ACADEMIC PROGRAM

CALCULUS

B.F.A. IN **COMPUTER SCIENCE**

MODALITY: ON CAMPUS

ACADEMIC YEAR: 2022-2023

Name of the course:	Calculus
Degree :	Computer Science
Location:	Centro Universitario de Tecnología y Arte Digital
Area:	Science Fundamentals
Year:	2º
Teaching period:	2
Type:	B
ECTS credits:	6
Teaching modality:	On campus
Language:	English
Lecturer / Email	-
Web page:	http://www.u-tad.com/

SUBJECT DESCRIPTION

Area description

This subject is an integral part of the area of scientific fundamentals. This material provides the student with the mathematical base that enables them to acquire the degree of abstraction necessary to solve problems that arise in the world of software engineering.

Subject description

The objective of Calculus is to present the basic concepts of differential and integral calculus of a variable, both from a theoretical and computational point of view. Additionally, this subject allows the student to become familiar with the concepts of limits and continuity of functions, differentiation and integration, approximation of functions, sequences and series of real numbers.

COMPETENCIES AND LEARNING OUTCOMES

Competencies

BASIC AND GENERAL SKILLSs

CB1: Students demonstrate possession and understanding of knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge arising from the forefront of their field of study.

CB2: Students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are typically demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

CB3: Students have the ability to gather and interpret relevant data (normally within their area of study) in order to make judgments that include a reflection on relevant issues of a social, scientific or ethical nature.

CB4: Students can transmit information, ideas, problems and solutions to both a specialized and non-specialized audience.

CB5: Students will have developed those learning skills necessary to undertake further studies with a high degree of autonomy

CG3 - Knowledge of the scientific foundations applicable to the resolution of problems in the area of computer science

CG11 – The ability to search for, analyze and manage information in order to extract knowledge from it

SPECIFIC SKILLS

CE24 – The Ability to solve mathematical problems that arise in computer engineering based on the knowledge acquired in linear algebra, differential and integral calculus and statistics

CE28 - Knowledge of the basic concepts of discrete mathematics, logic, algorithms and computational complexity and its application in solving problems in computer engineering

TRASVERSAL SKILLS

CT4 – The ability to update the knowledge acquired in the management of digital tools and technologies according to the current state of the sector and the technologies used

Learning outcomes

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- To understand and apply common demonstration strategies in mathematics (reductio ab absurdum, induction¿)

- To know and apply common numbering sets habituales (N, Z, Q, R y C).

- To know the basics of set theory.

- Basics of combinatorics in enumeration problems.

- To solve linear equation systems.

- To handle vectors, points, matrices, coordinates, distances, angles, conics, quadrics, movements, transformations, straight lines and planes in space

- To handle vector spaces and vector subspaces and linear applications.

- To apply the relation of linear applications and matrices to know the properties of a linear application according to its matrix representation.

- To apply real numbers, polynomials and expressions of inequality, absolute values, etc.

- To handle sequences and series of real number and to study their convergence.

- To understand and work intuitively and geometrically with the ideas of limits, derivative and integral.

- To know and handle common single variable functions and to find their properties (growth, maxima, minima, inflection points, concavity, convexity) and plot them.

- To be able to use elementary integration techniques of single variable functions and compute lengths, areas and volumes applying integral calculus.

- To be able to use software for symbolic computation and plotting

- To describe analytically and geometrically datasets

- To compute probabilities

- To solve elementary problems of regression, estimation and hypothesis testing

- To be able to use statistical software

CONTENTS

Properties of real numbers

Sequences and series

Functions: continuity and derivability

Differential calculus and applications (maxima and minima)

Function interpolation

Integral calculus and applications

SUBJECT SYLLABUS

Topic 1. Real numbers. Real functions of real variable.

Real numbers. Intervals on the real number line.

The absolute value.

Inequalities.

Polynomial and rational functions.

Logarithmic and exponential functions.

Circular trigonometric functions and their inverses.

Hyperbolic functions and their inverses.

Transformations of functions.

Topic 2. Limits and continuity of functions.

Concept of limit of a function and fundamental theorems.

Lateral limits, infinite limits and limits at infinity.

Continuous function.

Types of discontinuity.

Continuity in sets.

Theorems of Bolzano, Darboux and Weierstrass.

Uniform continuity.

Topic 3. Calculation of derivatives.

Basic properties of derivatives.

Geometric interpretation.

Lateral derivatives.

Successive derivatives.

Rolle and mean value theorems.

L'Hôpital's rule.

Calculation of derivatives.

Growth and decrease of a function at a point.

Relative and absolute extremes.

Convexity and concavity.

Turning points.

Graphical representation of functions.

Topic 4. Interpolation of functions.

Approximation of functions using polynomials.

Taylor development.

Piecewise linear interpolation.

The Lagrange interpolating polynomial.

Interpolation error.

Topic 5. Calculus of integrals and applications.

Primitive of a function.

General integration methods. Elementary, rational, piecewise integrals, etc.

Mean integral value theorem.

Fundamental theorem of calculus.

Applications of integral calculus to the calculation of lengths, areas, volumes, surfaces of revolution, etc.

Topic 6. Sequences of real numbers.

Concept of sequence of real numbers.

Growth and delimitation of a succession.

Cauchy sequences.

Convergence.

Divergent sequences.

Properties and practical calculation of the limit of sequences.

Topic 7. Series of real numbers.

Concept of series of real numbers.

Character of a series. Convergence.

Operations with series.

Series of positive terms.

Alternating series.

Leibniz's theorem.

Series of arbitrary terms.

Abel's criterion.

Exact and approximate sum of series.

Topic8. Introduction to differential equations.

