



DOCTORAL SCHOOL IN CIVIL ENGINEERING & ARCHITECTURE

Title: **INTRODUCTION TO NON-LINEAR PROBLEMS IN MECHANICS**

Teacher: Prof. *Roberto Brighenti*

No. of teaching hours: 12 (2 CFU)

Program of the course

Lecture 1 (3 hours)

1. Introductions to nonlinear problems in mechanics.
2. Solutions of non-linear problems, iterative methods, convergence criteria.

Lecture 2 (3 hours)

3. Stress and strain measures in large deformation. Examples.
4. Mechanical non-linearity: basic concepts and examples.

Lecture 3 (3 hours)

5. Introduction to plasticity of materials: elastic-plastic incremental problem. Examples.
6. Introduction to plasticity of materials: plastic models and flow rules. Examples.

Lecture 4 (3 hours)

7. Simulation of contact problems.
8. Basic concepts on the solution of non-linear problems with finite elements.



References

- G.A. Holzapfel. *Nonlinear solid mechanics: a continuum approach for engineering*. Wiley, 2000.
- D.R.J. Owen, E. Hinton. *Finite elements in plasticity: theory and practice*. Pineridge Press, 1980.
- P. Wriggers. *Nonlinear finite element methods*. Springer, 2008.
- R. De Borst, M.A. Crisfield, J.J.C. Remmers, C.V. Verhoosel. *Nonlinear finite element analysis of solids and structures*. 2nd Edition, Wiley, 2012.
- T. Belytschko, W.K. Liu, B. Moran, K. Elkhodary. *Nonlinear finite elements for continua and structures*. 2nd Edition, Wiley, 2013.
- Brighenti R. *Analisi numerica dei solidi e delle strutture: fondamenti del metodo degli elementi finiti*, III Ed., Esculapio, Bologna, 2019.
- Lecture notes provided by the teacher

(website: https://www.brighenti.unipr.it/4-Didattica/Dottorato_IngCiv.htm)

Final evaluation: oral test
