Course Specifications
Valid as from the academic year 2018-2019

Lecturers in academic year 2018-2019
Vanslambrouck, Bruno TW03 lecturer-in-charge

Offered in the following programmes in 2018-2019

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<tr>
<th>Linking Course</th>
<th>Master of Science in Electrical Engineering Technology (main subject Automation)</th>
<th>crdts</th>
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Teaching languages
Dutch

Keywords
Heat transfer, thermodynamics, thermodynamic processes, steam

Position of the course
This course gives an introduction to thermodynamics and applies the theory to machines, installations and processes in practice to be of value during further education and engineering practice.

Contents
In thermodynamics, the fundamental concepts of thermodynamics and thermodynamic cycles are treated in order to understand the overall operation of energy installations, to be able to make energy balances and interpret technical data. These are combustion engines, gas turbines, steam turbines, the organic Rankine cycle, chillers and heat pumps. Heat transfer is also studied. After introducing the fundamental concepts of specific heat, calorific value, heating value, thermal efficiency and ideal gas laws, the fundamental laws of thermodynamics are treated.

- the first law of thermodynamics: internal energy, reversible and irreversible processes, volume-work
- the second law of thermodynamics: heat reservoirs, Carnot cycle, reduced heat, entropy: entropy change in solid state, liquids and ideal gases; entropy change during phase transitions and irreversible processes, the principle of the entropy increase, the concepts exergy and anergy.

These concepts are applied to several processes: changes of state of ideal gases (isochoric, isobaric, isentropic, isothermal, polytropic), positive and negative cyclic processes such as Otto process, Diesel process, Carnot process, Stirling, Ericsson and Joule process, cooling machines, heat pumps, positive displacement compressors, work during irreversible state changes.

Energy equation for open systems: turbines, compressors, pumps, boilers, heat exchangers, throttling.
The applications include the steam turbine installation (Rankine cycle), organic Rankine cycle (ORC), high temperature industrial heat pumps, cogeneration versus centralized production.
The course component heat transfer includes conduction, convection and radiation, with applications in the heat losses through walls, dimensioning of thermal insulation and the calculation of heat exchangers.

(Approved)
Initial competences
E690037 makes use and continues on certain competences from Mathematics 1 (E610004) and 2 (E610005), as well as Physics (E610016).

Final competences
1. Describe energetic quantities correctly (including units) and apply in making energy balances.
2. Know the covered thermodynamic laws and assess concrete processes and new developments with respect to these laws.
3. Perform energy calculations associated with the production and use of steam (e.g. boiler efficiency, expansion work by a turbine).
4. To dimension thermal insulation.
5. Awareness of environment, quality, safety and durability.

Conditions for credit contract
Access to this course unit via a credit contract is determined after successful competences assessment.

Conditions for exam contract
Access to this course unit via an exam contract is unrestricted.

Teaching methods
Lecture, lecture: plenary exercises

Learning materials and price
1. Warmteleer voor technici
   A.J.M. Van Kimmenaede
   ISBN:9789001788520
   Pages:364
   10 th print, 2010
   Editor: Noordhoff Uitgevers B.V.
   Price: +/- € 70
2. Powerpoint presentations with numerous extensions and explanations (available in digital format for free)

References

Course content-related study coaching
Unscheduled counseling (with appointment), clarification and problem solving via mail (individual or Minerva).

Evaluation methods
end-of-term evaluation

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

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

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation
not applicable

Extra information on the examination methods
Written exercise exam, on which insights coming from different chapters are to combine to find a solution. Formulas, steam table and diagrams are available.

Calculation of the examination mark
100% on score PE1 or PE2

(Approved)