Calculus I

Academic Year: (2023 / 2024) **Review date: 28-04-2023**

Department assigned to the subject: Mathematics Department

Coordinating teacher: GUTIERREZ DIEZ, RICARDO

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 1

Branch of knowledge: Engineering and Architecture

OBJECTIVES

The student should acquire the background in calculus needed to understand and apply concepts and techniques for the solution of problems arising in the different areas of aerospace engineering.
SPECIFIC LEARNING OBJECTIVES:
- To acquire the basic concepts related to real functions and their graphical representations.
- To understand the formal definition of limit and to learn how to compute indeterminate limits.
- To learn and apply the basic numerical root-finding methods.
- To understand the concepts of continuity and differentiation.
- To understand the Taylor expansion technique and its applications.
- To understand the concepts of local and global approximation of functions and to be able to solve interpolation problems.
- To understand the formal definition of integral and to learn basic integration techniques.
- To be able to apply integration methods to compute lengths, areas, and volumes.
- To understand the concept of ordinary differential equation and to know basic solution techniques for first order equations.
- To learn complex numbers and to be able to operate with complex numbers.

SPECIFIC ABILITIES:
- To be able to handle functions given in terms of a graphical, numerical or analytical description.
- To understand the concept of differentiation and its practical applications.
- To understand the concept of definite integral and its practical applications.
- To understand the relationship between integration and differentiation provided by the Fundamental Theorem of Calculus.

GENERAL ABILITIES:
- To understand the necessity of abstract thinking and formal mathematical proofs.
- To acquire communicative skills in mathematics.
- To acquire the ability to model real-world situations mathematically, with the aim of solving practical problems.
- To improve problem-solving skills.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction: sets, numbers, the real line, absolute value, intervals, mathematical induction.
2. Sequences: convergence, limits, indeterminate forms, introduction to series.
3. Functions, limits and continuity: elementary functions, algebraic operations and composition, inverse function, limits, continuity, intermediate value theorem.
4. Differentiation: derivative, algebraic operations and chain rule, Rolle's theorem, mean value theorem, L'Hôpital's rule, extrema, convexity, derivative of an inverse function, polynomial approximation, Taylor's theorem.
5. Integration: Riemann's integral, properties, fundamental theorem of calculus, integration by parts, changes of variables, improper integrals.
6. Series: series of non-negative terms, alternating series, absolute and conditional convergence, convergence tests, power series, radius of conergence, Taylor series.

LEARNING ACTIVITIES AND METHODOLOGY

Theory lectures (3 credits).
Problem-solving seminars (3 credits).

ASSESSMENT SYSTEM

We follow a continuous-assessment system plus a final exam:

- The continuous-assessment activities are two written examinations, to be held in regular class hours, counting 40% of the final grade (20% each). The first midterm exam will take place about two thirds into the course, while the second one will be held near the end of the course.

- The final exam (counting 60% of the final grade) will be held in the examination period at the end of the semester.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Michael Spivak Calculus, 3rd ed, Cambridge University Press, 1994
- Tom M. Apostol Calculus, Vol. 1, 2nd ed, John Wiley & Sons, 1967

ADDITIONAL BIBLIOGRAPHY

- J. Stewart Calculus, Thomson Brooks/Cole, 2009
- Juan de Burgos Román Cálculo Infinitesimal de una variable, McGraw-Hill, 1994
- R. Larson, R. Hostetler, B. Edwards Calculus, Houghton-Mifflin, 2006