UCL Faculté des sciences appliquées

FSA

MECA2131 Introduction à la mécanique non linéaire des solides

[30h+30h exercises] 5 credits

This course is not taught in 2004-2005
This course is taught in the 2nd semester

Teacher(s): Issam Doghri
Language: french
Level: 2nd cycle course

Aims

Mathematical modeling and numerical simulation of nonlinear phenomena in solid mechanics (examples: plasticity, viscoplasticity, nonlinear elasticity, large deformations, displacements and rotations, damage, fracture, etc.)

Main themes

Most of the nonlinear phenomena studied in this course are briefly described hereafter. Numerous materials, when sollicited beyond a certain limit, witness irreversible deformations which are either sensitive to the loading rate (viscoplasticity) or insensitive (plasticity). However, rubber-like materials can sustain large deformations while remaining elastic (but nonlinear). Large deformations are encountered in metal forming applications. Large displacements and rotations are often observed for thin structures or elongated beams. Damage and fracture phenomena, under ductile (important plasticity), brittle (little or no plasticity) or fatigue (cyclic loadings) conditions are important in practice because they are potentially dangerous. One needs either to avoid them or take them into account in order to evaluate the residual life of a structure or a mechanical component.

Content and teaching methods

Chap. 1 Small deformation elasto-plasticity and elasto-viscoplasticity.
Chap. 2 Large displacements, deformations and rotations.
Chap. 3 Finite strain nonlinear elasticity.
Chap. 4 Finite strain elasto-plasticity and elasto-viscoplasticity.
Chap. 5 Finite element-based numerical algorithms in small deformations.
Chap. 6 Finite element-based numerical algorithms in finite strains.
Chap. 7 Damage mechanics and fracture.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

- Pre-requisites :
one course among: Continuum Mechanics, Theory of Elasticity, Strength of Materials;
and one course among: Finite Element Method, Numerical Analysis, Programming.
- Other information :
Project: use a commercial finite element software to solve a given problem, or
develop a small standalone computer code to implement a given algorithm.
Final grade: 50% written examination and 50% project.
- Book (suggested, not compulsory) : I. Doghri, "Mechanics of Deformable Solids- Linear, nonlinear, analytical and computational aspects", Springer, Berlin, 2000.