GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Thermodynamics, Heat and Mass Transfer (E039160)

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

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2024-2025

A (semester 1)	English	Gent

Lecturers in academic year 2024-2025

Maragkos, Georgios	TW14	lecturer-in-charge

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Postgraduate Studies in Fire Safety Engineering	6	A

Teaching languages

English

Keywords

first law of thermodynamics, equation of state, combustion, conduction, convection, radiation, mass transfer

Position of the course

This course is situated in the first year of the program.
The course provides the scientific basis of the thermodynamics processes, combustion, heat transfer and mass transfer occurring in case of fire.
The course supports the key competence of the education program: to master the scientific knowledge in order to understand, to evaluate critically and to analyse the fire phenomenon and its consequences.

Contents

Thermodynamics:
- First Law of Thermodynamics: conservation of energy
- Properties of Pure Substances: phase diagram, equation of state, ideal gas
- Real Gas Mixtures: saturated and unsaturated mixtures
- Second law of thermodynamics

Thermochemistry:
- Flue Gas Composition: combustion chemistry, air factor, combustion with moist air, triangle diagram, flue gases dew point
- Flame Temperatures: enthalpy of formation, heat of combustion, adiabatic flame temperature, flue gas temperature

Heat Transfer:
- Conduction: Basic law, multi-dimensional conduction, unsteady conduction
- Introduction to the Navier-Stokes equations
- Convection: Basic law, Convection coefficient - Nusselt number, forced convection, natural convection
- Radiation: Basic laws, Black and real body, Inter-surface radiation, Gas radiation

Mass Transfer: continuity equations, Fick's law

Initial competences

To have basic knowledge of mathematics, physics, chemistry and transport phenomena.

Final competences

1 Understand and apply the first law of thermodynamics.
2 Quantify thermodynamic properties of pure substances and mixtures.
3 Understand the thermodynamic aspects of combustion.

4 Calculate flue gas temperature and composition in case of combustion.
5 Understand the mathematical formulation of the physical processes of heat transfer.
6 Understand and calculate the consequences of heat transfer in case of fire.
7 Solve a new complex problem, involving the thermodynamic processes and the different modes of heat transfer that occur in case of fire.
8 Recognize the occurrence of mass transfer in case of fire.

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

Extra information on the teaching methods

The theory is taught as hearing classes. Exercises are made by the students, guided by a teaching assistant.

Study material

None

References

- H. Baehr, 'Thermodynamik', Springer-Verlag, 1999.
- J.R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, 'Fundamentals of momentum, heat and mass transfer', 4th edition. (ISBN 0-471-38149-7), John Wiley and Sons Ltd.
- M.J. Moran, H.N. Shapiro, 'Fundamentals of Engineering Thermodynamics: SI-version', 5th edition. (ISBN 0-470-03037-2), John Wiley and Sons Ltd.
- Y.A. Cengel, 'Thermodynamics and heat transfer' (ISBN 0-07-114109-X)

Course content-related study coaching

Interactive support through the electronic learning platform (Ufora, e-mail), in person: after agreement on date, fix contact hour: immediately before and after hearing classes. Additional guidance by assistant for exercise classes.

Assessment moments

end-of-term assessment

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

Oral assessment, Written assessment

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

Written assessment

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

- Oral examination with written preparation (closed book): a number of questions evaluate the student's understanding of the knowledge obtained in the hearing classes.
- Written examination (open book): a number of new, complex problems require calculation by the student.
- In the second examination period, the corresponding oral examination from the first examination period is evaluated by a written examination (closed book).

Calculation of the examination mark

oral exam 50%, written exam 50%