

ME-251

**Thermodynamics and energetics I**

Haussener Sophia

Cursus	Sem.	Type
Mechanical engineering	BA3	Obl.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	3 weekly
Exercises	1 weekly
<b>Number of positions</b>	

**Summary**

The course introduces the basic concepts of thermodynamics and heat transfer, and thermodynamic properties of matter and their calculation. The students will master the concepts of heat, mass, and momentum conservation, and apply these concepts to thermodynamic cycles and energy conversion systems.

**Content**

**Generalities and fundamentals:** Thermodynamic systems; Zero's Law; Energy and the First Law; Entropy and the 2nd Law; 3rd Law; Gibbs equations.

**Closed systems and basic relations:** Fundamental equations for homogeneous closed systems; specific heats, mathematical relations between state functions and various factors.

**Open systems in steady-state:** Elements of gas dynamics, nozzles, turbine and compressor efficiencies, etc.

**Thermodynamic properties of matter:** State and state changes, kinetic gas theory, perfect gas and ideal gas; state equations (Van der Waals, Lee-Kesler, etc.), approximate relations for liquid and solids.

**Thermodynamic processes and diagrams:** T-s, h-s, p-v diagrams.

**Exergy:** definition, exergy balance.

**Elementary energy systems analysis applied to reversible cycles and of simple real cycles:** Generalities; general properties of cycles; cycles with two thermal sources for engines and heat pumps.

**Keywords**

Thermodynamics, energy, matter, cycles

**Learning Outcomes**

By the end of the course, the student must be able to:

- Compute the thermodynamic properties of a fluid, E2
- Compute the main thermodynamic transformations of compressible and incompressible fluids, E4
- Formulate mass, energy, and momentum balances, E1
- Elaborate on limitations of the main energy conversion technologies, E7
- Distinguish the main thermodynamic cycles, E5
- Integrate the concepts of thermodynamic efficiency, E6

**Transversal skills**

- Respect relevant legal guidelines and ethical codes for the profession.
- Access and evaluate appropriate sources of information.
- Take responsibility for environmental impacts of her/ his actions and decisions.

- Take responsibility for health and safety of self and others in a working context.

### **Assessment methods**

Written exam at the end of the semester

### **Resources**

#### **Bibliography**

Moran, Shapiro et al., Fundamentals of Engineering Thermodynamics, John Wiley & Sons, 2011  
Borel, Favrat Thermodynamics and energy systems analysis I, EPFL Press, 2010  
Borel, Favrat et al. Thermodynamics and energy systems II, EPFL Press, 2011

#### **Ressources en bibliothèque**

- [Thermodynamics and energy systems analysis / Borel](#)
- [Fundamentals of Engineering Thermodynamics / Moran](#)