

Mathematics

Introducing

Description

Part: Mathematical Concepts (Lectures = 17.5h / Tutorials = 17.5h)

- 1.Generalized integrals and series (2 Lectures / 2 Tutorials)
- 2.Norms 1, 2, and infinity in finite and infinite dimensions (1.5 Lectures / 1 Tutorial)
- 3..Scalar product, Cauchy-Schwarz inequality, and Pythagoras (1.5 Lectures / 1 Tutorial)
- 4.Vector orthogonality, decomposition on orthogonal bases (1 Lecture / 2 Tutorials)
- 5.Special matrices: symmetric, projection, and isometries (1.5 Lectures / 2 Tutorials)
- 6.Continuity and differentiability of multivariable functions (2 Lectures / 3 Tutorials)
- 7.Multiple integration (3 Lectures / 3 Tutorials)
- 8.Hessian matrix and optimization (1.5 Lectures / 0 Tutorials)

Part: Numerical Analysis (Lectures = 7.5h / Tutorials = 7.5h / Lab Work = 17.5h)

- 0.Introduction to Python and numerical analysis (1 Lab Session)
- 1.Numerical integration (Rectangle, trapezoid, and Simpson methods) (1 Lecture / 1 Tutorial / 1 Lab Session)
- 2.Norms and conditioning (Induced norms and the impact of conditioning) (1 Lecture / 1 Tutorial / 1 Lab Session)
- 3.Direct resolution of linear systems (Gaussian elimination and LU decomposition) (1 Lecture / 1 Tutorial / 1 Lab Session)
- 4.Solving nonlinear equations (Bisection, Newton's method, and fixed-point iteration) (1 Lecture / 1 Tutorial / 1 Lab Session)
- 5.Polynomial interpolation (Vandermonde matrices and

the Runge phenomenon) (1 Lecture / 1 Tutorial / 1 Lab Session)

6.Least squares method (Normal equations) (1 Lecture / 1 Tutorial / 1 Lab Session)

Part: Probability and Statistics (Lectures = 13.75h / Tutorials = 13.75h / Lab Work = 2.5h)

- 1.Events, probabilities, conditioning, independence
- 2.Random variables, probability distributions, discrete variables
- 3.Continuous random variables, random vectors
- 4.Statistical inference: point estimation, confidence intervals, and hypothesis testing

Objectives

This Teaching Unit (UE) aims to master the essential concepts and foundational knowledge in mathematics for engineers in Civil Engineering or Mechanical Engineering. The UE is divided into three components with complementary objectives:

- 1.Mathematical Concepts: Master essential mathematical tools for Civil or Mechanical Engineering.
- 2.Numerical Analysis: Implement efficient algorithms using Python and analyze their convergence.
- 3.Probability and Statistics: Understand and apply probabilistic and statistical modeling.

Necessary prerequisites

First-year Mathematics course. Note that the different sections are not independent, and tools introduced in one part may be used in others.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

 Toulouse