Curricular Unit Form (FUC)

Course:	**FIRST CYCLE IN MECHANICAL ENGINEERING**					
Curricular Unit (UC)	**Mathematical Analysis I**			Mandatory	**X**	
				Optional		
Scientific Area:	**Basic Sciences**					
Year: **1º**	Semester: **1º**	ECTS:**7,0**		Total Hours: **6,0**		
Contact Hours:	T: **45,0**	TP:**45,0**	PL:	S:	OT:	TT:**90,0**
Professor in charge		Academic Degree /Title		Position		
Pedro Jorge da Silva Pereira		**Doutor**		**Professor Adjunto**		

T- Theoretical; TP – Theory and practice; PL – Laboratory; S – Seminar; OT –Tutorial; TT – Total of contact hours

Entry into Force	Semester: **Winter**	Academic Year: **2020/2021**

Objectives of the curricular unit and competences (max. 1000 characters)

1. Upon approval, the student should be able to:
2. Understand and use the concepts of differential calculus needed to the study of real functions of one real variable.
3. Know how to use the integration methods.
4. Understand and apply the notions of integral calculus and, in particular, the fundamental theorem of Calculus.
5. Know how to use series tests and obtain power series expansions of some functions.
6. Develop reflection, computing and deductive reasoning skills. To develop analytical and critical capacity.

Syllabus (max. 1000 characters)

Basics on functions.
Review of operations in IR. Complex numbers. Basic properties of functions. Library of functions: polynomials, rational fractions, powers, trigonometric, exponential, logarithmic and hyperbolic functions.
Sequences. Limits and continuity.
Numerical sequences. Topological concepts. Notion of continuous function. Properties.
Differential calculus in IR.
Concept of derivative. Derivation rules. Lagrange's Theorem. Local extrema. Optimization. Taylor's formula. Concavities. Cauchy's rule. Indeterminate forms.
Infinite series.
Convergence tests. Power series. Taylor series. Power series expansion. Complex exponential.
Primitives and Integral calculus on IR.
Concept of integral. Integrable functions. Properties of the definite integral. Mean theorem. Indefinite integral. Properties. Fundamental theorem of calculus. Barrow's rule. Calculation of integrals. Improper integrals.
Applications to engineering.

Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)
The objectives are met within the program content of the given chapters, which widely developed skills of analysis, calculus and deductive reasoning. In addition to the applications studied in each chapter, the systematic use of applied problems in context translates into greater motivation, effectiveness and the learning spectrum, since they: • convey the fact that the differential and integral calculus on IR is an indispensable tool in the study of Engineering; • practice the mathematical formulation of problems, their resolution and criticism; • allow a direct experience in the mathematical formalization of problems and their resolution, making conjectures, constructing algorithms, evaluates them, modify them and interpret the results obtained for modifications; • facilitate the students still in a very early stage of their higher education, recognition of the concepts and techniques studied when they have to resort following their studies.

Teaching methodologies (including evaluation) (max. 1000 characters)
Theoretical and practical lectures with exposition of the related subjects followed by illustrative examples and problems solving. **Continuous assessment:** Two partial written examinations. The student is approved with an average grade of at least 10 values and with a minimum grade of 8 values at each partial examination. **Summative assessment:** The summative assessment is obtained considering one of the three final exams: one on the 1st date, another on a 2nd date and a third on a special date. The student is approved with a final grade of at least 10 values.

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
Lectures are essential to a correct and comprehensive coverage of all topics of the syllabus, while in-class solution of exercises allows for a successful application of the theoretical knowledge to practical problems. By their organization, contents and diversity in the degree of difficulty, the exercises sheets provided allow students to closely monitor all topics of the syllabus and are the main tool regarding individual study. The exercises that constitute them are suited for the development of algebra skills and deductive reasoning.

Main Bibliography (max. 1000 characters)

1. Guerreiro, J. Santos, *Curso de Análise Matemática*, Escolar, 2ª ed., (2007);
2. C. Sarrico, *Análise Matemática. Leituras e exercícios*, Gradiva, (2005);
3. J. Campos Ferreira, *Introdução à Análise Matemática*, Fundação Calouste Gulbenkian, Lisboa (1987);
4. Deborah Hughes-Hallett et al., "Calculus: Single Variable", Fifth Edition, Wiley, 2008.
5. Jerrold Marsden and Alan Weinstein, "Calculus I", Second Edition, Springer, 1985.
6. Jerrold Marsden and Alan Weinstein, "Calculus II", Second Edition, Springer, 1985.
7. Phillip Kent, Phil Ramsden, John Wood, "Experiments in Undergraduate Mathematics – A Mathematica-Based Approach", Imperial College Press, 1996.
8. George Bluman, Problem Book for First Year Calculus, Springer, 1984
9. H. Jerome Keisler, "Elementary Calculus: An Infinitesimal Approach", On-line Edition, 2012. Disponível em: http://www.math.wisc.edu/~keisler/calc.html.