEMATICS and necessary for any other scientific discipline or branch of engineering.

4. Degree competences achieved in this course

Course competences

Code	Description
B01	Capacity to solve mathematical problems which might arise in the engineering field. Attitude to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivatives; numerical methods, numeric algorithms, statistics and optimization.
C01	Capacity to solve ordinary differential equations to be applied in Engineering problems.
C03	To know basic numerical calculus applied to the engineering field.
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.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
CT02	To be acquainted with Information and Communication Technology ICT
CT03	Capacity for written and oral communication skills.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

To manage and to know precisely basic concepts of differential geometry

To know the fundamentals and applications of the optimization and to solve and formulate Optimization problems

To know the use of functions of one and several variables including their derivation, integration and graphic representation

To know the main approximations to resolutions by means of numerical methods, to use (at user¿s level) sofware packages of statistics, data processing, mathematical calculations and visualization. to outline algorithms and to program using high level programming language, to visualize functions, geometrical figures and data, to design experiments, analize data and understand results.

Additional outcomes

Know how to describe processes related to industrial engineering subjects by means of ordinary differential equations and partial derivatives, solve them and interpret the results.

To be able to express oneself correctly in oral and written form and, in particular, to know how to use the language of mathematics as a way of accurately expressing the quantities and operations that appear in mining and energy engineering.

6. Units / Contents

Unit 1: DIFFERENTIAL GEOMETRY.

Unit 2: FUNCTIONS OF SEVERAL VARIABLES: LIMIT AND CONTINUITY.

Unit 3: FUNCTIONS OF SEVERAL VARIABLES: DIFFERENTIAL CALCULUS.

Unit 4: OPTIMIZATION OF SCALAR FUNCTIONS.

Unit 5: FUNCTIONS OF SEVERAL VARIABLES: MULTIPLE INTEGRALS.

Unit 6: VECTOR ANALYSIS.

Unit 7: INTRODUCTION TO DIFFERENTIAL EQUATIONS IN PARTIAL DERIVATIVES.

ADDITIONAL COMMENTS, REMARKS

NOTE: Taking into account the relationship between their contents, the aforementioned subjects can be classified into the following thematic blocks:

BLOCK I.- DIFFERENTIAL CALCULATION OF VARIABLES: Subjects 2, 3 and 4.

BLOCK II.- INTEGRAL CALCULATION OF VARIABLES: Topics 5 and 6.

BLOCK III.- COMPLEMENTS: Topics 1 and 7.

Practical exercises in the computer classroom (MATLAB):

Practice 1: Introduction and Representation of graphs. Functions, Derivation and Integration of functions with several variables.

Practice 2: Optimisation of functions with several variables.

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	B01 C01 C03 CB01 CB02 CB03 CB05 CT03	1.2	30	N	-	Participative master class, with blackboard and projector.
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	B01 C01 C03 CB01 CB02 CB03 CB05 CT03	0.7	17.5	Y	N	Participatory resolution of exercises and problems in the classroom. Presentation of academic work consisting of solving exercises and problems individually outside the classroom (progress tests).
Computer room practice [ON-SITE]	Practical or hands-on activities	B01 C01 C03 CB01 CB02 CB03 CB05 CT02 CT03	0.4	10	Y	Y	Realization of problems through the use of computer programs.
Self-study [OFF-SITE]	Self-study	B01 C01 C03 CB01 CB02 CB03 CB05 CT02 CT03	3.6	90	N	-	Autonomous personal study by the student.
Final test [ON-SITE]	Assessment tests	B01 C01 C03 CB01 CB02 CB03 CB05 CT03	0.1	2.5	Y	Y	The final assessment of the subject includes two partial written tests (not compulsory) and a final written test of the subject that has not been eliminated (compulsory).
		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 activities done in the computer labs	10.00%	10.00%	For the evaluation of practices in the computer classroom, with the application of specific software.
			The FINAL EXAMINATION will consist of TWO ELIMINATING written INTERIM EXAMINATIONS of subject matter (not compulsory) and a FINAL written EXAMINATION of the subject matter not eliminated (compulsory).

Final test	70.00%	90.00%	These exams will consist of questions, theoretical issues and problems where the approach to the subject or problem, the use of appropriate terminology and notation to express the ideas and mathematical relationships used, the choice of the most appropriate procedure for each situation, the justification of the different steps of the procedure used, the results obtained and the cleanliness and presentation of the document will be assessed.
Progress Tests	20.00%	0.00%	To test the progress of the students, at the end of each chapter, they must hand in an academic work consisting of a collection of solved problems in which the problem statement, the use of appropriate terminology and notation to express the ideas and mathematical relations used, the choice of the most appropriate procedure for each situation, the justification of the different steps of the procedure used, the results obtained and the cleanliness and presentation of the document will be assessed.
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 FINAL QUALIFICATION for the course will be calculated using the following expression:

0.7*FINAL EXAM + 0.2*PROGRESS TESTS + 0.1*COMPUTER PRACTICALS.

which will be applied provided that the grade of the FINAL TEST is equal to or higher than 4 points. Otherwise, the FINAL QUALIFICATION will be the one obtained in the FINAL TEST.

In order to obtain the mark for the FINAL EXAMINATION, the following procedure will be followed:

1. Students who in the two mid-term exams have obtained a mark equal to or higher than 5 points: the mark in the FINAL EXAM will be the average of the marks obtained in both mid-term exams.

