GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2026-2027

Thermal Machines (E048500)

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

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2027-2028

A (semester 2)	English	Gent
B (semester 2)	Dutch	Gent

Lecturers in academic year 2027-2028

Verhelst, Sebastian	TW08	lecturer-in-charge
De Paepe, Michel	TW08	co-lecturer

Offered in the following programmes in 2027-2028	**crdts**	**offering**
Bridging Programme Master of Science in Engineering: Ships and Marine Technology	6	A
Bridging Programme Master of Science in Mechanical and Electrical Systems Engineering	6	A
Master of Science in Electromechanical Engineering	6	B
Master of Science in Engineering: Ships and Marine Technology	6	B
Master of Science in Engineering: Ships and Marine Technology	6	A
Master of Science in Mechanical and Electrical Systems Engineering	6	A

Teaching languages

English, Dutch

Keywords

Heat exchangers, internal combustion engines, thermal installations

Position of the course

This is the fifth course in the learning line thermo-fluids

Contents

- Heat exchangers:
  - Classification
  - Design of recuperators: Logarithmic temperature difference, NTU method, Non constant heat transfer coefficient
  - Tubular heat exchangers: constructive aspects
  - Shell and tube heat exchangers: constructive aspects
  - Plate heat exchangers: constructive aspects
  - Compact heat exchangers
  - Fouling: Fouling types, Results of fouling
- Internal Combustion Engines:
  - Its role in a sustainable future: life cycle impact versus competing technologies, sustainable fuels
  - Thermodynamic foundations: air standard cycles, fuel-air cycles, combustion
  - Energetic study, performance parameters
  - Spark ignition and compression ignition engines: normal and abnormal combustion, load control, desired fuel properties, ignition and injection systems, engine control
  - Two-stroke and four-stroke cycles; engine boosting
  - Emission formation mechanisms, basics of emission aftertreatment systems and vehicle emission legislation
- Thermal installations:
  - Heat networks: steam boilers and steam distribution
  - Cooling cycles, cryogenics

- Decentralised energy production: Combined Heat and Power

Initial competences

This course builds on certain course competencies/learning outcomes of the courses Transport Phenomena, Technical Thermodynamics, Heat and Flow Engineering, Fluid Machines

Final competences

1 Choose an appropriate type of combustion engine depending on the application and determine the basic sizing
2 Clarify trends in engine design and emission legislation and explain why you would choose a specific engine design
3 Relate the effect of fuel properties to engine combustion
4 Point out heat exchanger types and their properties
5 Design heat exchangers
6 Use software for energy calculations
7 Approaching energy use in an industrial context in a critical way both in a company and in society

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, Practical

Extra information on the teaching methods

- The theory is taught in lectures.
- Exercises are made by the students, guided by a teaching assistant.

Study material

Type: Syllabus

Name: Syllabus (English)
Indicative price: Free or paid by faculty
Optional: no

Type: Syllabus

Name: Boek: Heat Exchangers: Selection, Rating, and Thermal Design. Sadik Kakaç, Hongtan Liu, Anchasa Pramuanjaroenkij, CRC press
Indicative price: Free or paid by faculty
Optional: no

Type: Slides

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

References

- Fundamentals of heat exchanger design, Shah, Sekulic, Wiley
- Heat exchanger design handbook, Kuppan, Marcel Dekker
- Introduction to Internal Combustion Engines, Richard Stone, Palgrave Macmillan

Course content-related study coaching

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

Assessment moments

end-of-term and continuous 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

Participation

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

PE1: The end score (S) is determined as: S = 0.05*P_ICE + 0.30*T_ICE + 0.15 *E_ICE + 0.25*T_HEX + 0.25*E_HEX, with P the score on the practical, T the score for the theory exam and E the score for the exercises exam. ICE denotes the part on internal combustion engines and HEX the part on heat exchangers.
PE2: The end score (S) is determined as: S = 0.35*T_ICE + 0.15*E_ICE + 0.5 *E_HEX, with T the score for the theory exam and E the score for the exercises exam. ICE denotes the part on internal combustion engines and HEX the part on heat exchangers.
Special condition: If a student scores less than 8/20 in at least one part of the evaluation (T/E), they cannot pass the entire course. If the final mark would still be 10 or more out of 20, it will be reduced to the failing mark, i.e. 7/20.