ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

DEC
ÁREA DEPARTAMENTAL DE ENGENHARIA CIVIL

Course file

Study cycle	BACHELOR IN CIVIL ENGINEERING		
Course	MATHEMATICAL METHODS TO CIVIL ENGINEERING	Mandatory	☒
		Optional	☐
Course scientific area	CIVIL ENGINEERING	Category	B

Course category: B - Basic; C - Core Engineering; E - Specialization; P - Complementary.

Year: 2nd	Semester: 3rd		ECTS: 5,5		Total: 148
Contact time	T:	TP: 45	PL: 22,5	S:	OT:

T - Lectures; TP - Theory and practice; PL - Lab Work; S - Seminar; OT - Tutorial Guidance.

Course Director	**Title**	**Position**
Luís Manuel Ferreira da Silva	Doutor	Professor Coordenador

Learning objectives (knowledge, skills and competences to be developed by students)

(max. 1000 characters)

1-Modeling in continuous time

2-Solve e.d.o. 's

3-Drafting slope fields

4-Analyze linear systems of e.d.o.'s

5-Study harmonic oscillators

6-To identify resonance phenomenon

7-Calculate Laplace transforms and their inverse

8-Study nonlinear systems of e.d.o.'s

9-Determine Fourier series of periodic functions

10-Approaching periodic functions through the Fourier partial sums and calculate the respective error

11-To introduce mathematical software tools, like Matlab, Maxima or another.

12-Implementing numerical methods for solving nonlinear systems

13-Implementing numerical methods for function approximation

14-Implementing numerical methods for solving differential equations

15-Develop a structured thinking and demonstrate analytical and critical skills in problem solving in engineering

Syllabus

(max. 1000 characters)

TP:

1 - 1st Order Ordinary Differential Equations

2 - Systems of Linear Differential Equations

3-Harmonic Oscillator

4 - External forces and resonance

5 - Laplace transforms

6 - Nonlinear systems (linearization and limit cycles)

7 - Fourier Analysis

PL:

1-Iterative Methods for non-linear equations and systems

2-Approximation and interpolation functions

3-Numerical Methods for o.d.e's

Demonstration of the consistency between the syllabus and the course objectives

(max. 1000 characters)

Objs. 1,2,3: Secs. 1,3,4,5 TP, 3 PL; objs. 4,5,6,8: Secs. 2, 3, 4, 5, 6 TP, 3 PL; obj. 7: Sec. 5 TP; objs. 9, 10: Sec. 7 TP, 2 PL; objs. 11, 12, 13, 14: Secs. 1, 2, 3 PL; obj. 15: transversal.

Teaching methodology (evaluation included)

(max. 1000 characters)

The TP component, consists of theoretical and practical lessons, where we present the theory behind the techniques used, choosing carefully the statements to demonstrate and illustrating with examples, preferably of applications to engineering. Next, we present exercises, supporting students in their resolution. The assessment of this component is classic: with the realization of two mid term exams, yielding the final grade as their arithmetic mean; alternatively students can make a final exam in two alternative dates. Grades less than 8 are not considered and one of the mid term exams can be repeated in the first date of final exam.

The PL component consists in the presentation and implementation of numerical methods, as well as introduction to mathematical software, using, whenever possible, the models of Civil Engineering. The assessment of this component is done through one or more practical works.

The final grade is obtained using the formula 0.75*TP + 0.25*PL.

Demonstration of the consistency between teaching methodology and the course learning objectives

(max. 3000 characters)

The overall goals of a discipline of applied mathematics to engineering, are ,given the usual constraints of time available and level of prior knowledge by the students, to introduce students, in a theoretically solid way, to the main mathematical techniques used in the specific area of engineering concerned, with obvious focus on the respective applications. These objectives are achieved in the methodology used, and the application c to Civil Engineering, is enhanced by the Lab component, usually taught by a Civil Engineer.

Main Bibliography

(max. 1000 characters)

T. M. Apostol, Calculus, Vol. II, Second Edition, Wiley.

P. Blanchard, R. L.Devaney, G. R. Hall, Differential Equations, Brooks/Cole (1997).

R. L. Devanney, An Introduction to Chaotic Dynamical Systems, Benjamin/Cummings (1986).

D. W. Jordan and P. Smith, Mathematical Techniques, Oxford University Press

E. Kreyszig, Advanced Engineering Mathematics, Wiley.

L. Silva, Lecture Notes to the discipline: Matemática Aplicada à Engenharia Civil, available in Moodle

F. Verhulst Nonlinear Differential Equations and Dynamical Systems, Springer (1990).

S. Oliveira, Matemática Aplicada à Engenharia Civil, Lecture Notes to the Lab classes of the discipline, available in Moodle

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