UCLouvain

lmeca1901

2023

Continuum mechanics.

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Chatelain Philippe ;Doghri Issam ;
Language :	French
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.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 In consideration of the reference table AA of the program "Masters degree in Mechanical Engineering", this course contributes to the development, to the acquisition and to the evaluation of the following experiences of learning: • AA1.1, AA1.2, AA1.3 • AA2.3, AA2.4, AA2.5 • AA3.1, AA3.3 • AA5.4, AA5.5, AA5.6 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.
Evaluation methods	A mid-term evaluation is organized. The obtained grade is included in the final grade if one passed the final exam (grade >= 10). Written exam: theory (30-40%) and exercises (60-70%) The lecturers will organize oral exams in case of technical problems during the written exam or whenever a fraud/cheating is suspected.
Teaching methods	**Lectures:** Supports: blackboard or virtual board using a tablet. Slides are used for the main results. Small Wooclap evaluations are performed during some of the lectures to provide a self-evaluation of the previous lectures **Exercises :** sessions supervised by a TA and tutor student, including corrections
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.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=1317
Bibliography	• Support de cours accessible sur page Web (https://moodle.uclouvain.be/course/view.php?id=1317). • Photocopies de documents si nécessaire.
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.
Faculty or entity in charge	MECA

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Additionnal module in Physics	APPHYS	5		🔍
Specialization track in Mechanics	FILMECA	5		🔍
Minor in Applied Chemistry and Physics	MINOFYKI	5		🔍
Specialization track in applied Chemestry and Physics	FILFYKI	5		🔍
Minor in Mechanics	LMINOMECA	5		🔍
Mineure Polytechnique	MINPOLY	5		🔍