

Thermodynamics

Code: MK3HOTAL04JX20

ECTS Credit Points: 4

Evaluation: mid-term grade

Semester: 3rd semester

Its prerequisite(s): Mathematics II

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The 1st law of thermodynamics. Ideal gas equation. Gas mixtures. Calorific properties, internal energy, specific heat capacity. Isothermal, isovolumetric, isobaric, adiabatic processes. Polytropic process. Cycle of vehicles (Otto, Diesel). Rankine-Clausius cycle. Technical work. Enthalpy. The 2nd law of thermodynamics. Entropy. Performance. Heat engines. Maximal work, exergy. T-s diagram. Changes in t-s diagram. Phase changes. Tension curve, boundary curves. Critical state. Melting, sublimation. Melting heat, heat of evaporation. Water-vapor T-s diagram. Heat flux. Fourier's heat conductivity equation. One dimensional steady state heat transfer through plain and cylindrical walls. Multilayered wall structures. Similitude modelling of heat transfer. Surface heat transfer coefficient.

Literature:

Compulsory:

- Dr. Lakatos Ákos. Basics of Heat Transfer and Fluid Mechanics. Debrecen, Magyarország : University of Debrecen (2014) ISBN: 9789634737988
- Müller – Müller: Fundamentals of Thermodynamics and Applications. Springer Verlag, 2009.
- Cengel: Thermodynamics: An Engineering Approach. 5th ed. Boston [etc]: McGraw-Hill Higher education, 2006

Schedule

1st week Registration week

2nd week:

Lecture: Definitions and Fundamental Ideas of Thermodynamics.

Practice: Solving ideal gas law problems.

4th week:

Lecture: The isothermal, isovolumetric, isobar, adiabatic and polytropic process. The First Law of Thermodynamics: Conservation of Energy

3rd week:

Lecture: Changing the State of a System with Heat and Work. Zeroth Law of Thermodynamics

Practice: Solving ideal gas law problems.

5th week:

Lecture:

Mixtures, Partial pressure, Dalton's laws. Gas mixtures. Gas mixtures. Real gases.

Practice: Solving gas mixture problems.

Practice: Solving 1st law problems, polytropic problems.

6th week:

Lecture Corollaries of the First Law. Generalized Representation of Thermodynamic Cycles (Joule, Otto, Diesel).

Practice: Solving cycle problems, gas turbine problems.

8th week: 1st test

9th week:

Lecture: Free convection, forced convection (the Reynolds, Grasshof, Prandtl, Galilei, Nusselt numbers).

Practice: Solving surface heat transfer coefficient problems.

11th week:

Lecture: Heat transfer. Basic forms of heat transfer.

Practice: Solving heat equation problems

13th week:

Lecture: Thermal resistance. Conduction (plane walls, cylindrical walls, spherical walls). Convection: concepts and basic relations, boundary layers, similarity concept.

Practice: Solving problems in the theme of the lecture

15th week: 2nd test

7th week:

Lecture: The Carnot Cycle. Entropy. The second law of Thermodynamics. Reversibility and Irreversibility in Natural Processes. Technical work. Enthalpy. Exergy.

Practice: Solving the Carnot efficiency problem and Joule's heat engine.

10th week:

Lecture: Changes and phase changes in T-s diagram (water-vapour).

Practice: Solving water vapour T-s diagram problems, gas turbine.

12th week:

Lecture: Fundamental equations. General differential equation of heat conduction. Steady state and transient conduction.

Practice: Solving heat equation problems.

14th week:

Lecture: Free convection, forced convection (the Reynolds, Grasshof, Prandtl, Galilei, Nusselt numbers).

Practice: Solving surface heat transfer coefficient problems.

Requirements

A, for signature:

Attendance on the **lectures** is compulsory, minimum 50 % attendance is required.

Participation at **practice** is compulsory. Student must attend the practices and may not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class.

If student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class.

During the semester there are two tests from the seminar's topic: the mid-term test is in the 8th week and the end-term test in the 15th week. Moreover, there is a test from the theory on the 15th week, too. Students have to sit for the tests.

B, for grade:

The course ends with end term grade. Based on the average of the seminar test results $\times 0.3$ + the grade of from the test of theory $\times 0.7$.

The minimum requirement for the mid-term, end-term tests and for the theory test is 51%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score	Grade
0-50	fail (1)
51-60	pass (2)
61-74	satisfactory (3)
75-89	good (4)
90-100	excellent (5)