# Calculus

**Academic Year: ( 2022 / 2023 )** **Review date: 15-07-2022**

**Department assigned to the subject: Department of Mathematics**

**Coordinating teacher: CIAGLIA , FLORIO MARIA**

**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 Robotics 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 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.

SPECIFIC ABILITIES:

- To be able to handle functions given in terms of a graphical, numerical or analytical description.
- To understand the concept of limits and continuity and their practical applications.
- 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. n-dimensional Euclidean space (n=1, n>1)
2. Sequences of real numbers. Numerical and powers series.
3. Elementary functions. Continuity.
4. Differentiability in one variable.
5. Differentiability of several variables: Partial derivatives, Jacobian matrix, chain rule, Taylor's Theorem.
6. Local extrema
7. Integration in one variable
8. Multiple integration

## LEARNING ACTIVITIES AND METHODOLOGY

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THEORETICAL-PRACTICAL CLASSES. [44 hours with 100% classroom instruction, 1.76 ECTS] Knowledge and concepts students must acquire. Students receive course notes and
will have basic reference texts to facilitate following the classes and carrying out follow-up work. Students partake in exercises to resolve practical problems and participate in workshops and evaluation tests, all geared towards acquiring the necessary capabilities.

TUTORING SESSIONS. [4 hours of tutoring with 100% on-site attendance, 0.16 ECTS] Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.

STUDENT INDIVIDUAL WORK OR GROUP WORK [98 hours with 0 % on-site, 3.92 ECTS]

FINAL EXAM. [4 hours with 100% on-site, 0.16 ECTS]
Global assessment of knowledge, skills, and capacities acquired throughout the course.

METHODOLOGIES

THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed while providing material and bibliography to complement student learning.

PRACTICAL CLASS. Resolution of practical cases and problems, posed by the teacher, and carried out individually or in a group.

TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with a teacher as a tutor.

## ASSESSMENT SYSTEM

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

- The continuous-assessment part consists of two written exams contributing with weight 40% to the final mark (20% + 20%). These exams
will be held in regular class hours, according to current regulations.

- The final exam (contributing with weight 60% to the final mark) will be held at the end of the semester.

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

## BASIC BIBLIOGRAPHY


- S. L. Salas, E. Hille, G. J. Etgen Calculus: One and several variables, Wiley (Tenth Edition), 2006
- J. A. Cuesta Calculus I, Creative Commons Attribution-NonCommercial 3.0 Unported License, (Sixth Edition) 2021
- J. E. Marsden, J. Tromba Vector Calculus, W. H. Freeman and Company (Sixth Edition), 2012


## ADDITIONAL BIBLIOGRAPHY


- J. Stewart Calculus. Single variable Calculus. Early trascendentals, Cengage Learning, 2015
- J. Stewart Multivariable Calculus, Cengage Learning, 2015