Course syllabus

Hållfasthetslära, allmän kurs
Solid Mechanics, Basic Course

FHLF15, 15 credits, G2 (First Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED M
Date of Decision: 2023-04-11

General Information

Main field: Technology.
Compulsory for: M2, MD2
Language of instruction: The course will be given in Swedish

Aim

The aim is to achieve such a knowledge within solid mechanics that every Master of Mechanical Engineering is expected to possess.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- have the ability to understand and apply the principles of classic solid mechanics.
- have the ability to solve solid mechanics problems when working in a group of students and be able to present the work in a technical report

Competences and skills
For a passing grade the student must

- have achieved the knowledge that is necessary for participation in the various advanced courses within solid mechanics.
- have worked in a group to solve tasks in solid mechanics.
- have gained the ability to present a solid mechanics project as a technical report.

Judgement and approach
For a passing grade the student must

- be able to analyse, evaluate and design commonly encountered construction elements.
- be able to work in a group.
- be able to present performed work as a technical report.

Contents

Part 1

This first part of the course treats uniaxial stress and deformation analysis with application to design with respect to allowable stresses and deformations in bars under axial loads, beams under bending loads, and circular bars under twisting loads.

The basic concepts of normal and shear stress, normal and shear strain are defined. Based on measurements on uniaxial test pieces, idealized constitutive models are formulated, which exhibit elastic, plastic and viscoelastic behavior. The difference between statically determinate and indeterminate problems are discussed with respect to the solution methodology, and the need for deformation conditions at statically indeterminate problems is paid attention.

Elementary stability theory for axially compressed struts is discussed, and design with respect to the Eulerian elementary cases is treated.

Part 2

This first The concepts from AKI are generalized, i.e. the general elastic boundary value problem is formulated (this comprises the generalized stress and strain state, Hooke's generalized law, the general equilibrium equations and the corresponding boundary conditions). As examples of solution or the general elastic boundary value problem, torsion of beams with non-circular cross-section and the response of axisymmetric discs are treated. Then the theory of strain gauges is given and the practical application is illustrated in a laboratory task. As design criteria for structural and mechanical components, yield criteria, fracture mechanics and fatigue are considered. Then a systematic matrix approach for analysis of truss structures is given and the principle of virtual work is introduced. Energy methods and the theorems of Maxwell, Castigliano and Betti are described. Finally, an introduction to the dynamic response of simple structures is given.

Exercises in problem solving.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Both parts (AKI and AKII) of the course include written examinations. In order to achieve a final grade, it is required that the labs and projects as well as the examinations are completed and approved.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0119. **Name:** Solid Mechanics, Basic Course I.
Credits: 7,5. **Grading scale:** UG. **Assessment:** See general description in the beginning. **Contents:** The course treats uniaxial stress and deformation analysis with application to design wih respect to allowable stresses and deformations in bars under axial loads, beams under bending loads, and circular bars under

twisting loads. The basic concepts of normal and shear stress, normal and shear strain are defined. Based on measurements on uniaxial test pieces idealized constitutive models are formulated, which exhibit elastic, plastic and viscoelastic behaviour. The difference between statically determinate and indeterminate problems are discussed with respect to the solution methodology, and the need for deformation conditions at statically indeterminate problems is paid attention. Elementary stability theory for axially compressed struts is discussed, and design with respect to the Eulerian elementary cases is treated.

Code: 0219. **Name:** Solid Mechanics, Basic Course II.
Credits: 7,5. **Grading scale:** UG. **Assessment:** See the description in the beginning. **Contents:** The uniaxial concepts from AKI are first generalized, i.e. the general elastic boundary value problem is formulated (this comprises the generalized stress and strain state, Hooke's generalized law, the general equilibrium equations and the corresponding boundary conditions). As examples of solution or the general elastic boundary value problem, torsion of beams with non-circular cross-section and the response of axisymmetric discs are treated. Then the theory of strain gauges is given and the practical application is illustrated in a laboratory task. As design criteria for structural and mechanical components, yield criteria, fracture mechanics and fatigue are considered. Then a systematic matrix approach for analysis of truss structures is given and the principle of virtual work is introduced. Finally, an introduction to the dynamic response of simple structures is given.

Code: 0319. **Name:** Assignment AK1.
Credits: 0. **Grading scale:** UG. **Assessment:** Written report. **Contents:** Mandatory hand-in assignment in course part AK1

Code: 0419. **Name:** Assignment 1 AK2.
Credits: 0. **Grading scale:** UG. **Assessment:** Written report. **Contents:** Mandatory hand-in assignment (1 of 2) in course part AK1

Code: 0519. **Name:** Assignment 2 AK2.
Credits: 0. **Grading scale:** UG. **Assessment:** Written report. **Contents:** Mandatory hand-in assignment (2 of 2) in course part AK1

Code: 0619. **Name:** Lab AK1 .
Credits: 0. **Grading scale:** UG. **Assessment:** Lab completed following provided instructions. **Contents:** Mandatory lab in course part AK1.

Code: 0719. **Name:** Lab AK2.
Credits: 0. **Grading scale:** UG. **Assessment:** Lab completed following provided instructions. **Contents:** Mandatory lab in course part AK2.

Admission

Assumed prior knowledge: FMAB30 Calculus in Several Variables, FMEA30 Engineering Mechanics.
The number of participants is limited to: No
The course overlaps following course/s: FHLA05, FHLA01, FHLA10

Reading list

- Ljung, C., Ottosen, N.S. and Ristinmaa, M., "Introduktion till Hållfasthetslära. Enaxliga tillstånd. Studentlitteratur 2007. ISBN 978-91-44-04898-7.
- Ottosen, N.S., Ristinmaa, M. och Ljung, C., "Hållfasthetslära. Allmänna tillstånd". Studentlitteratur 2007. ISBN 978-91-44-05032-4.
- "Handbok och formelsamling i Hållfasthetslära", KTH.

Contact and other information

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