



Faculty of Health, Science and Technology  
Mechanical Engineering

## Syllabus

### Solid Mechanics with computer-aided analysis

**Course Code:** MSAD17

**Course Title:** Solid Mechanics with computer-aided analysis  
*Hållfasthetslära med datorstöd*

**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)

#### Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2018-02-12, and is valid from the Autumn semester 2018 at Karlstad University.

#### Prerequisites

Mechanics 7.5 ECTS cr, Calculus in one variable 7.5 ECTS cr, Calculus in several variables 7.5 ECTS cr, Linear algebra and vector analysis, 7.5 ECTS cr., or equivalent.

#### Learning Outcomes

Solid mechanics is a basic engineering subject of great importance to engineering applications. The field of solid mechanics studies the interplay between the load on a body (a design) and the deformations and stresses that arise in the body due to the applied load. The design may be constructed in different materials. The aim of the course is to clarify how designs and components should be dimensioned to ensure that they will perform the intended technical function in a safe manner.

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

- give an account of basic vector and tensor analysis,
- give an account of the concepts of force, stress, deformation, strain and shear in one and many dimensions,
- calculate principal stresses and principal strains, and their directions,
- explain and make use of the relationship between stress and strain in isotropic, linear, thermoelastic materials
- give an account of the general equation of equilibrium,
- describe elastic-plastic material behaviour in metals and demonstrate knowledge of the concepts of yield strength and tensile strength,
- explain and make use of the ideal elastic-plastic material model in uniaxial stress states,
- analyse trusses,
- analyse torsion of shafts with circular cross-sections,
- give an account of cross-section quantities in plane bending,
- draw diagrams of shear force and bending moment, and calculate normal stress and deformation for

beams under bending in two planes,

- analyse rotation symmetrical bodies exposed to temperature load and/or radial pressure load,
- give an account of the phenomenon of elastic instability,
- analyse instability of beams,
- conduct fatigue analysis in terms of infinite life-span in stationary varying uniaxial stress states.

### **Content**

The course deals with basic concepts such as stress, strain, and shear and their interaction in three-dimensional states of load. The course also treats bending, torsion and tensile stress in slender structures and rotation symmetrical bodies exposed to temperature load and/or inner radial pressure load. Basic solid mechanical problems and issues of fatigue, fracture mechanics and buckling stress are outlined. Students are intended to use computer software to solve problems. This means that the problems studied in many cases are considerably more complicated than problems normally handled in the scope of a traditional course in strength of materials. When presenting the theory, the computer-aided analysis is considered, which means that generally applicable relations and methods are aimed for. Special attention is given to formulating relevant differential equations and their solutions with the help of boundary conditions. Note that the concept computer-aided does not aim to the application of the finite element method, but to the use of software for mathematical analysis.

### **Reading List**

See separate document.

### **Examination**

Assessment is based on a written exam and three mandatory hand-in assignments

### **Grades**

One of the grades Distinction (VG), Pass (G), or Fail (U) is awarded in the examination of the course. Engineering students are awarded one of the grades 5 (Distinction), 4 (Some Distinction), 3 (Pass), or Fail (U).

### **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.