UCL Université catholique de Louvain

# LAUCE2157

*2014-2015*

# Coastal and sea hydraulics

| 5.0 credits | 30.0 h + 15.0 h | 1q |
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| Teacher(s) : | Deleersnijder Eric ; Spinewine Benoît ; |
| Language : | Français |
| Place of the course | Louvain-la-Neuve |
| Inline resources: | Slides available on icampus |
| Prerequisites : | This course requires prior training in fluid mechanics (Navier Stokes equations, etc.). |
| Main themes : | This course aims at introducing the student to flows within the coastal and marine environment, transport processes and their environmental impacts, as well as their morphological and sedimentary aspects, with a focus on regional scale (estuaries, coastal regions and continental seas). This course is particularly focused on the domains of intervention of the engineer in coastal and maritime industry. It can advantageously be combined with an MSc thesis in one of the R& mp;D aspects pursued by this industry. |
| Aims : | a. Contribution de l'activité au référentiel AA (AA du programme)<br>--<br>AA1.2, AA1.3<br>--<br>AA3.1, AA3.2<br>--<br>AA5.2, AA5.3<br>b. Formulation spécifique pour cette activité des AA du programme<br>At the end of the course LAUCE2157, students will be able to understand and derive the equations of applied geohydrodynamics in the coastal and maritime environment, tackle the models governing the sediment dynamics in this environment, and set-up / perform relevant numerical simulations. This course develops competencies of varying nature and across multiple disciplines, and their interconnections to be able to tackle complex problems related to marine engineering.<br>*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".* |
| Evaluation methods : | Exam. |
| Teaching methods : | The course is taught through lectures that include many examples and problems. Part of the lectures will be delivered in the 'flipped classroom' mode. |
| Content : | The course covers the following elements:<br>1. Hydrodynamics:<br>equation of fluid mechanics in a non-inertial reference frame and their application to marine hydrodynamics<br>thin layer approximation, hydrostatic approximation, Boussinesq approximation, geostrophic equilibrium...<br>interactions between large-scale processes and forcings (stratification, infuence of Earth's rotation) and regional impacts on continental seas and coastal regions<br>notions about the turbulence closure models of first and second order generally used in marine applications<br>foundations of the dynamics of tides in open and semi-closed environments, and the penetration of tides into the estuaries ;<br>transport processes for dissolved and suspended constituents and environmental implications<br>foundations of wave dynamics ;<br>principal spatial and vertical reference systems used in maritime hydraulics, main « meteocean » measurement systems.<br>2. Sedimentary aspects:<br>general morphology of a « source-to-sink » sedimentary system linking the estuary / delta with the continental margin and abyssal plains ;<br>typical morphologies of estuaries, their links with sediment influxs and tidal interactions ;<br>specificities of the marine sediment, main modes of sediment transport along and across shores, implications of sediment transport for engineering ;<br>laws governing the sediment transport in marine environments, bedload and suspension, cohesive sediment erosion and transport ;<br>range of sedimentary bedforms (ripples / dunes / sand waves and banks), and links with flow regimes ;<br>Principles of local scour in marine environments ; local scour evaluation around a marine structure (monopile, pipeline, '), scour protection methods ;<br>Principles of various dredging techniques, their domain of application ; methods for cable and pipeline protection through trenching;<br>Sediment-laden submarine flows (turbidity currents, contour currents, debris flows) and their significance for engineering ; basics on modelling of such sediment-laden flows. |

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| Bibliography : | --<br>Copies of slides presented during the lectures, available on iCampus<br>--<br>Reference books, available in Library of Science and Technology :<br>- Savenije H.H.G., 2006, Salinity and Tides in Alluvial Estuaries, Elsevier<br>- Cushman-Roisin B. and J.-M. Beckers, 2011, Introduction to Geophysical Fluid Dynamics - Physical and Numerical Aspects, Academic Press<br>- Garcia, M.H., 2008, Sedimentation Engineering: Processes, Management, Modeling, and Practice, ASCE Manual and Reports on Engineering Practice No. 110<br>--<br>Additional reference books, also available in the library :<br>- Dyer K.R., 1997 (2nd ed.), Estuaries - A Physical Introduction, Wiley<br>- Fisher H.B. et al., 1979, Mixing in Inland and Coastal Waters, Academic Press<br>- Burchard H., 2002, Applied Turbulence Modelling in Marine Waters, Springer |
| Cycle and year of study : | > Master [120] in Civil Engineering |
| Faculty or entity in charge: | GC |