UCLouvain

lfyki1301

2026

Fluid and solid mechanics

5.00 credits	30.0 h + 22.5 h	Q2

Teacher(s)	De Wilde Juray ;Pardoen Thomas ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	This course assumes knowledge of the fundamentals of continuum mechanics: tensor calculus, basic concepts of kinematics, strain tensor, stress tensor, conservation laws, and energy principles.
Main themes	This course will cover the concepts of solid and fluid mechanics and transfers necessary to address the disciplines of chemical engineering, and materials science and engineering. The objective will be for students to master the basic concepts of fluid mechanics and transfers, and of solids mechanics. The focus will be on understanding the concepts (without delving into their physical origins and microstructural links) rather than on mathematical tools, favoring case studies and simple problem-solving methods.
Learning outcomes	**At the end of this learning unit, the student is able to :** **Contribution of the course to the program's learning outcomes** With regard to the learning outcomes for the « Bachelor of Engineering Sciences within the Civil Engineering program », this course contributes to the development and acquisition of the following learning outcomes: • Axis 1: knowledge of fundamental and polytechnic sciences: 1.1 • Axis 2: analyzing, organizing, and completing an engineering process applied to the development of a product (and/or service) that meets a specific need or problem, to the analysis of a given physical phenomenon or system: 2.1, 2.3. **Specific learning outcomes for the course** By the end of this course, students will be able to: • Master the conceptual foundations of fluid and solid mechanics: conservation and constitutive equations, boundary conditions, etc.; • Solve basic fluid mechanics problems using justified simplifying assumptions; • Solve basic solid mechanics problems using justified simplifying assumptions.
Evaluation methods	The students are evaluated individually accounting for their capacity of resolving simple fluid and solids mechanics problems.
Teaching methods	Theory sessions and exercise sessions are combined, allowing the students to apply the presented theoretical concepts to practical engineering cases.
Content	**Introduction** Importance of fluid and solid mechanics in chemical engineering and materials science. Review of continuum mechanics course material. Course outline: **A. Fluid Mechanics** 1. Conservation and constitutive equations: Newtonian viscous fluids, Fourier's law and thermal conductivity. Navier-Stokes equations, incompressible flows, compressible flows including the ideal gas case. Non-dimensionalization of the equations, dimensionless numbers and similarity, limiting cases. Introduction to non-Newtonian viscous fluids. 2. Conduction: Heat equation and thermal conduction in 1-D and in planar and cylindrical walls, concepts of thermal resistance and overall heat transfer coefficient. 3. Mass Transfer: Conservation equations, Fick's law and mass flux of species. Diffusion in stagnant media. 4. Incompressible Flows with simplifying assumptions: Decoupling of the equations in the case of constant viscosity, fully developed 2D and axisymmetric viscous flows: Poiseuille flow and pressure drop, Couette flow, annular flow. Heat transfer in fully developed flow. Development of laminar flow in a channel or pipe: inlet zone and length. 5. Laminar boundary layers in incompressible flow. Friction coefficient/factor. Thermal boundary layers with constant external velocity. Heat transfer coefficient, Reynolds analogy. Mass transfer coefficient - equimolar and non-equimolar diffusion. **B. Solid Mechanics**

	1. Linear elasticity including thermoelasticity; 1. General elasticity and symmetries, linear isotropic elasticity, applications in simple homogeneous loading states (uniaxial tension, uniaxial compression, simple and pure shear). 2. Viscoelasticity, applications in simple homogeneous static and cyclic loading states. 3. Critical states, plasticity entry criteria, simple failure criteria. 4. Fundamentals of beam theory: kinematics, equilibrium equations, stresses and strains, especially pure bending. 5. Fundamentals of torsion.
Bibliography	Sur Moodle - UCLouvain, sont disponibles : les transparents/syllabus de support, ainsi que quelques livres de support en version scannée.
Faculty or entity in charge	FYKI

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Specialization track in Applied Chemistry and Physics	FILFYKI	5		
Mineure Polytechnique	MINPOLY	5		