

SUBJECT TEACHING GUIDE

G376 - Calculus

Degree in Energy Resources Engineering First Degree in Energy Resources Engineering

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Degree in Energy Resources Engineering First Degree in Energy Resources Engineering			Type and Year	Core. Year 1 Core. Year 1
Faculty	School of Mines and Energy Engineering				
Discipline	Subject Area: Mathematics Basic Training Module				
Course unit title and code	G376 - Calculus				
Number of ECTS credits allocated	6	Term	Semester based (1)		
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION				
Name of lecturer	VERA EGOROVA				
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Other lecturers					

3.1 LEARNING OUTCOMES

- Knowledge and manipulation of elementary univariate functions. Comprehension and application of the concepts of limit and continuity of a function at a point. Differentiate real functions with ease and application to optimization problems. Differentiate an implicit function. Study the differentiability of functions at a point and within an interval. Deal with numerical series and power series. Use Taylor's polynomials to approximate real functions. Know how to numerically implement local approximations of a function using Taylor polynomials, providing an error estimate.
- Calculate partial and directional derivatives and gradients. Know how to apply formulas from variable change to polar and spherical coordinates. Determine the plane tangent to the graph of a function at a point. Calculate partial derivatives of higher order and Hessian matrices. Develop in Taylor series. Raise and solve optimizations problems using differential calculus.
- Applications of the most usual analytical integration techniques of univariate functions and calculation of arc lengths, areas and volumes using univariate integral calculus. Application of formulas for change of variable to polar coordinates. Learn to parametrize common curves.

4. OBJECTIVES

In the context of the curriculum of this Engineering program, the Calculus course serves as an introduction to a significant portion of the core mathematical tools that students will require throughout their studies. The objectives of this course are as follows:

- Familiarize students with the language and logical reasoning of mathematics.
- Cultivate effective intellectual work habits and study skills.
- Introduce the potential of calculus as a powerful modeling tool.
- Develop operational proficiency in manipulating mathematical functions and their key properties.
- Acquaint students with the fundamental concepts of differential and integral calculus in single and multiple variables, along with their applications to physics and engineering problems.
- Foster an understanding of specific software tools and programming as crucial for learning and solving complex problems.
- Instill in students the importance of consistent study and independent work, both individually and in group settings.

6. COURSE ORGANIZATION	
CONTENTS	
1	<p>BLOCK I: INTRODUCTION</p> <p>UNIT 1: NUMBER SETS 1.1. Real numbers. Absolute value 1.2. Complex numbers</p> <p>UNIT 2: SEQUENCES AND SERIES 2.1. Series 2.2. Convergence of series</p>
2	<p>BLOCK II: DIFFERENTIAL CALCULATION</p> <p>UNIT 3. REAL FUNCTIONS OF ONE VARIABLE 3.1. Concept. Definitions. Operations with functions. 3.2. Limit of a function at a point. Continuity. 3.3. Theorems about continuous functions. 3.4. Derivation of functions of one variable. 3.5. Taylor's theorem and its applications.</p> <p>UNIT 4. REAL FUNCTIONS OF SEVERAL VARIABLES 4.1. Concept. Definitions. Operations with functions. 4.2. Limit of a function at a point. Continuity. 4.3. Differential calculus in several variables. 4.4. Differentiation of functions with scalar values. 4.5. Applications to problems related to engineering.</p>
3	<p>THEMATIC BLOCK III: INTEGRAL CALCULATION</p> <p>UNIT 5. INTEGRAL CALCULATION 5.1. Integration of functions of one variable. 5.2. The Riemann integral. 5.3. Defined integral applications. 5.4. Multiple integration. 5.5. Applications of the double and triple integral to problems related to engineering.</p>

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Partial Exam I This individual written test will serve to assess the skills acquired in the contents corresponding to the Thematic Block I of the program.	Written exam	No	Yes	25,00
Lab Practice Continuous assessment during the practical sessions, focusing on problem-solving tasks related to the acquired knowledge and utilizing specific software. It is important to note that only students who have attended the laboratory session in p	Laboratory evaluation	No	Yes	25,00
Partial Exam II This individual written test will serve to assess the skills acquired in the contents corresponding to the Thematic Block II.	Written exam	No	Yes	25,00
Final Exam This individual written test will be used to evaluate the competencies acquired during Block III. In addition, there will be specific sections for the revision of the previous blocks if they have been unsuccessful. For those who have successful	Written exam	Yes	Yes	25,00
TOTAL				100,00
Observations				
During the extraordinary examination period, students will only be allowed to take exams for subjects in which they have received a failing grade (below 5 out of 10). In the exams, the following will be penalized (among other things): Answers that are not properly justified. Procedures that demonstrate a lack of acquisition of basic mathematical competencies. Only for duly justified reasons (e.g., health restrictions), evaluation tests may be conducted remotely, with prior authorization from the School's Management. In the tests will be penalized (among others): - Answers that are not duly justified. - Procedures that demonstrate the lack of acquisition of basic mathematical skills. Only for duly justified reasons (eg health restrictions) the assessment tests may be organized remotely, with prior authorization from the Center's Management.				
Observations for part-time students				
The course can be followed through the Moodle platform. Part-time students will be required to take the same evaluation tests as full-time students.				

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Larson, L. y Edwards, B. H. Cálculo I y II. 9ª ed. Mc Graw Hill. ISBN: 978-970-10-5710-0.
<http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=263113>

Material puesto a disposición para clase (presentaciones, ejercicios, piezas audiovisuales y programas de software y código)