MH2032 Mechanical Properties of Materials 6.0 credits

Materials mekaniska egenskaper

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for MH2032 valid from Spring 2009

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Specific prerequisites

MH2027 Micro and nano structures in materials

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After the course, the students will be able to:

- use Weibull statistics to predict fracture of brittle materials
- use fracture criteria according to theoretical strength, Griffith's theory, fracture mechanics and grain size dependence according to Cottrell
- understand the influence of defects on mechanical properties of ceramics

For metals, the students will be able to:

- calculate true stresses and strains from technological ones and to use theoretical and empirical models, like the Ludwik and Ludwik-Hollomon equations, for describing experimental stress-strain data.
- use the instability criterion for predicting necking and be able to calculate elastic and plastic energies involved in deformation processes
- describe the fundamental properties of dislocations and their interactions with solute atoms, particles, other dislocations and grain boundaries
- use models for each hardening mechanism including the temperature-dependent Peierls-Nabarro stress
- describe climb, cross slip, splitting into partials, the elastic stress fields around dislocations, Frank-Read sources, cutting of particles and the Orowan mechanism
- understand the transition from particle cutting to over-ageing and Orowan looping during a heat treatment
- apply their knowledge to solve problems related to the stress-strain curve, fracture, fatigue and creep
- describe dimple-fracture, the cup- and cone fracture, the embrittlement at high deformation rate, large grain sizes and three-axial stress-states
- describe the transition from brittle to ductile fracture for increasing temperature and decreasing grain size
- predict changes in the transition temperature for changes in grain size as well as changes in the transition grain size for temperature changes
- describe the initiation and propagation of fatigue cracks and to predict the number of cycles to failure from information on crack propagation rate, load conditions, initial crack size and fracture toughness, KIC
- predict the influence of a static load on the fatigue strength of a material according to the Goodman and the Gerber relations
- describe the development of striations and how they can be used in a failure analysis
- describe cyclic hardening and cyclic softening based on the development of dislocation microstructure
- describe static- and dynamic strain ageing and the formation of Cottrell atmospheres
- describe the primary, secondary and ternary regions of a creep curve and account for the requirements for obtaining creep resistant materials

- account for the creep mechanisms based on dislocation creep, Nabarro-Herring creep and Coble creep
- describe deformation mechanism maps according to Ashby.

Course contents

The course includes lectures, home assignments and exercises. The lectures will be given together with the lectures of the inorganic block of the course MH2050, Mechanical Properties of Materials.
Due to the extended amount of exercises in the present course, solving of engineering problems is more emphasized than in the inorganic block of MH2050. In addition, there is no organic block in the present course.

A theoretical (closed) and a practical (open) exam will be given at the end of the course. No material is allowed in the theoretical exam, while all books (including the course book) and tables are allowed in the open exam where practical problems are to be solved.

Course literature

Kurskompendium, “Mechanical Properties of Metals and Dislocation Theory from an Engineer’s Perspective” av Prof. S. Jonsson, är på engelska.

Examination

- INL1 - Assignment, 3.0 credits, grading scale: P, F
- TEN1 - Examination, 3.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.