

Course Unit	Applied Mathematics	Field of study	Mathematics
Master in	Chemical Engineering	School	School of Technology and Management
Academic Year	2025/2026	Year of study	1
Type	Semestral	Semester	1
Workload (hours)	162	Contact hours	T - TP - PL 60 TC - S - E - OT - O -
		Level	2-1
		ECTS credits	6.0
		Code	6362-756-1104-00-25

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.
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. Data Analysis Applications. Ordinary 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.
 - Data analysis applications
3. Constrained Optimization
 - Penalty method and it's variants.
 - Sequential quadratic programming method.
 - Data analysis applications
4. Ordinary Differential Equations
 - Euler and modified Euler method.
 - Runge-Kutta Method and it's variants.

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/Python). Equality, Equity, Diversity and Inclusion strategies will be considered in the classroom context.

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	Simão Pedro de Almeida Pinho	José Carlos Rufino Amaro
13-10-2025	15-10-2025	04-11-2025	11-11-2025