Mécanique des milieux continus

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** Presential 50
- **Code:** N5EM03B

Presentation

Objectives

This course allows to assimilate the basic formalism of the mechanics of the continuous environments leading to the writing of the Lamé and Navier-Stokes equations.

At the end of the first part of the course, freshmen will be able to:

- to use the formalism of the linear algebra to follow the demonstrations leading to the equations of the mechanics of the continuous mediums;
- explain the transformations between volumes and surfaces in the balance equations;
- describe behavioral laws for the diffusion of heat or the rheology of elastic solids;
- calculate analytical solutions for simple linear elasticity problems.

At the end of the second part of the course, freshmen will be able:

- to describe the kinematics of the flows using matrices expressing the rotation or the deformation of the particles;
- to formulate the conservation equations of mass, momentum and energy;
- to describe behavioral laws for the Newtonian fluid rheology;
- to calculate analytical solutions for simple fluid mechanics problems.

Description

1) Linear algebra and tensors: Einstein convention, differential operators, the divergence formula
2) The continuum hypothesis: heat flux vector by small tetrahedra, Fourier law and state law leading to the heat equation.
3) Large and small deformations: Jacobian matrice, dilatation tensor and small strains tensor, Jacobian.
4) Stress tensor under small strains: mass conservation in Lagrangian representation, fundamental principle of dynamics, existence and symmetry of the stress tensor.
5) Lamé equations : Hooke's Law, longitudinal and transverse waves in solids.
6) Kinematics: trajectories, streamlines, particle spin.
7) Transport theorems: rotation vector and tensor strain rate, pass on a moving domain.

8) incompressible Navier-Stokes equations: fundamental principle of the dynamics, law of behavior.
9) Compressible Navier-Stokes equations: "theorem" of kinetic energy and power of internal forces, first principle of thermodynamics.
A session of Practical Work (4h): "Hydraulic jump", to illustrate the notion of discontinuity and jump relation.

Useful info