RAK.RS.300 Introduction to materials modelling

Autumn 2023

Lectures: Lectures at 14.15-17 on Tuesdays K1702, except weeks 36 and 37 when the lectures are on Thursday at RH215. Reijo Kouhia, office RM216, tel 040-8490561, e-mail: `reijo.kouhia@tuni.fi`.

Exercises are voluntary. In the exercise hours students solve the problems with the help of assistant. Exercises 3 h/week on Fridays 12.15-15 at K4242. Assistant: William Meneses Fuentes, and Erik Snellman (first five exercises).

Goal: Basic knowledge of the most common materials models (elastic, elasto-plastic, viscoelastic, viscoplastic, damage). Decomposition of stress and strain, invariants. The symmetry properties are treated using the invariant theory.

Literature: Lecture nodes, which can be found from http://webpages.tuni.fi/rakmek/?id=6 and in Moodle. Highly recommendable books are J. Lemaitre, J.-L. Chaboche, *Mechanics of Solid Materials* and N.S. Ottosen, M. Ristinmaa, Mechanics of Constitutive Modelling.

Grading: Based on home assignments.

Info: Moodle + webpage http://webpages.tuni.fi/rakmek/?id=6

Time table and content

Lecture 1, week 35. The general structure of mechanics. Mathematical preliminaries, tensor analysis, index notation. Stress (Lecture notes Ch. 1, 2.1-2.3)

Lecture 2, week 36, Thursday lecture hall RH215. Stress (Ch. 2.4 - 2.8)

Lecture 3, week 37, Thursday, RH215. Equilibrium equations, state of strain (Ch. 3 and 4)

Lecture 4, week 38 Isotropic elastic material model (Ch. 5.2)

Lecture 5, week 39 Transversely isotropic elastic material model (Ch. 5.3)

Lecture 6, week 40 Orthotropic elastic material model (Ch. 5.4)

Lecture 7, week 41 Plasticity - general behaviour + yield criteria (Ch. 6.1 and 6.2.1-6.2.2)

Lecture 8, week 43 Plasticity - yield criteria (cont'd) (Ch. 6.2.3-6.2.4)

Lecture 9, week 44 Plasticity - flow rule and hardening rule (Ch. 6.3 and 6.4)

Lecture 10, week 45 Continuum damage models (Ch. 7)

Lecture 11, week 46 Viscoelasticity (Ch. 8)

Lecture 12, week 47 Creep models, viscoplasticity, (Ch. 9 and 10)

Lecture 13, week 48 On numerical solution methods for material models.

Lecture 14, week 49 Visiting lecture (might be earlier)

Reference to the lecture note chapters are for the version dated 15.8.2023. I might update the notes time to time.