UCLouvain

lgciv2053

2023

Fluvial hydraulics

5.00 credits	30.0 h + 15.0 h	Q2

Teacher(s)	Soares Frazao Sandra ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Good prior knowledge of basic hydraulics or fluid mechanics, and good knowledge of open-channel flows (uniform flow, critical depth, flow profiles) as taught for example in LGCIV2051.
Main themes	• Characterization of the fluvial environment • Sedimentology: erosion criteria and sediment transport • Fluvial morphology
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 Contribution to the acquisition and evaluation of the following learning outcomes of the programme in civil engineering: AA1.1, AA1.2, AA1.3, AA2.1 et AA2.2, AA6.2, AA6. More specifically, at the end of the course, the student will be able to: • Calculate a flow in a natural river taking into account the sediment roughness and the influence of bedforms • Evaluate the sediment transport in a river • Use of a flow calculation software (HEC-Ras) • Design river training works to improve the river morphological stability Transversal learning outcomes: links are made in the course to physical geography, geopolitics and history.
Evaluation methods	Continuous evaluation though homework assignments (60%). Oral examination with preparation time (40%), based on a list of questins available on Moodle.
Teaching methods	The teaching activities are organized as follows: • Ex-cathedra courses for the main theory • Practical exercises • River flow calculation project using HEC-RAS, aiming at the analysis of flood episodes and their morphological consequences • Well illustrated examples and field cases taken from the literature or from the experience of the professor This course addresses issues related to sustainable development and transition through the following activities: • Co-construction of a wiki describing a river (Danube, Rhine, Rhône, etc.) and the issues linked to its management and modification by human activity, based on the analysis of the scientific literature and the elements seen during the courses; • Analysis of the impact of flood events and their morphological consequences on a watercourse (HEC-RAS project)
Content	The course covers technical content which will allow students to study and design sustainable river training works while limiting the risk of flooding and the consequences for local populations. Directly linked to SDG 13 "Climate action", the course explores nature-based solutions (NBS) by relying on the underlying fundamental river mechanisms. The course outline is as follows: 1. Introduction : definition of fluvial hydraulics, types of rivesr 2. Sedimentology • Definitions, general river morphology, bedforms • Modes of sediment transport • Non-dimensional variables of sedimentology • Velocity distribution, mean velocity, shear velocity • Dimensional analyssis and characteristic numbers

	• Threshold for erosion of sediment bed
	  • Velocity criterion and river equilibrium profile
	  • Shear stress criterion : Shields and van Rijn diagrams
	• Bed roughness in natural rivers, stage-discharge relation : Einstein's analysis
	• Bed-load sediment transport
	  • Transport principles of du Boys
	  • Analysis of Meyer-Peter and Müller
	  • Other current approaches (Einstein, Bagnold, etc.)
	• Suspended load sediment transport
	  • Transport equations
	  • Equilibrium concentration profile (theory of Vanoni–Rouse)
	  • Suspended load (Einstein's integration)
	
	3. Morphological evolution of rivers
	• Sedimentologic equilibrium
	  • Practical formulae : regime theories
	  • Bank stability, stable cross-section shape
	• Morphological response to river training works
	• Helical flow in meanders
	
	4. River training works
	• Principles : Fargue's laws and rules, Girardon
	• Local works (surface panels, bandalling, bottom panels, bottom sills, bank protection) and river works (banks, longitudinal dikes, groynes, sills)
	• Nature-based solutions (NBS)
	
	5. Examples

Inline resources	Available on Moodle: powerpoint slides, partial lecture notes and other useful documents. MOOC course on the edX platform: "Hydraulique fluviale 2: sediments et morphologie fluviale".
Bibliography	Notes de cours Jansen et al., "Principles of river engineering" Chang, "Fluvial processes in river engineering"
Other infos	The use of generative Artificial Intelligence (AI) tools is tolerated as long as they are used responsibly and in accordance with academic and scientific integrity practices. In particular, the student is required to systematically indicate all parties having used AI, e.g. in a footnote specifying whether AI was used to search for information, to draft the text or to correct it. Furthermore, sources of information must be systematically cited while respecting bibliographic referencing standards. The student also remains responsible for the content of his or her production, regardless of the sources used.
Faculty or entity in charge	GC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Civil Engineering	GCE2M	5		🔍