

## Heat and Combustion Engineering (E037010)

**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 2024-2025**

A (semester 1)	Dutch	Gent	lecture
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**Lecturers in academic year 2024-2025**

Lecompte, Steven	TW08	lecturer-in-charge
Verhelst, Sebastian	TW08	co-lecturer

**Offered in the following programmes in 2024-2025**

<a href="#">Bachelor of Science in Engineering(main subject Electromechanical Engineering)</a>	<b>crdts</b>	<b>offering</b>
	6	A

**Teaching languages**

Dutch

**Keywords**

energy, heat transfer, conduction, convection, radiation, evaporation, condensation, heat exchangers, combustion, combustibles, combustion technology

**Position of the course**

This course is situated in the third bachelor year of electro-mechanical engineering. The course builds upon basic knowledge of thermodynamics, chemistry and transport phenomena. It provides the knowledge on heat transfer and combustion techniques, with associated basic technological implementations as applied in e.g. thermal power plants, cooling cycles, heat pumps, heat recovery, industrial burners, boilers and combustion engines.

**Contents**

- Energy equation;
- Conductive heat transfer: Basic law - non-stationary conduction, Multidimensional stationary conduction, Multidimensional non-stationary conduction, Numerical methods, Technological aspects;
- Convective heat transfer: Convection coefficient - Nusselt number, Forced convection, Free convection, Correlations
- Radiative heat transfer: Basic laws, Black and real body, Inter-surface radiation, Gas radiation
- Boiling: Phenomenon, Pool boiling, Nucleate boiling, Flow boiling
- Condensation: Phenomenon, Film condensation, Droplet condensation, Direct contact condensation
- Heat Transfer in Heat exchangers: Introduction LMTD and epsilon-NTU
- Combustion: Phenomenon, Stoichiometry, Flame types, Turbulent flames, Combustion of solid fuels
- Global chemical aspects of combustion: exhaust gas composition, technical calculations of flow rates and composition of exhaust gases, exhaust gases dew point
- Global chemical aspects of combustion: heating value of a fuel, adiabatic flame temperature, exhaust gas temperature, heat balance of installations
- Emissions: NO<sub>x</sub>, Combustible species, CO<sub>2</sub>
- Examples of combustion technology
- Fuel properties

**Initial competences**

This course builds on the learning outcomes of the course 'Transport phenomena'.

**Final competences**

- 1 To be able to identify types of heat transfer and combustion in practical applications
- 2 Understand and calculate different types of heat transfer (such as conduction, convection, radiation)
- 3 Being able to identify, describe and calculate heat transfer with phase change (evaporation / condensation)
- 4 To be able to characterize and calculate the thermodynamic aspects of combustion and different flame types.
- 5 Know the most important technical properties of fuels.
- 6 Calculate exhaust gas composition and enthalpy of a furnace.
- 7 Know the formation mechanisms, consequences and basic countermeasures for harmful emissions, as well as principles related to emissions legislation

#### **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. Exercises are made by the students, guided by a teaching assistant.

#### **Study material**

None

#### **References**

- An Introduction to Combustion, Stephen R Turns, 2001
- A heat transfer textbook, John H. Lienhard V, Phlogiston press, 2019

#### **Course content-related study coaching**

Interactive support through the electronic learning platform (forums, e-mail), in person: after agreement on date, fix contact hour: immediatelt 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**

Oral assessment, 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**

Theory: oral exam (closed book)

Exercises: written exam (open book)

#### **Calculation of the examination mark**

The end score (S) is determined as:  $S = 0.5 \cdot T + 0.5 \cdot E$ , with T the score for the theory exam and E the score for the exercises exam.