Course guide
300010 - CAL-T - Calculus

Last modified: 01/06/2023

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

PRIOR SKILLS

Ability in arithmetic calculations and in simplifying algebraic expressions.
Knowledge of the concept of function and of the graphic representation of a function.
Ability to think in abstract terms.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE 1 TELECOM. Students will acquire the ability to solve mathematical problems for engineering. An aptitude for applying knowledge of linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics and optimisation. (CIN/352/2009, BOE 20.2.2009)

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
4. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

In the theory lectures we will introduce the fundamental concepts of the subjet, and will present the basic exercise and problem solving techniques.

In the problems sessions, exercises and problems proposed a priori by the lecturer and autonomously prepared by the students will be dicussed and solved.

LEARNING OBJECTIVES OF THE SUBJECT

On completing the Calculus course, students should be able to:

- Sketch a graph of the main one variable elementary functions.
- Solve simple inequations.
- Operate with logarithms and exponentials.
- Interpret the concept of derivative of a function in physical and geometric terms.
- Calculate derivatives of functions.
- Approach and solve optimisation problems involving one variable functions.
- Compute Taylor polynomials and approximate its Lagrange remainder.
- Understand the geometrical meaning of gradient of a function of two variables.
- Identify conics and quadrics from their equations.
- Use several techniques for calculating primitives.
- Calculate the area of plane regions and the volume of some solids in space.
- Operate with binomial and exponential forms of complex numbers.
- Polynomial factoring, over the fiels of real numbers and complex numbers.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	26.00
Self study	84,0	56.00
Hours medium group	13,0	8.67
Guided activities	14,0	9.33

Total learning time: 150 h

CONTENTS

Content 1: Equations and graphics

Description:
1.1 Straight line: basic concepts, equations, properties.
1.2 Conics: introduction, parabola, circle, ellipse, hyperbola, identification of conics according to its equation.
1.3 Elementary functions: introduction, polynomial and rational functions, exponential and logarithmic functions, absolute value function, trigonometric functions and their inverses.

Related activities:
Test C1, Mid term exam and Final term exam.

Full-or-part-time: 26h 12m
Theory classes: 6h 36m
Practical classes: 2h 12m
Guided activities: 2h 24m
Self study : 15h

Content 2: Derivation of functions of one variable

Description:
2.1 Concept of derivative: definition, geometric interpretation, the derivative function.
2.2 Calculation of derivatives: properties of the derivative, high-order derivatives, the chain rule, derivative of the inverse function, implicit derivation, logarithmic derivation.
2.3 Tangent and normal straight lines.
2.4 The criterion of L'Hôpital.
2.5 Extrema of a function: absolute and relative extrema, increase and decrease of functions, determining relative extrema using the first derivative, concavity and convexity, determining relative extrema using the second derivative, criterion of the n-th derivative, absolute extrema on a closed interval, absolute extrema on a non closed interval.
2.6 Optimization problems.
2.7 Taylor polynomial.

Related activities:
Directed activity AD1, Mid term exam and Final term exam.

Full-or-part-time: 36h 12m
Theory classes: 9h 36m
Practical classes: 3h 12m
Guided activities: 3h 24m
Self study : 20h

Content 3: Integration of functions of one variable

Description:
3.1 Indefinite integral: primitive of a function, concept of indefinite integral, geometric interpretation, differential of a function, first properties of the indefinite integral.
3.2 Calculation of primitives: immediate integrals, linearity of the indefinite integral, almost immediate integrals, integration by parts, integration of rational functions, integration by change of variable, integration of trigonometric functions, integration of irrational functions.
3.3 Definite integral: definition, properties of the definite integral, the Fundamental Theorem of Calculus, Barrow's rule, change of variable in the definite integral.
3.4 Applications of the definite integral: calculation of areas of planar figures, calculation of volumes of solids of revolution.
3.5 Improper integrals.

Related activities:
Test C2 and Final term exam.

Full-or-part-time: 36h 12m
Theory classes: 9h 36m
Practical classes: 3h 12m
Guided activities: 3h 24m
Self study : 20h

Content 4: Functions of two variables

Description:
4.1 Functions of two variables: definition, contour lines, contour map, R^3 surfaces, sections, implicit equation of a surface, quadrics.
4.2 Derivation in two variables: slope of a curve on a surface, directional derivatives, partial derivatives, slope of a surface, tangent plane, normal line, tangent plane and normal line of an implicitly given surface, gradient of a function of two variables, properties of the gradient.

Related activities:
Final term exam.

Full-or-part-time: 25h 12m
Theory classes: 6h 36m
Practical classes: 2h 12m
Guided activities: 2h 24m
Self study : 14h

Content 5: Complex numbers

Description:
5.1 The imaginary unit.
5.2 Binomic form of a complex number: definition, operations in binomic form.
5.3 The complex plane.
5.4 Exponential form of a complex number: definition, operations in exponential form, trigonometric formulas.
5.5 n-th roots of a complex number.
5.6 Fundamental theorem of Algebra. Factoring polynomials

Related activities:
Test C1, Mid term exam and Final term exam.

Full-or-part-time: 26h 12m
Theory classes: 6h 36m
Practical classes: 2h 12m
Guided activities: 2h 24m
Self study : 15h

ACTIVITIES

Activity 1: Test C1

Description:
Test of Contents 5 and 1.

Full-or-part-time: 1h
Theory classes: 1h

Activity 2: Test C2

Description:
Test of Content 3.

Full-or-part-time: 1h
Theory classes: 1h

Activity 3: Directed activity AD1

Description:
Directed activity on using Taylor's polynomial to approximate functions.

Full-or-part-time: 1h 30m
Guided activities: 1h 30m

Activity 4: Mid term exam

Description:
Exam of Contents 1 and 2.

Full-or-part-time: 1h 30m
Guided activities: 1h 30m

Activity 5: Final term exam

Description:
Test of Contents 1, 2, 3, 4 and 5.

Full-or-part-time: 2h
Guided activities: 2h

GRADING SYSTEM

Defined at the subject's infoweb.

EXAMINATION RULES.

Tests are made during lecture sessions and are previously announced in ATENEA. The mid and final semester exams are made according to the EETAC's schedule.

Tests and exams are made individually. The use of books, notes, calculator, software and mobile phone is not allowed.

BIBLIOGRAPHY

Basic:
- Barrière, Lali. Fonaments matemàtics per a l'enginyeria de telecomunicació. Barcelona: Edicions UPC, 2007. ISBN 9788483019078.

Complementary:
- Ayres, Frank; Mendelson, Elliott; Abellanas, Lorenzo. Cálculo diferencial e integral. 3ª. Madrid: McGraw-Hill, 1991. ISBN 8476155603.
- Salas, Saturnino L.; Hille, Einar; Etgen, Garret J. Calculus : una y varias variables [on line]. 4ª. Barcelona [etc.]: Reverté, 2002 [Consultation: 26/07/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7713. ISBN 9788429151565.
- Larson, Ron; Hostetler, Robert P.; Edwards, Bruce H. Cálculo. Vol. 1, Cálculo con geometría analítica. 8a. Madrid [etc.]: McGraw-Hill, 2006. ISBN 9701052749.
- Larson, Ron; Hostetler, Robert P.; Edwards, Bruce H. Cálculo. Vol. 2, Cálculo 2 de varias variables. 8a. Madrid [etc.]: McGraw-Hill, 2006. ISBN 9701052757.

RESOURCES

Other resources:
- Course schedule with syllabus.
- Initial knowledge material.
- List of exercises (and answers) of the course.
- Sample models of exams and tests of previous courses.

All of them are available in ATENEA.