Course program FHLN05
Beräkningsbaserad materialmodellering
Computational Inelasticity
- Solid Mechanics -

(period 1 HT , 2019)

Contents and aims of the course

The course aims at providing the students with the knowledge of linear and non-linear material modelling and how to these are treated by numerical methods. After finishing the course one should have enough knowledge of the mathematical description and the numerical treatment of the non-linear material models that one should be able to; describe different linear and non-linear elastic models, understand the frame work defining plasticity theory and be able create now models from this frame work, understand the types of assumptions and simplifications done in a mathematical description of the material behaviour. From numerical viewpoint; implement and thereby understand how a plasticity model is implemented in finite element program, write a non-linear finite element program. understand how a commercial finite element program treat non-linear material problems from a described theory, follow the progress within material modelling both within the theoretical description of material models as well as the numerical issues.

Lectures: Matti Ristinmaa

Tuesday kl 8-10, room M:B week 1, room MA 3 weeks 2,3
Tuesday kl 13-15, room M:B
Thursday kl 13-15, room M:B (not week 1)

Exercise classes: Axel Henningsson

Wednesday kl 10-12, rom E:1144
Friday kl 13-15, room E:1144

Computer exercise:

Wednesday 25/9 k 13-17, room M:Ina3, Ina4
Thursday 26/9 kl 8-12, room M:Ina3, Ina4
Friday 27/9 kl 8-12, room M:Ina3, Ina4
Thursday 3/10 kl 8-12, room M:Ina3, Ina4

Friday 4/10 kl 8-10, room M:Ina3, Ina4 (if needed)

Tentamen

Friday 1/11 kl 14-19, rooms Vic 2A, Vic 2B

Course litteratur

N.S. Ottosen and M. Ristinmaa "The Mechanics of Constitutive Modelling" . The book is available as Ebook at Lunds Universitet. Browse www.ub.lu.se, In box "Sök i LUBsearch" press alternative "Fler söktjänster och databaser". Choose LUBsearch, write the title of the book. Choose book "Elektronisk resurs" and select "Online access".

Exercises are available at the course home page, "Literature and software".

Course contents, relevant chapters

1	Notation and Cartesian tensors.
2	Strain tensor.

3	Stress tensor.
4	Hyper-elasticity.
6	Representation theorems
8	Failure and initial yield criteria
9	Introduction to plasticity theory.
10	General plasticity theory.
12	Common plasticity models.
13	Nonlinear kinematic hardening laws.
15	Creep and viscoplasticity.
16	Nonlinear finite element method.
17	Solution of nonlinear equilibrium equations.
18	Integration of constitutive equations.

Lectures will make a jump from chapter 4 and 6 to chapter 16 and 17 (parts), and then jump back to chapter 8 and continue. This is needed for the computer exercise.

Assignments

In the course two compulsory elements exist ; computer exercise and an assignment. The computer exercise considers a FE-calculation of a non-linear elastic problem solved using the Newton-Raphson method. The assignment treats a FE-calculation when plastic response is present. Both tasks requires that a FE-code is written.

The assignment is solved individually or in groups of two persons. If a group of two persons solve the problem, both will obtain the same number of points (see below).

Examination

Written exam	max 60 points	pass, minimum 30 points
Computer exercise	pass/not pass	pass required
Assignment	max 5 points	these points can be used to add the score on the first compulsory written exam

For a final grade it is required that the computer exercise is passed as well as a working FE-code used in the assignment. The final grad is calculated as: 30-39 points grade 3, 40-49 points grade 4 and 50- points grade 5.

Matti Ristinmaa
Divsion of Solid Mechanics

Preliminary schedule

1	Ex: 1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.11, 1.12
2	Ex: 1.5, 1.8, 1.9, 1.10, 1.13, 2.1, 2.2, 2.3, 2.4, 2.5
3	Ex: 3.1, 3.3, 3.2, 3.4, 3.5, 3.7, 3.8, 3.9, 3.10
4	Ex: 4.1, 4.3, 4.4, 4.5, 4.2, 4.6, 4.7, 4.8, 4.9
5	Ex: 4.10, 4.11, 4.12
6	Ex: 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7
7	Ex: 8.8, 8.9, 8.10, 8.11, 8.12
8	Ex: 8.13, 8.14, 8.15, 8.16 9.1, 9.2
9	Ex: 9.3, 9.4, 9.5
10	Ex: 10.1, 10.2, 12.1
11	Ex: 12.2, 12.4, 17.1
12	Ex: 18.2, 18.3
	Last date to hand in assignment,
	Monday 4/11, at 10.00