Reg No: FAK2 2011/57:7

Faculty of Technology and Science
Mechanical Engineering

Syllabus

Course Approval
The syllabus was approved by the Faculty Board of Technology and Science on 4 July 2011 , and is valid from the Spring semester of 2012 at Karlstad University.

Course Code: MSGB31
Solid Mechanics for Engineering Science, 7.5 ECTS Credits
(Hållfasthetslära för civilingenjörer, 7.5 Swedish credit points)
Degree Level: Bachelor
Progressive Specialisation: G1F (First cycle, has less than 60 credits in first-cycle course/s as entry requirements)

Language of Instruction
Swedish

Prerequisites
Mathematics 22.5 ECTS cr and Mechanics 7.5 ECTS cr, or equivalent

Major Field of Study
MTA (Mechanical Engineering), TKA (Engineering Physics)

Learning Outcomes

Solid mechanics is a basic engineering subject of great importance to engineering applications. The field of solid mechanics studies the interplay between forces on a body (a design) and the deformations and stresses that arise in the body due to the forces. The design may be performed 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:
- describe the concepts of force, stress, strain, deformation, 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 material
- describe the general equation of equilibrium
- describe the elastic-plastic behaviour in metals and demonstrate knowledge of the concepts of yield strength and tensile strength
- explain and make use of the Ideal Elastic-Plastic Behaviour model in uniaxial stress states
- analyse statically determinate and indeterminate trusses
- analyse torsion in circular cross-sections of statically determinate and indeterminate load cases
- describe cross-section quantities in plane bending
- draw diagrams of shear force and bending moment, and calculate normal stress and deformation for beams under plane bending in statically determinate and indeterminate load cases
- analyze tubes exposed to temperature load and/or inner surplus pressure,
- describe the phenomenon of elastic instability
- analyse the instability force of beams using the Euler-Bernoulli beam equation

- apply standards of steel construction to dimension against elastic instability with a margin of safety
- conduct fatigue analysis in terms of infinite life-span in stationary varying uniaxal stress state
- judge the impact of cracks on the strength of materials under linear conditions using the stress intensity factor and the material's fracture toughness, as well as give an account for the limitations of linear theory
- perform lifetime analyses using the Paris crack growth law
- calculate eigen frequencies of one-dimensional systems with discrete point masses
- perform eigen frequency analysis of beams with continuously distributed mass under simple conditions
- calculate the first eigen frequency of beams with continuously distributed mass as well as with one or several discrete masses using the Dunkerley and Rayleigh-Ritz approximation methods
- describe how the principle of virtual work can be used to derive the finite element method.

Content and Form of Instruction

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 structures of thin oblong elements and tubes exposed to temperature load and/or inner surplus pressure. Basic solid mechanical problems and issues of fatigue, fracture mechanics and buckling stress are outlined. Students perform a computer laboratory analysis of a problem using the FEM method and submit a written report of the analysis.

Reading List

See separate document.

Examination

Assessment is based on a written exam and a mandatory laboratory assignment.

Grades

One of the grades Fail (U), 3 (Pass), 4 (Some Distinction), or 5 (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 assessment is based on student views and experiences as reported in written course evaluations and/or group discussions. Students will be informed of the result of the evaluation and of the measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional Information

Students who enrolled before 1 July 2007 will complete their studies in accordance with the requirements of the earlier admission. Upon completion students may request degree and course certificates to be issued under the current ordinance if they meet its requirements.

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