



PhD Course: An Introduction to Nonlinear Solid Mechanics

The course, open to all the interested PhD students, will be delivered online by **Anna Pandolfi** in the period **November 9-November 24, 2020**.

Overview. Rigorous introduction to nonlinear solid mechanics, especially addressing finite kinematics, material frame indifference, constitutive models within a thermodynamic framework. Analysis of nonlinear material behaviors. **Specific topics:**

1. Mathematical preliminaries. Dual basis. Tensors.
2. Kinematics of deformations. Motions, kinematics of local deformation. Polar decomposition.
3. Conservation laws (mass, linear & angular momentum, energy). Thermodynamics. Virtual work principle.
4. Constitutive theories. Coleman-Noll's theory. Material frame indifference. Thermodynamic potentials. Kinetic relations. Material classification.
5. Hyperelasticity. Elasticity symmetry. Internal constraints. Elastic materials: isotropic, transversally isotropic, anisotropic materials.
6. Finite Plasticity. Multiplicative decomposition of the deformation gradient. Exponential and logarithmic mapping. J2 plasticity. Pressure dependent plasticity.
7. Special materials: fiber reinforced tissues, liquid crystals.

TEACHING ORGANIZATION

- The course, 5 credits for the Italian learning system, is delivered online in 12 lectures of 2 hours each, using drawing tablet and slides. Most lectures deal with theoretical explanations and proofs, supported by examples and applications. Lecture notes are provided. Standard textbooks in continuum mechanics and exercise material are suggested for further readings in each specific topic.
- Learning evaluation: theoretical exam on the whole program, by appointment (*).
- Non-Polimi students must confirm the attendance to anna.pandolfi@polimi.it. Polimi students must be registered to the course.

(*) Official Polimi certificates of attendance, credit acquisition, and exam taking require the registration to the course through the [Polimi PhD School](#) (PhD students will receive a fee waiver for this specific course).

SCHEDULE (order of the topics may change)

Monday 9-Nov-20 9:00-13:10 (Preliminaries, notation, dual bases, kinematics)
Tuesday 10-Nov-20 9:00-13:10 (Kinematics)
Thursday 12-Nov-20 9:00-13:10 (Balance principles, thermodynamics)
Tuesday 17-Nov-20 9:00-13:10 (Constitutive laws, objectivity)
Thursday 19-Nov-20 9:00-13:10 (Isotropic hyperelasticity)
Tuesday 24-Nov-20 9:00-13:10 (Anisotropy, plasticity, other behaviors)

A password protected **OneDrive folder** will be used to distribute the material of the course.

Scheduled Zoom meeting

Topic: NLSM 2020

Meeting ID: **647 886 4474**

Time: This is a recurring meeting Meet anytime

Join Zoom Meeting

<https://polimi-it.zoom.us/j/6478864474>