# Continuum Mechanics

## Prof. Alfredo Marzocchi

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

Continuum Mechanics represents the most complete and powerful mathematical theory to date for describing the behaviour of macroscopic mechanical systems, and finds applications in many fields such as Engineering, Medicine, Biology and Materials Science.

At the end of the course, students will know how to frame a mechanical problem for deformable bodies within the relevant mathematical reference, and know the main results that Mechanics imposes for its analysis and solution. They will also be able to deduce simple results on problems related to continuous bodies, such as the application of the general results learned. Finally, the wide variety of mathematical techniques used in the course should increase students' learning skills, in particular when searching for the best technique to deal with a given problem.

***COURSE CONTENT***

**9 ECTS programme:**

Kinematics: deformation and homogeneous deformations. Polar decomposition theorem. Eulerian and Lagrangian representation. Speed and acceleration. Euler’s formula. Transport theorems. Subbodies. Mass. Dynamics: Power and D'Alembert's Principle and its consequences. Boundary conditions. Constraints. Heat and the first principle of thermodynamics. Entropy. Constitutive laws. Elasticity: finite elasticity and hyperelasticity, material symmetry group, isotropic materials. Linear elasticity: examples and applications. Elastic waves. The Saint-Venant problem. Elastic membranes. Fluid dynamics: perfect fluids. Fluid statics of perfect barotropic fluids. Theorems on perfect fluids. Plane motions. Surface waves in incompressible fluids. Fluid dynamics of compressible fluids. Viscous fluids.

**6 ECTS programme:**

Kinematics: deformation and homogeneous deformations. Polar decomposition theorem. Eulerian and Lagrangian representation. Speed and acceleration. Euler’s formula. Transport theorems. Subbodies. Mass. Dynamics: Power and D'Alembert's Principle and its consequences. Boundary conditions. Restrictions. Heat and the first principle of thermodynamics. Entropy. Constitutive laws. Elasticity: finite elasticity and hyperelasticity, material symmetry group, isotropic materials. Linear elasticity: examples and applications. Elastic waves. The Saint-Venant problem. Elastic membranes.

***READING LIST***

Lecture notes on the course topics and videolessons of support to didactics will be provided.

***TEACHING METHOD***

Lectures.

***ASSESSMENT METHOD AND CRITERIA***

An oral interview on the blackboard, aimed at ascertaining the student's knowledge of the concepts, results and procedures illustrated during the course, including references to any prerequisites or links between them. Generally, by way of example and not exhaustively, at least three topics will be addressed, normally including one on the general part of Kinematics or Dynamics, and two on applications in Fluid Dynamics and Elasticity, with the possibility of frequent references to other concepts illustrated during the course.

The assessment will focus on the relevance of the student's answers, their appropriate use of the specific terminology, the well-argued and coherent structuring of their discourse, and their ability to identify conceptual links and respond to open questions.

***NOTES AND PREREQUISITES***

Students will have to know the most important results of Differential and Integral Calculus in one or more variables, the basics of Linear Algebra and Geometry, and the principles of classical Mechanics; an anonymous assessment of the acquired knowledge may be carried out in order to evaluate any necessary revision.

*Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.*