Last update: 06-05-2019

230450 - CAL1 - Calculus 1

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: PERE PASCUAL GAINZA

Others: MARTA VALÈNCIA GUITART

Degree competences to which the subject contributes

Specific:

1. Ability to solve math problems that may arise in engineering. Ability to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, ordinary and partial differential equations, probability and statistics.
2. Ability to select numerical and optimization methods suitable for solving physical and engineering problems. Ability to apply the knowledge of numerical algorithms and optimization.

Generical:

3. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:

1. 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.
2. 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

There will be two classes of sessions: the main lectures will be devoted to a careful presentation of the basic concepts and results of Calculus in one variable, developping complete proofs when possible, while the lab sessions will be devoted to the solution of a variety of exercises and problems.

Learning objectives of the subject

The main objective is that the student know the basic concepts, techniques and results from the Calculus of one variable in order to be able to apply them in other cientific contexts. Moreover, this course serves also as a basic background for future courses.

Study load

Total learning time: 150h	Hours large group:	65h	43.33%
	Self study:	85h	56.67%

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Content

1. Numbers and functions

Learning time: 10h 50m

Theory classes: 3h
Practical classes: 2h
Guided activities: 3h 20m
Self study : 2h 30m

Description:
Natural numbers: the induction principle. Integer and rational numbers:the arithmetic operations. Real numbers: order, absolute value. Sequences of real numbers, limit of a sequence. Complex numbers: the fundamental theorem of algebra.
Real functions of one variable. Domain of a function. The elementary function: polynomials, rational fractions, exponentials, trigonometric and hyperbolic functions.

2. Limits and continuity

Learning time: 10h 50m

Theory classes: 3h
Practical classes: 4h 30m
Guided activities: 1h 40m
Self study : 1h 40m

Description:
Limits, examples. Algebraic properties of limits. Infinit limits and limits at the infinite. One-sided limits. Continuous functions, examples. Bolzano's theorem and applications. Bisection method for zeros of continuous functions.

3. Derivaties and approximation of functions

Learning time: 46h 40m

Theory classes: 12h
Practical classes: 8h
Guided activities: 2h 30m
Self study : 24h 10m

Description:
Derivative of a function at a point, examples. The derivative function. Derivability and continuity. Derivatin rules, the chain rule. Derivation of implicit and inverses functions. Rolle's theorem and the mean value theorem. L'Hôpital rule. Taylor polynomial and its applications. Graphics.Optimization problems.

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4. Integration	Learning time: 45h 50m Theory classes: 12h Practical classes: 8h Guided activities: 2h 30m Self study : 23h 20m

Description:
Integral of a function. Intagrability of continuous functions. The Calculus fundamental theorem and Barrow's rule. Primitive calculus.Numerical integration: ntegració aproximada: Simpson's rule.Improper integrals. Convergence criteria. The Euler gamma function. . Applications of integral calculus: area, volues of revolution, lenght of a curve, center of mass, energy, work, moments of inertia, ...

5. Numerical series and power series	Learning time: 35h 50m Theory classes: 9h Practical classes: 6h Guided activities: 2h 30m Self study : 18h 20m

Description:
Sequences and series. The geometric series. Convergence for numerical series. Convergence criteria for positive and alternating series. Absolute convergence. The integral criterium.
Power series. Radious of convergence, function defined by a powwr series., its derivability and integrability.
Taylor series, examples: exponencial, trigonometric and binomial series.

Qualification system

There will be a final exam (EF) and a partial exam (EP). The students participation in practical sessions will also be taken into account (P). The final score will follow from

max(EF, 0.65*EF+0.30*EP+0.05*P)

Regulations for carrying out activities

The exams will consist a some theoretical questions and some exercices and problems.

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Bibliography

Basic:

Burgos, J. de. Cálculo infinitesimal de una variable. 2a ed. Madrid: MacGraw-Hill, 2007. ISBN 9788448156343.

Ortega, J.M. Introducció a l'anàlisi matemàtica. 2a ed. Bellaterra: Universitat Autònoma de Barcelona, 2002. ISBN 84-490-2271-1.

Spivak, M. Calculus. 3a ed. Barcelona: Reverté, 2012. ISBN 9788429151824.

Marsden, J.; Weinstein, A. Calculus. 2nd ed. New York: Sringer Verlag, 1986. ISBN 0387909745 (V.1); 0383909753 (V.2); 0387909850 (V.3).

Zill, D. Cálculo de una variable: trascendentes tempranas. 4a ed. Mexico: McGrawHill, 2011. ISBN 9786071505019.

Others resources: