

Course guide

230001 - CAL - Calculus

Last modified: 25/05/2023

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

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Compulsory subject).

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

LECTURER

Coordinating lecturer: Consultar aquí / See here:
<https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura>

Others: Consultar aquí / See here:
<https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma>

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

12 CPE N1. They will be able to identify, formulate and solve engineering problems in the ICC field and will know how to develop a method for analysing and solving problems that is systematic, critical and creative.

TEACHING METHODOLOGY

Problem solving classes
On campus lessons
Individual work (no face to face lessons)
Short answer controls and homework
Final exam (long answer exam)

LEARNING OBJECTIVES OF THE SUBJECT

Achieving sufficient level of one variable Calculus to deal with, or to base the treatment of phenomena that can be described in these terms. Also support of parties other subjects that require mastery of real functions of one variable. Introduction to functions defined by series, the Laplace Transform and its use to solve elemental differential equations and system of differential equations.

Learning outcomes:

Clearly expresses the process of planning and problem solving, and problems that require the use of calculus of one variable.
Comprehend and dominates the most useful methods for solving problems in the field of one variable.
He/she is able to confront the equations and numerical description of problems with descriptive statement.
He/she uses more than one source, and uses it as complementary to observe the events described in the main text.
Identifies problems and models from open situations. Study alternatives for their resolution.

STUDY LOAD

Type	Hours	Percentage
Self study	85,0	56.67
Hours large group	65,0	43.33

Total learning time: 150 h

CONTENTS

Unit 1. Real numbers

Description:

Real numbers. Properties of numbers . Inequalities. Absolute value. Natural numbers and the principle of induction. Supreme, infimum and the field of real numbers. The real line . Intervals .

Full-or-part-time: 11h 30m

Theory classes: 5h

Self study : 6h 30m

Complex numbers

Description:

Definition and properties. Real and imaginary parts, magnitude and angle . Conjugate . Euler's formula . binomial representation, polar, exponential. Moivre's formula . Roots and Powers of complex numbers.

Full-or-part-time: 6h 54m

Theory classes: 3h

Self study : 3h 54m

Unit 3. Functions

Description:

Definition and first examples . Operations between functions. Domain and range . Intervals . Injective , exhaustive, function bijective and inverse function. Elementary functions. Polynomials and factoring TFA . Trigonometric , hyperbolic , exponential and logarithm . Function graphs.

Full-or-part-time: 16h 06m

Theory classes: 7h

Self study : 9h 06m

Unit 4. Function limits

Description:

Limit of a function at a point . infinite limits . limits at infinity. Properties of the limit , algebra of infinit limits. lateral limits . Uncertainties : infinite / infinite (rational functions) infinity - infinity (difference of roots or logarithms), 1^∞ (number e)

Full-or-part-time: 16h 06m

Theory classes: 7h

Self study : 9h 06m

Unit 5. Continuity

Description:

Continuous functions , definition and properties . Type of discontinuity . Bounds, maximum and minimum . Weierstrass theorem . Bolzano theorem . Mean value theorem .

Full-or-part-time: 9h 21m

Theory classes: 4h

Self study : 5h 21m

Unit 6. Differentiability

Description:

Derivative of a function at a point , derivative function . Tangent line . Derived of elementary functions. Properties of the derivative (Leibnitz chain rule , inverse function) . Rolle theorem . Mean value theorems . L' Hopital Theorem and application to computation of limits.
infinitesimals and infinits.

Full-or-part-time: 16h 06m

Theory classes: 7h

Self study : 9h 06m

Unit 7. Taylor polynomials

Description:

Contact order . Taylor polynomials of a function . Taylor residue . Taylor formula .
Taylor polynomials of elementary functions. Properties Taylor polynomials .
Applications: estimates , calculations of limits.

Full-or-part-time: 11h 30m

Theory classes: 5h

Self study : 6h 30m

Unit 8. Local study of functions

Description:

Increasing and decreasing. Local extrema . Concavity and convexity. Inflection points .
Characterization from the signs of the derivatives. Asymptotes . Graphs study of functions.

Full-or-part-time: 9h 12m

Theory classes: 4h

Self study : 5h 12m

Unit 9. Primitives

Description:

Definition. Calculation of immediate primitives, by parts and using change of variable. Calculation of rational primitives, trigonometric and irrational.

Full-or-part-time: 16h 06m

Theory classes: 7h

Self study : 9h 06m



Unit 10. Riemann's Integral

Description:

Definition of Riemann integral . Properties. Fundamental Theorem of Calculus . Applications of the definite integral

Full-or-part-time: 9h 12m

Theory classes: 4h

Self study : 5h 12m

Unit 11. Indefinite integrals.

Description:

Locally integrable functions . Improper integrals of the first kind . improper integrals the second kind . Convergence criteria. Absolute convergence . Euler gamma function.

Full-or-part-time: 9h 12m

Theory classes: 4h

Self study : 5h 12m

Unit 12. Series of numbers and power series

Description:

Sequences. Numerical series. Examples (geometric , harmonics) . Convergence criteria (comparison, root ratio , integral) . Alternating series . Absolute convergence . Power series . Radio and interval of convergence. Derivation and integration of functions defined by power series.
Taylor series .

Full-or-part-time: 13h 48m

Theory classes: 6h

Self study : 7h 48m

ACTIVITIES

FINAL EXAMEN

Description:

Final exam

Full-or-part-time: 3h

Theory classes: 3h

CONTROL

Description:

Short answer controls

Full-or-part-time: 3h

Theory classes: 3h

GRADING SYSTEM

Kind of exams to do and weight on the final evaluation:

Final exam: 60%

Continuous evaluation: 40%

On this subject will be evaluated the degree competences:

- Self-directed learning (Elementary level)
- Ability to identify, formulate and solve engineering problems (Elementary level)

EXAMINATION RULES.

The standard ones for this kind of controls

BIBLIOGRAPHY

Basic:

- Gracia, I.; Padró, C. Apunts de teoria per a l'assignatura de càlcul. (Atenea) [on line]. [Consultation: 13/05/2020]. Available on: <https://atenea.upc.edu/login/index.php>.
- Aguiló, F. [et al.]. Aprenentatge de càlcul [on line]. Barcelona: Edicions UPC, 2002 [Consultation: 28/04/2020]. Available on: <http://hdl.handle.net/2099.3/36227>. ISBN 8483016311.
- Aroca, Josep Maria. Càlcul infinitesimal: notes de classe [on line]. Barcelona: Departament de Matemàtica Aplicada IV, Universitat Politècnica de Catalunya, 2014 [Consultation: 23/10/2014]. Available on: <https://web.mat.upc.edu/josep.m.aroca/calcul/calcul-apunts-jmaroca.pdf>.
- Spivak, M. Calculus [on line]. 3a. ed. Barcelona: Reverte, 2012 [Consultation: 04/05/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8018. ISBN 9788429151824.

Complementary:

- Professors de l'assignatura. Col·lecció d'exercicis de càlcul. (Atenea) [on line]. 2009 [Consultation: 14/05/2020]. Available on: <https://atenea.upc.edu/login/index.php>.
- Baranenkov, G.; Demidovich, B. P. Problemas y ejercicios de análisis matemático. Madrid: Paraninfo, 1969. ISBN 8428300496.
- Spivak, M. Answer book for calculus. 3rd. ed. Publish or Perish, ISBN 9780914098904.