

Materials of Vehicles

Code: MK3GEPAJ06JJ20-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Semester: 5th semester

Its prerequisite(s): Vehicle Materials and Technologies

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Deepening the scientific content of the most important topics of materials engineering. Understanding in convenient depth the automotive materials bulk and surface modification.

Main areas:

- thermodynamic principles of solid consistency,
- solid phase transformations and their thermodynamics (homogeneous and heterogeneous transformations),
- non-equilibrium systems,
- opportunities for increase of strength,
- metal-gas systems,
- interface energies,
- types, purposes and methods of surface modification processes.

Conventional and advanced materials used in the automotive industry, their properties and modifications:

- alloys: iron-based (non-alloy, low-alloy and high-alloy), advanced high-strength steels, aluminium-based (castable and formable alloys), Mg-based, Cu-based and special alloys (high-strength, super-alloys, Ti-based alloys)
- ferromagnetic materials,
- associated and composite materials and structures,
- types and production of traditionally manufactured technical ceramics.

The main issues of quality assurance in the production of raw materials.

Laboratory practice, measurement. Material testing. Destructive testing methods Introduction to non-destructive testing (NDT) methods (visual, radiographic, ultrasonic, magnetic, eddy current, dye penetrant, acoustic emission, etc.). Physical principles and areas of application. Flaw detection and sizing. Automation of NDT processes. The performance and evaluation of various laboratory tests (tensile, fracture mechanics, hardness). Metallography and relevant testing methods.

Literature:

Compulsory:

- Mikell P. Groover: Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley, 2006, ISBN: 9780471744856
- William D. Callister, David G. Rethwisch: Fundamentals of materials science and engineering: SI version, John Wiley and Sons, 2013., ISBN 978 1 118 32269 7

Recommended:

- Mikell P. Groover: Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley, 2006, ISBN: 9780471744856

Schedule

1 st week Registration week	
2nd week: Lecture: Overview the solid state phase transformations and their thermodynamic background. Practice: Introduction to safety laboratory work. Introduction to basic heat treatment processes.	3rd week: Lecture: Conventional and advanced materials used in the automotive industry, their properties and modifications Practice: Heat treatment process of applied steels for automotive industry.
4th week: Lecture: Magnesium alloys for lightweight powertrains and automotive structures Practice: Magnesium alloys for lightweight powertrains and automotive structures	5th week: Lecture: Magnesium alloys for lightweight powertrains and automotive structures Practice: International designation systems for aluminium alloys. Casting of Al-alloy in laboratory.
6th week: Lecture: Thermoplastic-matrix and thermoset-matrix composites for lightweight automotive structures Practice: Produce of carbon fiber reinforced thermoset-matrix composites	7th week: Lecture: Direct Hardening: Annealing methods: full annealing, stress relief annealing. Austenitization and quench, selective hardening. Practice: TTT diagrams in case of isothermal and continuous cooling.
8 th week: 1 st drawing week	
9th week: Lecture: Destructive testing methods: Mechanical properties of metals. Concepts of stress and strain. Elastic, plastic deformation Practice: Tensile test. Determination of proof stress.	10th week: Lecture: Destructive testing methods: Comparison of materials harnesses. The difference between the theoretical and practical strength of the materials and their reason. Practice: Micro hardness testing.
11th week: Lecture: Charpy impact test. Crack theory: Fracture mechanism, Failures. Practice: Charpy impact test.	12th week: Lecture: Metallographic analysis of metals. Interpretation of metals microstructure. Specimen preparation process. Practice: Optical microscopy investigations.
13th week: Lecture: Non-destructive testing methods: visual, radiographic, ultrasonic, magnetic,	14th week: Lecture: Microscopic Examinations: Scanning electron microscopy, EDS-Energy Dispersive Spectroscopy

eddy current, dye penetrant, acoustic emission.

Practice: Non-destructive testing

Practice: SEM examination

15th week: 2nd drawing week

Requirements

A, for a signature:

1. Students have to visit the lectures and seminars. Three misses are permissive for the seminar.
2. Students have to write a two tests from the two parts of the lecture and seminar. They have to write them for minimum sufficient marks. Based on these result they will get the final practice mark.

B, for grade:

The course ends with a **mid-semester grade**. Based on the average of the marks of the planning task and the average of the test results, the mid-semester grade is calculated as an average of them:

- grade of the planning task
- average grade of the two tests

The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, the student once can take a retake test covering the whole semester material.