



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 14-November 28, 2022**.

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 7 lectures of 4 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 by **November 12, 2022** 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

Date	Time	Room (for in presence students)
Monday November 14, 2022	14:15-18:15	E.P.1 (via Colombo 40)
Tuesday November 15, 2022	09:15-01:15	E.P.1 (via Colombo 40)
Thursday November 17, 2022	12:15-16:15	BL27.1.5 (Via Lambruschini, Bovisa)
Monday November 21, 2022	14:15-18:15	B2.2.15 (Via Durando, Bovisa)
Tuesday November 22, 2022	09:15-01:15	E.P.2 (via Colombo 40), BL.12.17-18 (Via Lambruschini, Bovisa)
Thursday November 24, 2022	12:15-16:15	BL27.1.5 (Via Lambruschini, Bovisa)
Monday November 28, 2022	14:15-18:15	E.P.1 (via Colombo 40)
Tuesday November 29, 2022	09:15-01:15	BL.12.17-18 (Via Lambruschini, Bovisa)

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

The course will be also streamed in webex. Access will be granted only to the enrolled students.