Course title: Thermodynamics II.	**Neptun code: GEAHT402-a**

Course coordinator: name, position, scientific degree: **Dr. Péter Bencs, associate professor, Ph.D.**

type and number of lesson: lecture/seminar/practical lesson/consultation: **20**/ week or **semester**

method of accountability: **colloquium**/practical mark/other

curriculum location of the subject: autumn/**spring**

pre-study conditions: GEAHT401-a

The task and purpose of the subject:

The aim is to introduce the students to the hierarchy of models (theories) of thermodynamics (classical, ordinary/ homogeneous nonequilibrium and irreversible/continuum nonequilibrium thermodynamics) with selected applications demonstrating the role of the basic concepts in engineering. During the semester the students deepen their understanding of the basic concepts and methods of the subject, like equilibrium, energy/exergy/extropy, material modelling, etc….

Course description:

Homogeneous systems - Ordinary (equilibrium) thermodynamics
1) Basic thermodynamic concepts.
Models, theories and laws. Extensive and intensives.
Math1: partial derivatives,
Math2: Legendre transformations, differentials.
2) Zeroth, First and Second Law - statics
3) Laws of thermodynamics
Math3: Differential equations, stability, Liapunov-functions.
Gibbs relation and differential equations. Equilibrium. Quasistatic and irreversible processes. Single body in an environment.
4) System of bodies and environments. Heat and work.
Reservoirs, extended systems.
5) Exergy analysis. Entropy generation minimization.
Heat exchangers, power plants.
6) Multicomponent phase equilibrium, solutions.
B) Continua - Non-equilibrium thermodynamics
7) Basics – balances of basic quantities
Math4: Tensor analysis, indices.
Balances, partial diff. equations, constitutive functions, objectivity and second law.
8) Second law.
Entropy production. Linear laws. Onsager reciprocity. Isotropy. Local equilibrium.
9) Heat conduction, diffusion and flow in one component fluids. Cross effects.
10) Heat conduction and flow in isotropic solids. Cross effects.
11) Out of local equilibrium. Internal variables.
Heat conduction and flow in isotropic solids. Cross effects. Rheology. Poynting-Thomson body.

Required literature:

1. Matolcsi, T., Ordinary thermodynamics, 2005, Academic Publishers, Budapest.
2. Bejan, A., Advanced Engineering Thermodynamics, 2006, Wiley.
3. Verhás, J., Thermodynamics and rheology, 1997, Kluwert-Academic, Budapest.

Recommended literature:
1. Dr. Czibere Tibor: Vezetéses hőátvitel. Miskolci Egyetemi Kiadó, 1998