DU MICRO AU MACRO EN MÉCANIQUE

FROM MICRO TO MACRO IN SOLID AND FLUID MECHANICS

Lecturers: Alexandre DANESCU, Mathieu CREYSSELS

| Lecturers : 12.0 | TC : 12.0 | PW : 0.0 | Autonomy : 0.0 | Study : 8.0 | Project : 0.0 | Language : FR

Objectives

The objective of the course is to understand the laws of behaviour and the macroscopic models observed and studied in solid and fluid mechanics from a microscopic description of solids and fluids. The course will provide essential elements to integrate the fact that every body is made up of atoms or molecules interacting more or less strongly into the macroscopic laws of motion. The examples presented in tutorials will illustrate the application of the methods developed in the course. Examples include: carbon nanotubes, elasticity of metamaterials, design of auxetic materials, perfect gases and denser gases.

Keywords : - Discrete and continuum elasticity
- Homogenization theory
- Periodic media
- Voigt and Reuss bounds

Programme

1. Discrete to continuum elasticity : one-dimensional problems
2. Discrete-to-continuum elasticity : multi-dimensional problems
3. Inhomogeneous to effective constitutive relations : the scalar case (thermal diffusion)
4. Inhomogeneous to effective constitutive relations : the vectorial case (elasticity)
5. Case studied : negative Poisson ratio materials
6. Case studied : mechanical behaviour of single wall carbonne nanotubes (SWCNT)
7. Kinetic theory of gases
8. The fundamental Boltzmann equation and its practical applications.

Learning outcomes

- Understanding the interplay between microstructure geometry/physics and macroscopic mechanical behaviour.
- Simplification of complex physical problems
- Formulation/computation of effective constitutive behavior in elasticity
- Relating the microscopic properties of fluids to their macroscopic behaviour

Independent study

Objectifs : The classes are not concerned with framed autonomy activities

Méhodes :

Core texts

Assessment

Case studied results : 1/3 of the final mark
Written examination (2h) : 2/3 of the final mark