



# Heat Treatment

5 ECTS

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Lectures: 30h | Tutorials: 6h | Labs: 24h | Project: 0h | Lang.: 

## Objectives

The objective of the Heat treatment course is to provide the students with the necessary fundamentals for understanding the material properties given by the available heat treatment processes. A special presentation is delivered of phenomena occurring in the materials and influencing the achieved properties of core and surface of treated material.

Thus, the objectives of this course are the following:

- To find out the effect of different types of heat treatment of metallic materials, what happens from the microstructural point of view during the heating of the material and what properties of the material can be achieved with different degrees of cooling intensity and technological parameter of heat treatments.
- To know the machines and devices in connection with determining the time for the implementation of the individual elements of the process of heat treatment of the material.
- Ability to evaluate the properties of heat-treated materials in terms of the resulting microstructure and achieved properties and to achieve desired properties.
- Mastering the determination of heat treatment time for different types of heat treatments and for different product materials.

## Programme

Analysis of microstructural transformations, Continuous and isothermal cooling diagram, Cooling rate and steel microstructure, Hardenability and thru-hardenability, Hardening stresses and cracks, Distortion and hardening cracks due to transformation and thermal stresses, change of microstructure and residual stresses during hardening and tempering, Local and case hardening, Thermo-chemical surface treatments, carbonization, nitriding, Plastic forming in hot and cold state, recrystallization, Heat treatment processes, annealing, Selection of tempering technological parameters, Furnace atmosphere, furnace selection, Vacuum heat treatment, Special techniques for heat treatment of steels.

## Prerequisites

In order to successfully achieve this course, the students must have:

- Meeting the enrolment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.
- Basic knowledge of fundamentals in the field of material science in Materials (properties of metals, i.e. microstructural and mechanical properties and characterization).

## Learning outcomes

After attending this course, the student will obtain:

- The ability to assess the behaviour of materials from the viewpoint of the selected heat treatment.
- A good knowing of surface integrity yielded by different heat treatment processes.
- The ability to evaluate the microstructural transformations in the material after different thermal and thermochemical treatments and to select an optimal heat treatment or surface hardening.
- The knowledge about the materials used in mechanical engineering, the physical properties and the microstructural phenomena characteristic to the individual material groups, with respect to the different heat treatment processes.

## Assessment

Contribution to the final grade:

- 50% theoretical written exam with the mutual exam.
- 50% laboratory work (including reports).

## Literature

D. R. Askeland: The science and engineering of materials, Sixth Edition, Chapman & Hall, 2011.  
M. Philip, B. Bolton: Technology of engineering materials, Butterworth Heinemann, Oxford, 2007.  
P.H. Morton: Surface engineering and heat treatment, The institute of metals, 1991.  
Moderno proizvodno inženirstvo, priročnik, ur. Karl Kuzman, Grafis trade, 2010.  
H.E. Boyer: Practical heat treatment, American society for metals, 1984.