

Thermodynamics, Heat and Mass Transfer (E039161)

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

Credits 6.0 Study time 180 h Contact hrs 60.0 h

Course offerings and teaching methods in academic year 2018-2019

A (semester 1)	English	lecture	30.0 h
		seminar: coached	30.0 h
		exercises	

Lecturers in academic year 2018-2019

Stankovic, Ivana	TW03	lecturer-in-charge
Maragos, Georgios	TW03	co-lecturer

Offered in the following programmes in 2018-2019

	crdts	offering
International Master of Science in Fire Safety Engineering	6	A
Master of Science 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 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

This course unit cannot be taken via a credit contract

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, seminar: coached exercises

Learning materials and price

- Handouts of slides
- Book: Fundamentals of momentum, heat and mass transfer, J.R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer.
- Book: Fundamentals of Engineering Thermodynamics: SI-version, M.J. Moran, H.N. Shapiro.

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

Personal guidance, after setting an appointment with the teacher or the assistant

Evaluation methods

end-of-term evaluation

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

Written examination, oral 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

- Oral examination with written preparation: a number of open questions evaluate the student's understanding of the knowledge obtained in the hearing classes.
- Written open book examination: 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.

Calculation of the examination mark

oral exam 50%, written exam 50%