GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Computational Fluid Dynamics (E045280)

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

Credits 3.0 **Study time 90 h**

Course offerings in academic year 2025-2026

A (semester 1)	English	Gent
B (semester 1)	Dutch	Gent

Lecturers in academic year 2025-2026

Degroote, Joris	TW08	lecturer-in-charge
Haas, Thomas	TW08	co-lecturer

Offered in the following programmes in 2025-2026	crdts	offering
Bridging Programme Master of Science in Engineering: Ships and Marine Technology	3	A
International Master of Science in Advanced Design of Sustainable Ships and Offshore Structures	3	A
Master of Science in Engineering: Ships and Marine Technology	3	B
Master of Science in Engineering: Ships and Marine Technology	3	A

Teaching languages

English

Keywords

CFD

Position of the course

A fundamental introduction to the computational techniques in fluid mechanics for engineering students.

Contents

- Flow equations: mathematical character of convection-diffusion equations
- Finite volume methods for convection-diffusion equations: steady state diffusion, steady state convection-diffusion, central and upwind discretisation, quadratic upwind discretisation, non-linear upwind discretisation: TVD-schemes
- Unsteady flows: implicit and explicit time stepping schemes, stability analysis
- Turbulence models for viscous flows: Reynolds averaging, eddy viscosity, two-equation eddy viscosity models, RSM, LES, DNS, transition models
- Grid generation and spatial discretisation: structured and unstructured grids, cell-centred and vertex-based finite volume methods
- Solution methods for systems of equations: direct methods, iterative methods, multigrid formulation, pressure-velocity coupling, momentum interpolation, pressure correction algorithms

Exercise with a commercial CFD package:

- Calculate mixing of a cold and hot flow in a tube
- Compare discretisation schemes in a cavity
- Calculate the oscillating wake of a cylinder in cross flow
- Compare turbulence models for a dump diffusion

Initial competences

Transport phenomena, Heat and flow engineering

Final competences

1 Describe selected techniques in computational fluid dynamics
2 Select appropriate numerical techniques and settings for a flow problem

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

lecture, seminar: practical PC room classes, independent work

Study material

Type: Handbook

Name: Book
Indicative price: Free or paid by faculty
Optional: no

Type: Slides

Name: Slides
Indicative price: Free or paid by faculty
Optional: no

Type: Other

Name: Tutorials
Indicative price: Free or paid by faculty
Optional: no

References

An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H. Versteeg and W. Malalasekra,

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 with multiple-choice questions, Written assessment with open-ended questions

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

Written assessment with multiple-choice questions, Written assessment with open-ended questions

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Periodic (end-of-term) evaluation: written examination with open questions and with multiple choice questions (closed book).

Calculation of the examination mark