Ordinary differential equation. General and singular solutions.

Solution of first-order ordinary differential equations of separable variables and homogeneous equations.

Exact differential equations. Integrating factor.

TRAINING ACTIVITIES AND TEACHING METHODOLOGIES

TRAINING ACTIVITIES

LEARNING ACTIVITIES	Total hours	Hours of presence
Theoretical / Expository classes	30,00	30,00
Practical classes	24,00	24,00
Tutorials	4,00	2,00

Independent study and autonomous work of the student	57,50	0,00
Elaboration of work (group or individual)	28,50	0,00
Evaluation Activities	6,00	6,00
TOTAL	150	62

Teaching methodologies

Expository method or master lesson

Case learning

Learning based on problem solving

Cooperative or collaborative learning

inquiry learning

Flipped classroom methodology

Gamification

Expository method or master lesson

Case method

Learning based on problem solving

Cooperative or collaborative learning

inquiry learning

Flipped classroom methodology

Gamification

TEMPORAL DEVELOPMENT

DIDACTIC UNITS / TOPICS TIME PERIOD

Topic 1. Real numbers. Real functions of real variable Week 1

Topic 2. Limits and continuity of functions Weeks 2 and 3

Topic 3. Calculation of derivatives Weeks 4, 5 and 6

Topic 4. Interpolation of functions Weeks 7 and 8

Topic 6. Calculus of integrals and applications Weeks 9, 10 and 11

Topic 7. Sequences of real numbers Weeks 12 and 13

Topic 8. Series of real numbers Weeks 14 and 15

Topic 9: Introduction to differential equations Week 15

EVALUATION SYSTEM

ASSESSMENT SYSTEM	MINIMUM SCORE RESPECT TO THE FINAL ASSESSMENT (%)	MAXIMUM SCORE RESPECT TO THE FINAL ASSESSMENT (%)
Assessment of participation in class, exercises or projects of the course	0	30
Assessment of assignments, projects, reports, memos	30	60
Objective test	30	60

GRADING CRITERIA

ASSESSMENT SYSTEM	ORDINARY EVALUATION	EXTRAORDINARY EVALUATION
Assessment of participation in class, exercises or projects of the course	10	10
Assessment of assignments, projects, reports, memos	30	30
Objective test	60	60

General comments on the evaluations/assessments

The evaluation of participation in class, in practices or in projects of the subject will be carried out based on attendance and active participation in class and in the rest of the activities developed during the course. This aspect will represent 10% of the final grade for the subject in the ordinary call.

- Throughout the course, activities, exercises and problems will be proposed that must be delivered before the indicated date through the virtual platform. This work will be evaluated through the virtual platform itself and will account for 30% of the final grade for the subject in the ordinary call.

- In the middle of the semester, the first partial exam will be taken, which will be liberatory if the student so wishes, with the condition of obtaining at least a grade of 4.0 in said exam. Those students who do not pass this grade or who decide to voluntarily discard it must take separate exams corresponding to the two partial

exams on the date assigned for the ordinary June session. The two partial exams will represent 60% of the final grade in the ordinary call (30% each).

- To pass the subject in the ordinary call, it is essential that the final grade (including the partial exams, the problems and activities to be delivered and the participation) is at least 5.0 (out of 10). In addition to this requirement, it is necessary that the average of the partial exams be at least 5.0 (out of 10), where the grade of each partial exam must necessarily be greater than or equal to 4.0 (out of 10). If any of these requirements are not met, the subject will be automatically considered failed regardless of the rest of the grades.

- If the student does not pass the exam in June, the student may take the extraordinary exam in July, where he or she will take a final exam that will represent 100% of his or her grade in said exam, and in which he or she will be part of the subject required of the student, all the content of the subject seen in class (including the activities delivered through the virtual classroom).

- The use of notes or programmable scientific calculators is not allowed in the exams, for which the student must refer to the teacher's specific instructions on this topic.

- No grades of any kind will be kept between different academic years, nor between different calls.

LIST OF REFERENCES (BOOKS, PUBLICATIONS, WEBSITES):

Basic Bibliography:

- Domingo Pestana, José M. Rodríguez, Elena Romera, Eva Tourís, Venancio Álvarez and Ana Portilla. Practical course on Calculus and Precalculus. Third edition. Ed. Ariel Ciencia. ISBN-84-344-8030-1.

Recommended Bibliography:

- Emilio Tébar Flores. Infinitesimal calculus problems. Tébar Flores Editorial. ISBN 978-8473602068.

- José Ramón Franco Grañas. Introduction to Calculus. Problems and exercises solved. Pearson Education. ISBN-84-205-3676-8.

- Juan de Burgos Román. Derivatives and their applications: Definitions, theorems and results. García-Maroto Editores. ISBN-84-937-7805-7.

- Juan de Burgos Román. Limits and continuity. Definitions, theory and results. García-Maroto Editores. ISBN-84-937-7804-0. • Michael Spivak. Calculus. Reverté Editorial. ISBN: 978-84-291-5182-4.

- Pablo Martín, Jorge Álvarez, Amelia García. Calculation. Delta Publications ISBN-84-934034-1-5.

- Pilar Cembranos and José Mendoza. Limits and derivatives. University Base. Anaya. ISBN-84-667-3068-6.

- Pilar Cembranos and José Mendoza. Integral calculus. University Base. Anaya. ISBN-84-667-2615-3.

- Geogebra Manual: https://wiki.geogebra.org/en/Manual

REQUIRED MATERIALS, SOFTWARE AND TOOLS

Type of classroom

Theory classroom

Board and projection system

Materials:

Personal computer.

Notebook or tablet for taking notes

Software:

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