ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA

DMA-GITI-102, DMA-GITT-102 Calculus

SEMESTER: Full-year (Fall and Spring)

CREDITS: 12 ECTS (4 hrs. per week)

LANGUAGE: Spanish

DEGREES: GITI, GITT

Course overview

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.

Prerequisites

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

Course contents

Theory:

Part I

0. Real and complex numbers. Elementary functions.
1. Limits and continuity. Definitions, properties and theorems.
2. Differentiation. The mean value theorem. 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 $\Gamma(p)$ and $\beta(p,q)$ 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.

Part II

6. Limits and continuity for vector and scalar valued functions.
7. Partial and directional derivatives. The gradient vector. Differentiability.
8. Composition of functions. Implicit and inverse functions.
9. Maxima and minima. Lagrange multipliers.
10. Multiple integrals: double and triple integrals. Definition and properties. Application to centers of mass and inertia moments.
11. Line integrals: definition and properties. The Green Theorem. Applications.
12. Surface integrals. Definitions and properties. The Stokes theorem. The Divergence theorem.

Laboratory:

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

P1. Introduction to the software *Matlab (MUPAD).*
P2. Interpolation methods. Applications.
P3. Taylor polynomials. Integral Calculus. Applications.
P4. Limits. Partial and directional derivatives. Composition of functions.
P5. Maxima and minima. Lagrange multipliers.
P6. Double integral. Application to centers of mass

Textbooks

- García, A., García, F., López, A., Rodríguez, G. and De la Villa, A. Cálculo I: Teoría y problemas de análisis matemático en una variable. 3ª edición. Ed. CLAGSA, 2007.
- García, A., López, A., Romero, S., Rodríguez, G. and De la Villa, A. Cálculo II: Teoría y problemas de funciones de varias variables. 2ª edición. Ed. CLAGSA, 2006.

Grading

The overall grade by term is obtained as follows:

- Final term exam 60%.
- Mid-term exam (1.5-hour long) 25%.
- Additional short-term exams (included a Lab term exam) 15%.
- 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.