Final exam questions

Subject group name: **Materials Science**

Neptun code: ZVEGEMTNWMS

Credit points: 3

Subject in this subject group:

- **Materials Science** (BMEGEMTNWMS)

Program: Mechanical Engineering Modelling, MSc (2N-MW0)

Specialization: Design and Technology

Responsible person:

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  Department of Materials Science and Engineering, Faculty of Mechanical Engineering

You can check the current subject forms at the Educational Portal of the Faculty of Mechanical Engineering.

https://oktatas.gpk.bme.hu/

Always check the for updates at edu.gpk.bme.hu before preparing for the exam, especially if the subject group contains at least one subject from your final semester!

Valid from 01 September 2021

Dr. István Attila Mészáros

full professor

Materials Science

1. Major groups/classes of engineering materials. Intrinsic and extrinsic material properties
2. Crystallography. Crystalline structures of metals. Bravais space lattices, common features. Connections between crystal structures and bulk material properties. Intrinsic properties.
3. Defects of crystalline structure. Point defects, dislocations, surface defects. Lomer dislocations. Connections between defect structures and bulk material properties. Extrinsic properties.
4. Solid state diffusion process. Fick's laws. Infinite half space solution. Atomic mechanisms of diffusion. Rate of diffusion process.
5. Microstructure of alloys. Solid solutions, intermetallic compounds, eutectic and eutectoid microstructures.
6. Binary equilibrium diagrams of alloys. Cooling curves. Free energy curves.
7. Crystal nucleation and growth. Homogenous and heterogeneous nucleation of crystals.
8. Phase transformations. Diffusion controlled and martensitic phase transformations of alloys.
9. Mechanisms of strengthening in metals.
10. Mechanisms of plastic deformation of metals. Slip planes and slip directions.
11. Recovery after strain hardening. Recrystallization after strain hardening.
12. Heat treatments of alloys. Annealing operations with allotropic transformation. Annealing operations without allotropic transformation. Quenching. Surface quenching. Time-Temperature-Transformation diagrams. Precipitation hardening.
13. Surface modification and deposition technologies. Cementation, nitridation, PVD, CVD, ion implantation. High energy surface modification, laser and electron beam technologies.
14. Material testing. Methods of hardness testing for metals. Charpy impact test. Fatigue test, Wöhler curve. Creep testing. Nondestructive testing.
15. Fine microstructure investigation. Optical microscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), surface tunnelling microscopy (STM), atomic force microscopy (AFM). X-ray diffraction, electron beam scattering diffraction (EBSD).
16. Technological possibilities for improving the strength of alloys.
17. Deterioration processes. Fatigue of materials. Creep process. Corrosion processes.
18. Magnetic properties of materials. Dia-, para-, ferro-, ferri-, antiferro-magnetic materials. Magnetization curves, hysteresis loops. Magnetic properties. Soft-, and hardmagnetic materials.
19. Conduction properties. Electrical and heat conductivity of materials. Band structure of metals, semiconductors, insulators. Effect of temperature, alloying and plastic deformation to the resistivity of alloys. Types of semiconductors. Direct- and indirect band structures. Superconductivity.