

Course Unit	Applied Mathematics	Field of study	Mathematics
Master in	Industrial Engineering - Mechanical Engineering	School	School of Technology and Management
Academic Year	2022/2023	Year of study	1
Type	Semestral	Semester	1
Workload (hours)	162	Contact hours	T - , TP 40 PL 20 TC - S - E - OT - O -
		Level	2-1
		ECTS credits	6.0
		Code	9572-356-1102-00-22

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; 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 its variants.
  - Sequential quadratic programming method.
4. Ordinary Differential Equations
  - Euler and modified Euler method.
  - Runge-Kutta Method and its 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 - 80% (The presentation is mandatory and compliance with deadlines has a weight of 10%).
  - Final Written Exam - 20%
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	Carla Sofia Veiga Fernandes	José Alexandre de Carvalho Gonçalves	Paulo Alexandre Vara Alves
02-10-2022	03-10-2022	04-10-2022	05-11-2022