lphys1213

2026

Physics of fluids

5.00 credits	37.5 h + 30.0 h	Q2

Teacher(s)	Crucifix Michel ;Deleersnijder Eric ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	It is recommended that students master the notions of classical mechanics including in particular wave phenomena as developed in the LPHYS1113 course and thermodynamics as developed in the LPHYS1114 course. Having followed LPHYS1202 and having followed and passed LMAT1121 are assets.
Main themes	This teaching unit aims to enable one to understand the basic principles of fluid dynamics and the associated reactive transport processes (kinematics, budget of mass, momentum and energy) and comprehend important flow regimes (incompressible viscous, geophysical and free-surface flows).
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 **a. Contribution of the teaching unit to the learning outcomes of the programme** AA1: 1.1, 1.4, 1.5 AA2: 2.3, 2.4 AA3: 3.4, 3.5 AA6: 6.3 **b. Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able to : 1. understand the difference between physical principles and phenomenological laws; 2. assess the reliability and coherence of mathematical models; 3. estimate relevant orders of magnitude in a mathematical model based on partial differential equations; 4. study the budget of physical quantities on fixed or moving control volumes; 5. select the mathematical models relevant to specific flows; 6. solve simple fluid dynamics and reactive transport problems; 7. grasp the specific aspects of geophysical and free-surface flows.
Evaluation methods	Written exam in session. Non-mandatory continuous assessment of knowledge offering bonus points, based on homework assignments or the development of codes in python or oral presentations. Mandatory written exam consisting of problems.
Teaching methods	Face-to-face teaching. Exercise sessions aimed at solving problems as realistic as possible. Invitation to self learning.
Content	Basic assumptions of continuum mechanics. Lagrangian and Eulerian descriptions. Mass balance, momentum balance, energy and entropy balance. Non-inertial reference frame. Dynamic similitude: dimensionless parameters. Incompressible irrotationnal flows. Incompressible viscous flows. Flows with two space scales: lubrication and boundary layers theory. Natural and forced convection: Boussinesq approximation. Reactive flows. Geophysical flows: geohydrodynamics equations, dimensionless parameters, idealised models. Free surface flows: 1D and 2D models, linear and non-linear waves, tides, tsunamis. As far as possible, case studies are selected that are related to environmental and sustainable development issues.
Inline resources	Online resources will be provided on Moodle

Bibliography	Cushman-Roisin B. and J.-M. Beckers, 2011 (2nd ed.), Introduction to Geophysical Fluid Dynamics - Physical and Numerical Aspects, International Geophysics Series (Vol. 101), Elsevier, Amsterdam, 828 pages. Kundu P., I. Cohen and D. Dowling, 2015 (6th ed.) (ou éditions précédentes), Fluid Mechanics, Elsevier, Amsterdam, 928 pages.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Physics	MINPHYS	5		🔍
Bachelor in Physics	PHYS1BA	5		🔍