GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2016-2017

Modelling of Turbulence and Combustion (E045930)

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

Credits 3.0 **Study time 90 h** **Contact hrs** 15.0 h

Course offerings and teaching methods in academic year 2017-2018

A (semester 1)	lecture	15.0 h
B (semester 1)	lecture	15.0 h

Lecturers in academic year 2017-2018

Merci, Bart	TW03	lecturer-in-charge

Offered in the following programmes in 2017-2018	crdts	offering
Bridging Programme Master of Science in Fire Safety Engineering	3	A
Master of Science in Electromechanical Engineering (main subject Control Engineering and Automation)	3	A
Master of Science in Electromechanical Engineering (main subject Electrical Power Engineering)	3	A
Master of Science in Electromechanical Engineering (main subject Maritime Engineering)	3	A
Master of Science in Electromechanical Engineering (main subject Mechanical Construction)	3	A
Master of Science in Electromechanical Engineering (main subject Mechanical Energy Engineering)	3	A
International Master of Science in Fire Safety Engineering	3	A
Master of Science in Fire Safety Engineering	3	A

Teaching languages

English

Keywords

Key words: turbulence, combustion, modelling, phenomenology

Position of the course

This course is optional. It aims at all engineering students who get in contact with numerical simulations of turbulent flows, with or without chemical reaction (in particular combustion).

Contents

- The phenomenon turbulence: Examples of turbulent flows, Properties of turbulence
- Equations of fluid motion: Continuity equation, Momentum equations, Transport equations for a conserved passive scalar
- Statistical description of turbulent flows: The random nature of turbulence, Random variables, Averaging, Random processes and fields
- Mean-flow equations: Reynolds equations, Reynolds stresses, Mean conserved passive scalar equation
- Scales of turbulent motion: Kolmogorov hypotheses and energy cascade, Energy spectrum
- Turbulent flows: Free shear flows, Wall flows
- Turbulence modelling: Introduction, Direct numerical simulation (DNS), Large-Eddy Simulations (LES), Turbulent-viscosity models, Reynolds stress models (RSM)
- Turbulent combustion: Transport equations for species and enthalpy, Scales in turbulent combustion, Combustion types and regimes
- Non-premixed turbulent combustion: Examples, Mixture fraction, Combustion models, Turbulence - chemistry interaction
- Premixed turbulent combustion: Examples, Burning velocity, Regimes, Bray-Moss-

Libby model (BML), Other models

Initial competences

This course builds on certain end competences of the course 'Transport phenomena'.

Final competences

1 Explain the phenomenology of turbulence
2 Discuss properties of turbulence models (turbulent viscosity, k-epsilon model, LES) and combustion models
3 Read literature in the domain of turbulent combustion in a critical manner
4 Talk about field of specialisation, also in English

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

Lecture

Extra information on the teaching methods

The theory is taught as hearing classes. The students must read a scientific journal paper on turbulent combustion, on which they are tested during the exam.

Learning materials and price

Syllabus (Dutch) and slides(English)

References

- S. B. Pope, 'Turbulent Flows', Cambridge University Press (2000).
- N. Peters, 'Turbulent Combustion', Cambridge University Press (2000).
- H. Tennekes and J.L. Lumley, 'A First Course in Turbulence', The MIT Press (1972).
- F. Nieuwstadt, 'Turbulentie', Epsilon Uitgaven (1998).
- T. Poinsot and D. Veynante, 'Theoretical and Numerical Combustion', Edwards (2001).
- K. Kuo, 'Principles of Combustion', John Wiley & Sons (1986).

Course content-related study coaching

In person: after agreement on date, fix contact hour: immediatelt before and after hearing classes.

Evaluation methods

end-of-term evaluation

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

Open book examination, oral examination

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

Open book examination, oral examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Oral exam, starting from a scientific journal article on turbulent combustion the student has to read. From there onwards, global overview questions and more specific detailed questions are asked on turbulent combustion. The exam is open book.

Calculation of the examination mark

The score is determined on the oral exam.