COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2024 - 2025

GENERAL INFORMATION

Data of the subject	
Subject name	Calculus
Subject code	DMA-GITI-102
Mainprogram	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Grado en Ingeniería en Tecnologías Industriales y Grado en Administración y Dirección de Empresas [First year] Grado en Ingeniería en Tecnologías Industriales [First year]
Level	Reglada Grado Europeo
Quarter	Anual
Credits	12,0 ECTS
Type	Básico
Department	Department of Applied Mathematics
Coordinator	Félix Mariano Alonso Sanz

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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

This course is an introduction to One-Variable Calculus and Vector Calculus. It focuses on providing the basic tools from these fields to be used in technical topics, and in showing some of their applications in the engineering field. All the contents will be analyzed including several examples taken from the real life or other sciences like physics, economics, etc. The theoretical classes complement each other with practical sessions in the laboratory where the problems are solved using the computer.

Basic knowledge of Real Analysis is required for attending this course.

Course contents

Contents

Part I: One-Variable Calculus

0. Real and complex numbers. Elementary functions.

1. Limits and continuity. Definitions, properties and theorems.
2. Differentiation. The mean value theorem. L'Hopital Rule. Taylor polynomials. Taylor formula. Applications of differentiation: increasing and decreasing intervals, concavity, local and global maxima and minima. Optimization problems.
3. Integration: definition and properties. The Fundamental Calculus Theorem. Improper integrals. The Eulerian functions. Applications of definite integral: area between two curves, length of an arc of curve and volumes.
4. Real number sequences. General definitions, properties and limits. Monotone sequences and bounded sequences.
5. Infinite series: general definitions and properties. Positive series: definition, properties and convergence. Alternating series. Sum of series: exact sum and approximate sum.
6. Interpolation. Statement of the problem. Lagrange intepolation. Piecewise linear interpolation. Hermite interpolation. Splines.

Part II: Multivariable Calculus

7. Limits and continuity for vector and scalar valued functions.

8. Partial and directional derivatives. The gradient vector. Differentiability. Tangent Plane and linear approximations.

9. Composition of functions. The Chain Rule. Implicit and inverse functions.
10. Maxima and minima. Lagrange multipliers.
11. Multiple integrals: double and triple integrals. Definition and properties. Changes of variable and symmetries.
12. Line integrals: definition and properties. Green's Theorem. Applications.
13. Surface integrals. Definitions and properties. The Divergence theorem.
14. Applications of the integrals. Volumes, centers of mass and inertia moments.

Laboratory

There will be six 1-hour sessions during the course, between the third and the last lecture week.

1. Introduction to the software *Matlab (LiveScript)*.
2. Interpolation methods. Applications.
3. Taylor polynomials. Integral Calculus. Applications.
4. Limits. Partial and directional derivatives. Composition of functions.
5. Maxima and minima. Lagrange multipliers.
6. Double integral. Application to centers of mass

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Theoretical-practical exams: • Mid term exams (1.5-hour long) (25%) • Final term exams (60%)	• Understanding of concepts • Application of concepts, techniques and procedures to problem solving • Analysis and interpretation of the results obtained in the resolution of problems • Presentation and written communication	85
Continuous performance evaluation: • Short continuous assessment tests	• Understanding of concepts • Application of concepts, techniques and procedures to problem solving • Analysis and interpretation of the results obtained in the resolution of problems • Presentation and written communication	10
Evaluation of the experimental wok: • Practice exam with MATLAB (one per semester)	• Understanding of concepts • Application of concepts, techniques and procedures to practice problem solving • Mastery in solving problems with the help of the computer and specific software • Analysis and interpretation of the results obtained in the problems solved with a computer	5

Grading

- The grade obtained in the partials/final exams must be at least 4 over 10 to take into account the previous ponderations of the overall assessment criteria. In other case, the term overall grade will be the grade obtained in the exam.
- The final second term exam will only cover the contents taught in the second term, if the first term overall grade is at least 4 over 10. In other case, it will cover all the contents of the course.
- The following conditions must be accomplished to pass the course:
    - If the first term overall grade was at least 4, then the second term overall grade must be at least 4 over 10 and the average of both overall grades (first and second terms) must be at least 5 over 10.
    - If the first term overall grade was less than 4, then the second term overall grade must be at least 5 over 10.

BIBLIOGRAPHY AND RESOURCES

Basic References

Textbooks:

- García, A., García, F., López, A., Rodríguez, G., Villa, A. de la. Calculo I: Teoría y problemas de análisis matemático en una variable (3ª edición). CLAG, 2007.
- García, A., López, A., Romero, S., Rodríguez, G., Villa, A. de la. Calculo II: Teoría y problemas de funciones de varias variables (2ª edición). CLAG, 2006.
- Stewart, J., Multivariable Calculus (7th edition). Cengage Learning. 2011,