Curricular Unit Form (FUC)

Course:	**FIRST CYCLE IN MECHANICAL ENGINEERING**					
Curricular Unit (UC)	**Numerical Methods**			Mandatory	**X**	
				Optional		
Scientific Area:	**Basic Sciences**					
Year: **2º**	Semester: **1º**	ECTS:**4,5**		Total Hours: **3,0**		
Contact Hours:	T: **22,5**	TP:**22,5**	PL:	S:	OT:	TT:**45,0**
Professor in charge		Academic Degree /Title		Position		
Tiago Charters de Azevedo		**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: **2010/2011**

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

Given the approval on the unit, one should be able to:

1. Understant the aproximation tecnics ; explain how, why and when they should work.
2. Identify tipical problemes where these thecnics can be applied.
3. Understand how does the roundoff errors propagate.
4. Implement computer programs for each of the numerical methods.

Syllabus (max. 1000 characters)

Introduction

Numerical methods in engineering.

Computer arithmetic and errors

Floating point arithmetic and roundoff errors. Error propagation.

Non-linear equations

Roots and zeros. Zero location, Iteration and convergence.

Methods: bisection, fixed point iteration, Newton-Rapson (IR and Irn), *regula falsi* method and secant.

Linear system of equations

Conditioning. Direct methods: Gauss. Iterative methods: Jacobi, Gauss-Seidel.

Polynomial interpolation

Existence and unicness (Vandermonde). Lagrange and Newton formula. Inverse interpolation.

Least square approximation

Discrete case: linear and non-linear. Continuos case.

Numerical integration

Trapezoidal, Simpson and 3/8's rule: simple and composite. Gaussian quadrature

Initial-value problems for ordinary differential equations

Euler's method. Higher-order Taylor methods. Runge-Kutta methods.

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 chapters in which widely developed skills of analysis, calculus and deductive reasoning and computational modeling.
In addition to the applications studied in the last chapter, the systematic use of applied problems, computational and contextual translates into greater motivation, effectiveness and the learning spectrum, since they enable:

- transmitting numerical methods that are an essential tool in the study of engineering;
- practice the mathematical formulation of problems, their resolution and criticism;
- facilitate to students, which are still in a very early stage of their higher education, the recognition of the importance of the concepts and techniques studied when they have to resort to them in the following studies.

Teaching methodologies (including evaluation) (max. 1000 characters)

Lectures based on application examples with theoretical, practical and computational exercises and problem solving. Special emphasis is given to issues that connect with the tools and concepts developed in latter engineering syllabus, lecture notes and exercises are also available are for effective monitoring and strengthen the knowledge presented.

The assessment on this unit complies of two ways: continuous assessment (assessment during the whole semester) and sumative assessment (final exams).

Continuous assessment:

Two written tests during the semester (75% totoal grade), or a final test (75% totoal grade) and a series of practical problems to be solved during the semester (25% totoal grade). It is possible to repeat the test on the normal exam season.

Summative assessment:

The summative assessment complies a final exam: Normal exam season (1st Season), 2nd exam season or special exam season.

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
Given that success in mathematics is not compatible with pre-assessment study on its own, it is essential to implement processes to avoid this inclination. The use of group work or summative tests requires students to closely monitor the progress of the syllabus. The considerable weight of this component in the final grade is due to the two-fold intention of not being easily neglected and to reward the student for his or her effort. (In addition, significant higher attendance rates have been observed, since students feel some concern about wasting the effort that has already been developed.) When confronted with less straightforward problems, students are led to question and deepen their knowledge while acquiring work and independence skills. This type of problems is also the most suitable for the development of analysis, reflection and criticism skills. By their organization, content 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 and computational skills and deductive reasoning.

Main Bibliography (max. 1000 characters)
1. Quarteroni, A., Saleri, F., *Calculo Cientifico Com MATLAB E Octave*, Springer Texts in Computational Science and Engineering, 2007 2. R. L. Burden, and J. D. Faires, *Numerical Analysis*, Books/Cole, 1997 3. H. Pina, *Métodos Numéricos*, Mc Graw-Hill, 1995