GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2025-2026

Mathematical Modelling in Engineering (C003788)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 1)	Dutch	Gent	lecture
			seminar

Lecturers in academic year 2025-2026

Van Acoleyen, Karel	WE05	lecturer-in-charge

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Bachelor of Science in Computer Science	6	A

Teaching languages

Dutch

Keywords

Basic mathematical concepts, mathematical models for engineering applications, differential equations, integral transforms, vector calculus

Position of the course

Mathematics and mathematical models play a crucial role in engineering science. They allow for a quantitative approach and form the foundation for technological innovation.
This course has a twofold aim: (1) to train the students in the basic mathematical tools used in engineering; (2) to train students in constructing mathematical models.
As such, we choose to focus on the following important topics:
1.Linear Algebra
2. Ordinary and partial differential equations
3. Signal transforms and operations
4. Vector calculus
Geometrical and computational skills will also be further developed.

Contents

Linear algebra
Recap basic concepts: matrices and determinants
Linear operators: eigenvalues and eigenvectors, Jordan normal form, symmetrice and unitary matrices
Applications: least squares method, linear systems of differential equations (normal modes), linear iterative processes (e.g. Markov process, fixed-point analysis) discrete Fourier transform as unitary transformation, O(3) transformations with quaternions
Calculus with multiple variables
Partial derivatives: chain rule, coordinatetransformation, gradient, Taylor series.
Multiple integrals: Jacobian determinant, special coordinate systems
Vector calculus
Vectors: scalar product, vector product, mixed product. Vector analysis: nabla operator (gradient, divergence, curl), Laplace-operator, scalar and vector fields, line- surface- and volume-integrals, theorems of Green, Gauss and Stokes, continuity equation
Differential equations
Linear ordinary differential equations: solution strategies, initial value problems,

Sturm-Liouville boundary value problems
Partial differential equations: heat equation, wave equation, Laplace equation,
Fourier series, Fourier method
Integral transforms
Fourier transform
Laplace transform

Initial competences

This course uses the content taught in Calculus, Linear Algebra and Geometry, and Scientific Computing.

Final competences

1 To expand functions in Fourier or Taylor series.
2 To perform integral transforms.
3 To solve standard types of ordinary and partial differential equations.
4 To interpret and evaluate multiple integrals.
5 To gain insight in the mathematical and physical meaning of scalar and vector potential, nabla operator, curl-free and divergence-free fields, conservative and solenoidal fields and their links.
6 To gain insight in the mathematical and physical meaning of line and surface integrals and the theorems of Green, Gauss and Stokes.
7 To evaluate line and surface integrals directly as well as using theoretical results.
8 To model and compute mathematical models for problems in engineering.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture, Independent work

Extra information on the teaching methods

Study material

Type: Syllabus

Name: Mathematical modelling for engineering science
Indicative price: Free or paid by faculty
Optional: no
Language : Dutch
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

-Mathematical methods for Physics and Engineering, Riley, Hobson, Bence, Cambridge University Press, ISBN 9781139164979

Course content-related study coaching

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment open-book

Examination methods in case of periodic assessment during the second examination period

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Exercises (some of theoretical nature) with use of Maple. A list of useful formula and a Maple helpfile will be provided.

Calculation of the examination mark

written exam: 100%