Structural Mechanics (9 CFU)

Academic Year 2021/2022

Sustainable Building Engineering

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Note: the numbering of the lectures may not correspond to the sequence of the lectures given during the semester, although the content is the same.

Lecture 1.

1.1 Introduction to structural and continuum mechanics. Summary of basic tensor and vector algebra. Summary of basic calculus. Examples.

Lecture 2.

2.1 Kinematics of three-dimensional continua. The infinitesimal strain tensor and the mechanical meaning of its components. Principal strains and principal directions.

Lecture 3.

3.1 Statics of three-dimensional Cauchy continua. The Cauchy theorem. Equilibrium equations. Principal stresses and principal directions.

Lecture 4

4.1 Exercises developed in class.

Lecture 5.

5.1 The octahedral shear stress and the maximum shear stress in 3D continua.
5.2 The Mohr's circles and their application to plane stress-states.
5.3 Exercises developed in class.

Lecture 6.

6.1 Constitutive behaviors for 3D continua.
6.2 Linear elastic behavior of isotropic homogeneous materials. The elastic problem in 3D continua
6.3 Yield surfaces: the von Mises criterion and the Tresca yield surface. Examples.

Lecture 7.

7.1 The Saint-Venant problem
7.2 Geometric properties of surfaces. Thin-walled sections.

Lecture 8.

8.1 Exercises developed in class

Lecture 9.

9.1 Global equilibrium equations of the Saint-Venant solid: stress resultants and strain resultants. The S-V sub-problems.

Lecture 10.

10.1 The axial problem: theory and applications. The one-axis bending problem and the two-axes bending problem: theory and applications. The case of eccentric axial forces: theory and applications.

Lecture 11.

11.1 Exercises developed in class

Lecture 12.

14.1 Torsion of thin-walled open sections.
14.2 Exercises developed in class

Lecture 13.

12.1 The shear problem and the Jourawsky theory**.**
12.2 The shear center.

Lecture 14.

13.1 Exercises developed in class

Lecture 15.

16.1 Kinematics and statics of rigid bodies systems.
16.2 The constraints and their kinematic and static meaning
16.3 The kinematic and the static problems

Lecture 16.

17.1 Exercises developed in class: solution of the kinematic problem, the isokinematic case

Lecture 17.

18.1 Exercises developed in class: solution of the static problem, the isostatic case.

Lecture 18.

19.1 The beam theory: the in-plane problem
19.2 Kinematics of the beam.
19.3 Statics of the beam

Lecture 19.

20.1 Systems of beams, the case of isostatic systems: stress resultants diagrams.

Lecture 20.

21.1 The elastic beam problem and the Euler-Bernoulli beam model.

Suggested books

Lecture notes, taken by the student

Notes provided by the teacher

R.C. Hibbeler

Mechanics of Materials, Ninth edition

R.C. Hibbeler

Statics, Thirteenth Edition