LMECA1901

2012-2013

Continuum mechanics.

5.0 credits	30.0 h + 30.0 h	1q

Teacher(s) :	Dupret François ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	a. General theory of continuous media. - Basic principles and physical justification of the continuity assumption. Tensor field representation. Invariance. Cylindrical and spherical coordinates. - Principal concepts and tools to analyze the kinematics of deformable media (velocity, acceleration, strain, rotation, strain and rotation rates, Eulerian and Lagrangian representations). - Principal concepts and laws governing the dynamics of continuous media. Stresses, Mohr circles. Conservation laws. - Elementary Thermodynamics of continuous media. Constitutive equations. b. Applications. - Solid Mechanics: Basic infinitesimal Thermo-Elasticity (elastic moduli, thermal effects). Classical analytical examples. - Fluid Mechanics: Pressure, viscosity, and compressibility concepts. Newtonian viscous fluid model. Classical examples (e.g. flow in a pipe). Perfect fluid approximation and elementary applications.
Aims :	The objective is to provide a general introduction to the Mechanics of continuous media, together with its elementary applications to Solid and Fluid Mechanics. At the end of his learning, the student should have assimilated the principal concepts and laws governing the kinematics and dynamics of deformable media. In addition, he should understand the application of this theory to the cases (i) of infinitesimal Thermo-Elasticity, and (ii) of Newtonian and perfect Fluid Mechanics. Moreover, he should be able to apply these concepts to the solution of simple analytical problems. *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Content :	Introduction: Continuity assumption, tensorial field representation, invariance. Elements of kinematics: Velocity, acceleration, pathlines, strain and rotation rates, Eulerian and Lagrangian motion representations, material derivative, small displacements, strain, rotation, compatibility equations, transport theorem (Reynolds). Dynamics: Stresses, Mohr circles, conservation laws (mass, momentum, moment of momentum, energy). Thermodynamics: Clausius-Duhem inequality. Constitutive equations. Application to Solid Mechanics: Infinitesimal Thermo-Elasticity, isotropic media, elastic moduli. Isothermal or adiabatic problems: solution existence and uniqueness, examples, beam theory (St-Venant), elastic waves. Non-isothermal problems. Application to Fluid Mechanics: Viscous Newtonian fluid, Navier-Stokes equations, Poiseuille and Couette flows, flow in a pipe, Reynolds number, non-isothermal problems. Perfect isentropic or incompressible fluid flow approximation, irrotational flows, lift of an airfoil. Acoustic waves. Appendices: Introduction to tensor calculus. Cartesian and curvilinear coordinates.
Other infos :	Prerequisite: Basic knowledge in Mathematics and Physics as obtained from previous basic formation. Evaluation procedure: Normal written exam, half on the theory and half on original exercises. Support: Lecture notes available on web page (www.mema.ucl.ac.be/teaching/meca2901). Some document photocopies are supplied if necessary. Teaching framework: exercises (in classes), and one or two interrogations (taken into account in the final evaluation in case of success). Associated stream: Basic module in Mechanics 50.10. Reduced part: Part A of the course (which does not include the application of the theory to Fluid Mechanics), includes 22,5h of theory and 22,5h of exercises, for 3,5 credits.

Cycle and year of study :	> Bachelor in Engineering > Bachelor in Mathematics > Master [120] in Biomedical Engineering > Bachelor in Computer Science > Master [120] in Mathematical Engineering > Bachelor in Physics > Bachelor in Engineering : Architecture
Faculty or entity in charge:	MECA