Course Unit	Applied Mathematics			Field of study	Mathematics		
Master in	Industrial Engineering - Mechanical Engineering			School	School of Technology and Management		
Academic Year	2020/2021	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9572-356-1102-00-20		

Workload (hours)	162	Contact hours	T -	TP 40	PL 20	TC -	S -	E -	OT -	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tuturial; O - Other

Name(s) of lecturer(s): Ana Isabel Pinheiro Nunes Pereira

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Use mathematical tools to solve problems numerically.
2. Solve numerically ordinary differential equations and partial differential equations.
3. Solve numerically optimization problems with and without constraints.

Prerequisites

Before the course unit the learner is expected to be able to:
Have knowledge in the area of Numerical Analysis.

Course contents

An introduction to Optimization. Unconstrained Optimization. Constrained Optimization. Ordinary Differential Equations. Partial Differential Equations.

Course contents (extended version)

1. Optimization Theory
   - Basic definitions of optimization theory. Optimality conditions.
   - Global and local optimization.
2. Unconstrained Optimization
   - Line search methods. Newton and Quasi-Newton methods.
   - Nelder–Mead method.
3. Constrained Optimization
   - Penalty method and it's variants.
   - Sequential quadratic programming method.
4. Ordinary Differential Equations
   - Euler and modified Euler method.
   - Runge-Kutta Method and it´s variants.
5. Partial Differential Equations
   - Finite element method.

Recommended reading

1. Burden, R. and Faires, J. “Numerical Analysis”, 7th ed. , Brooks/Cole, 1997.
2. Nocedal, J. and Wright S. , "Numerical Optimization", Springer, 1999.
3. Mathews, J. and Fink, K. , "Numerical Methods Using Matlab", Prentice Hall, 1999.
4. Hoffman, J. , "Numerical Methods for Engineers and Scientists", Marcel Dekker, 2001.
5. Pereira, A. "Apontamentos de Matemática Aplicada", IPB, 2015.

Teaching and learning methods

Topics will be presented and explored in class. There will be individual and group sessions outside class to accompany the student's work. The classes will be in informatics rooms using mathematical software (Matlab/Octave, Mathematica/Maple).

Assessment methods

1. Continuous Evaluation - (Regular, Student Worker) (Final, Supplementary)
   - Practical Work - 70%
   - Final Written Exam - 30%
2. Final Exam - (Regular, Student Worker) (Special)
   - Final Written Exam - 100%

Language of instruction

1. Portuguese
2. English

Electronic validation

Ana Isabel Pinheiro Nunes Pereira	Joao Paulo Pais de Almeida	José Alexandre de Carvalho Gonçalves	Paulo Alexandre Vara Alves
30-10-2020	30-10-2020	30-10-2020	02-11-2020