



Faculty of Health, Science and Technology
Materials Engineering

Syllabus

Deformation and Failure

Course Code:	MTAD12
Course Title:	Deformation and Failure <i>Deformation och brott</i>
Credits:	7.5
Degree Level:	Master's level
Progressive Specialisation:	Second cycle, has only first-cycle course/s as entry requirements (A1N)

Major Field of Study:

MTA (Mechanical Engineering)
TKA (Engineering Physics)

Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2022-08-31, and is valid from the Spring semester 2023 at Karlstad University.

Prerequisites

Registered for Materials Engineering, 7.5 ECTS credits, Materials in Industrial Applications, 7.5 ECTS credits, Polymer Engineering, 7.5 ECTS credits, Materials Characterisation, 7.5 ECTS credits, and Solid Mechanics, 7.5 ECTS credits, plus upper secondary level English 6, or equivalent

Learning Outcomes

The aim of the course is for students to develop their understanding of materials engineering further, specifically the connection between mechanical properties, composition, and structure of engineering materials and their application, as well as acquire knowledge of modern methods of materials testing and basic skills in materials engineering laboratory work.

Upon completion of the course, students are expected to have acquired in-depth knowledge of connections between the chemical composition, structure, and mechanical properties of engineering materials. In particular, students should be able to give a detailed account of:

- deformation properties in engineering materials,
- basic dislocation theory on deformation,
- slip and twinning deformation in crystalline materials,
- strengthening mechanisms in metallic materials,
- deformation of crystalline materials at high temperatures, especially creep deformation,
- deformation of polymers,
- failure mechanisms in engineering materials and notch effects,
- basic fracture mechanics,
- ductile- to brittle transition and deformation conditions,
- the connection between microstructure and fracture toughness,
- fatigue, low- and high-cycle fatigue
- fatigue crack growth,
- failure analysis including analysis, concepts, and performance.

Upon completion of the course, students should also be able to:

- use methods of materials testing such as light microscope, scanning electron microscope, hardness measuring to examine and interpret microstructures and failure surfaces, and
- compile laboratory results, literature studies, and calculations in a technical report with an emphasis on materials engineering concepts and present the report orally.

Content

The course deals with deformation and failure mechanisms, toughness and high temperature properties in engineering materials. It also deals with basic fracture mechanics and fatigue theory including crack growth. Course emphasis is on metallic materials but polymers and composites are also treated.

The course includes practical laboratory sessions where students work with metallographic test preparation, light microscopy, scanning electron microscopy with energy dispersive X-ray analysis, micro and macro hardness testing and impact testing. Students learn about modern methods for materials investigation and some skills in materials engineering laboratory work on a failure case and solve a material technical problem. Theoretical components with literature studies and calculations are also included.

Instruction is in the form of lectures, exercises, and laboratory sessions. Based on a real failure case, students solve a materials problem involving theory and laboratory work.

Reading List

See separate document.

Examination

Assessment is based on a written exam, mandatory participation in laboratory sessions, and a written and oral presentation of a failure case.

If students have a decision from Karlstad University entitling them to Targeted Study Support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades

One of the grades U (Fail), 3 (Pass), 4 (Pass with some distinction), or 5 (Pass with distinction) is awarded in the examination of the course.

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional information

The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.