2. Students who in one of the mid-term exams have obtained a mark between 4 and 5 points but whose average with the mark obtained in the other mid-term exam equals or exceeds 5 points: the mark in the FINAL EXAM will be the average of the marks obtained in both mid-term exams.

3. Students, not covered in section 2, who have obtained a grade equal to or higher than 5 points in one of the mid-term exams (eliminating that subject for the final exam) and lower than 5 points in the other mid-term exam: they will have to take the part corresponding to the subject not eliminated in the final exam. The mark in the FINAL EXAM will be the average of the mark obtained in the part of the mid-term exam and the mark obtained in the part of the final exam corresponding to the subject not eliminated.

4. Students who have not passed any of the partial exams: they must take the entire final exam. Their grade in the FINAL EXAM will be the grade obtained in the final exam.

Non-continuous evaluation:

It will be analogous to the continuous assessment, except that the FINAL QUALIFICATION of the subject will be calculated using the following expression:

0.9*FINAL EXAM + 0.1*COMPUTER PRACTICES

.

Specifications for the resit/retake exam:

There will be a single final written exam where 90% will be questions, theoretical issues and problems where the approach to the topic or problem, the use of appropriate terminology and notation to express the ideas and mathematical relationships used, the choice of the most appropriate procedure for each situation, the justification of the different steps of the procedure used, the results obtained and the cleanliness and presentation of the document will be assessed; the remaining 10% will be questions related to the computer practices. The student will decide whether or not to participate in the questions related to the computer practices if he/she wants to improve the grade obtained in them in the ordinary exam.

Specifications for the second resit / retake exam:

There will be a single final written exam where 90% will be questions, theoretical issues and problems where the approach to the topic or problem, the use of appropriate terminology and notation to express the ideas and mathematical relationships used, the choice of the most appropriate procedure for each situation, the justification of the different steps of the procedure used, the results obtained and the cleanliness and presentation of the document will be assessed; the remaining 10% will be questions related to the computer practices.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	**hours**
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2.5
Self-study [AUTÓNOMA][Self-study]	10
Final test [PRESENCIAL][Assessment tests]	2.5

General comments about the planning: This planning is indicative and may vary depending on the teaching needs of the group of students enrolled.

Unit 1 (de 7): DIFFERENTIAL GEOMETRY.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1
Self-study [AUTÓNOMA][Self-study]	4

Unit 2 (de 7): FUNCTIONS OF SEVERAL VARIABLES: LIMIT AND CONTINUITY.

Activities	**Hours**

Class Attendance (theory) [PRESENCIAL][Lectures]	3.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Self-study [AUTÓNOMA][Self-study]	12
Unit 3 (de 7): FUNCTIONS OF SEVERAL VARIABLES: DIFFERENTIAL CALCULUS.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	6.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	4
Self-study [AUTÓNOMA][Self-study]	24
Unit 4 (de 7): OPTIMIZATION OF SCALAR FUNCTIONS.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.5
Self-study [AUTÓNOMA][Self-study]	12
Unit 5 (de 7): FUNCTIONS OF SEVERAL VARIABLES: MULTIPLE INTEGRALS.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	7
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3.5
Self-study [AUTÓNOMA][Self-study]	24
Unit 6 (de 7): VECTOR ANALYSIS.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	6
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Self-study [AUTÓNOMA][Self-study]	10
Unit 7 (de 7): INTRODUCTION TO DIFFERENTIAL EQUATIONS IN PARTIAL DERIVATIVES.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1
Self-study [AUTÓNOMA][Self-study]	4
Global activity	
Activities	**hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	30
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2.5
Self-study [AUTÓNOMA][Self-study]	100
Final test [PRESENCIAL][Assessment tests]	2.5
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Fernández Viña, José Antonio	Ejercicios y complementos de análisis matemático I	Tecnos		84-309-0803-X	1999	
García, A. y otros	Ecuaciones diferenciales ordinarias : teoría y problemas	CLAGSA		84-921847-7-9	2006	
Haberman, Richard	Ecuaciones en derivadas parciales con series de Fourier y pr	Prentice Hall		978-84-205-3534-0	2008	
Marcellán, Francisco	Ecuaciones diferienciales : problemas lineales y aplicacione	McGraw-Hill		84-7615-511-5	1990	
Pedregal Tercero, Pablo	Iniciación a las ecuaciones en derivadas parciales y al anál	Septem Ediciones		84-95687-07-0	2001	
Pinkus, Allan M. (1946-)	Fourier series and integral transforms	Cambridge University Press		0-521-59771-4	2002	
FERNANDEZ VIÑA, José Antonio	Ejercicios y complementos de análisis matemático II	Tecnos		8430913440	1986	
San Martín Moreno, Jesús	Métodos matemáticos : ampliación de matemáticas para ciencia	Thomson		84-9732-288-6	2005	
Simmons, George Finlay	Ecuaciones diferenciales : teoría, técnica y práctica	McGraw-Hill		978-0-07-286315-4	2007	
Tenenbaum, Morris	Ordinary differential equations : en elementary texbook for	Dover		0-486-64940-7	1985	
Zill, Dennis G.	Ecuaciones diferenciales con aplicaciones de modelado	Cengage Learning		978-970-830-055-1	2009	
Braun, Martin	Differential equations and their applications : an introduct	Springer-Verlag		0-387-97894-1	1993	