543 M5110

ELASTICITY (I)　彈性力學一

Course Introduction:

As a body is loaded, stress is developed in the body and the shape of the body changes. If the body restores its original shape upon unloading, the body is said to exhibit elastic behavior; On the other hand, if the loading is exceedingly large so that the body cannot recover its original shape upon unloading, the body is said to exhibit non-elastic behavior. Common engineering materials at service are usually within elastic limits. The purpose of this course is to discuss the methods of analysis of stress and deformation for an elastic body under loading.

Pre-requisites:

Mechanics of Materials, Applied Mathematics, tensor.

Syllables：

1. Kinematics of Deformation (2.5 weeks)
2. Stress Analysis (2 weeks)
3. Constitutive Laws (2 weeks)
4. Formulation of Elasticity Problems (1 week)
5. One-Variable Problems (1 week)
6. Two-Dimensional Problems (3 weeks)
7. Torsion Problems (1 week)
8. Bending Problems (1 week)
9. Plate Problems (2 week)

Course Objectives:

It is expected that after completing this course, a student will be able to

1. describe deformation of a body using various strain measures including deformation gradient, Cauchy-Green deformation tensor, Lagragian strain tensor, infinitesimal strain tensor, principal strains; understand the meanings of these measures and the transformations among them; know what compatibility conditions the stains must satisfy.
2. understand the definitions of stress vector and stress tensor and their relation，principal stresses and maximum shear stresses, and the stress equilibrium equations.

3. understand hyperelastic materials and generalized Hooke's law for linear elastic materials.，material symmetries, and conversions of different material constants for linear isotopic elastic materials.。
4. write down the governing equations and boundary conditions in rectangular, cylindrical, or spherical coordinate system.
5. analyze one-dimensional problems such as a spherical shell under external and internal pressures.
6. analyze plane strain and anti-plane strain problems with the method of Airy's stress function.
7. understand the method of analysis for a rod twisted by end torques.
8. understand the method of analysis for a cantilever beam subjected to an end load and Timoshenko beam theory.
9. understand the method of analysis for a plate.

Textbooks：

1. Lecture notes.
2. Atkin and Fox, An Introduction to the Theory of Elasticity, Longman, 1980.
3. Timoshenko and Goodier, Theory of Elasticity, 2nd ed..
4. Sokolnikoff, Mathematical Theory of Elasticity.
5. Fung, Foundation of Solid Mechanics.
6. Boresi and Chong, Elasticity in Engineering Mechanics, 2nd ed.