GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2016-2017

Hydraulics (E045411)

Course size (nominal values; actual values may depend on programme)

Credits	6.0	Study time	180 h
Contact hrs	60.0 h		

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	Dutch	group work	3.75 h
		seminar: coached exercises	18.75 h
		practicum	1.25 h
		project	6.25 h
		demonstration	1.25 h
		lecture	28.75 h
B (semester 2)		lecture	28.75 h
		group work	3.75 h
		seminar: coached exercises	18.75 h
		project	6.25 h
		practicum	1.25 h
		demonstration	1.25 h

Lecturers in academic year 2018-2019

De Mulder, Tom	TW15	lecturer-in-charge

Offered in the following programmes in 2018-2019	crdts	offering
Bachelor of Science in Civil Engineering	6	A
Bridging Programme Master of Science in Civil Engineering	3	B
Bridging Programme Master of Science in Civil Engineering	3	B
Preparatory Course Master of Science in Civil Engineering	6	A

Teaching languages

Dutch

Keywords

pressurized flow in pipe networks, water hammer, open channel flow, backwater-curves, weirs, energy dissipating structures, hydrometry, hydrology, rainfall-runoff modelling, long waves, flood waves, numerical hydraulics

Position of the course

This course is a sequel to the course on basic fluid mechanics. With respect to pressurized flow, the acquired knowledge of gravitary and steady flow in a single pipe is extended to flow driven by pumps, pipe networks and unsteady flow phenomena, including water hammer. In addition to this, a thorough study of open channel flow is offered, both in steady regime (backwater-curve theory) and unsteady regime (long waves, such as translatory waves and flood waves). Attention is paid to the mathematical modelling and numerical solution techniques, as well as to experimental techniques to determine the main hydraulic parameters. Also the interaction between the water surface profile and the construction of hydraulic constructions and other engineering measures taken in rivers and canals is dealt with. In a final part of the course, an introduction is given to hydrological processes and rainfall-runoff modelling for rivers as well as sewers. Along with these subjects, the socio-economic importance of water on earth and the related problems are sketched.

Contents

- Pressurized flow in pipes: flow driven by gravity or by pumps; design and verification calculations in pipe networks; unsteady flow in pipes; water hammer and protection against pressure surges
- Steady open channel flow: theory, calculation and lab demonstration of backwater-curves in prismatic channels; Application of theory to hydraulic engineering measures taken in rivers and canals; Non-prismatic channels and transition sections; Weirs; Energy dissipating structures; Hydraulically optimal cross-sections; Flow in partially filled circular pipes, with application to design of sewer systems
- Concepts of hydrometry: Measuring water level, water depth, bathymetry, flow velocities and discharge
- Unsteady open channel flow: The 1D Shallow Water (or Saint-Venant) equations; Propagation and deformation of translatory waves; Propagation and deformation of flood waves; Hydraulic and hydrological flood-routing; Rating curve and the chronology of peaks in flow speed, discharge and water depth
- Numerical solution methods for problems governed by the 1D Saint-Venant and 1D transport equations: Theory of the characteristics; Finite difference discretization methods
- Concepts of hydrology and rainfall-runoff modelling: The hydrological cycle; The winds; Rainfall, measurement of precipitation, processing of rainfall data; Evaporation and transpiration; Groundwater, infiltration and surface run-off; Run-off towards rivers: the hydrograph, processing of runoff data, rainfall-runoff modelling, the rational method, the method of the (instantaneous) unit hydrograph; Run-off towards sewer systems, IDF tables of precipitation, design discharge for sewers

Initial competences

Transport phenomena

Final competences

1 Having insight into the behaviour and modelling of pressurized flow in pipe networks.
2 Being able to analyze and rationally solve a pipe network problem.
3 Having insight into the different types of models for unsteady flow in pressurized pipes.
4 Being able to identify and assess pressure surge problems in pipes.
5 Being able to determine and calculate backwater-curves in prismatic open channels.
6 Having insight into the influence of boundary conditions onto backwater-curves in prismatic open channels.
7 Having insight into the position of water surface profiles in non-prismatic channels and transition sections.
8 Having insight into the effect of hydraulic engineering measures onto the position of water surface profiles.
9 Having insight into the function, modelling and design of weirs and energy dissipating structures.
10 Having insight into different methods for single measurement or continuous measurement of the river discharge.
11 Having insight into the propagation, deformation and modelling of flood waves.
12 Having insight into the propagation, deformation and modelling of translatory waves in open channels.
13 Having insight into the influence of numerical discretization methods and parameters on the approximate solution of the 1D Saint-Venant of 1D transport problems.
14 Being able to deduce information about winds from maps of isobars.
15 Having insight into the hydrological processes and parameters that determine the surface run-off to rivers.
16 Having insight into the rainfall-runoff modelling for rivers.
17 Being able to determine the design discharge and to dimension stormwater pipes and sewers.
18 Having insight into the problematics and the socio-economic importance of water on earth.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Demonstration, group work, lecture, practicum, project, seminar: coached exercises

Extra information on the teaching methods

For exercises and project, ideally a laptop is brought along.

Learning materials and price

Syllabus (partly in Dutch and partly in English) can be purchased at VTK in Plateau building for ca. 25 EUR.

References

- Boulos, P.F., Lansey, K.E. & Karney, B.W. (2006). Comprehensive water distribution systems analysis handbook for engineers and planners - Innovyze Press.
- Jeppson W., "Analysis of flow pipe networks" - Ann Arbor Science.
- Chaudry M.H. (1979). "Applied hydraulic transients" - Van Nostrand Reinhold
- Wylie E.B. and Streeter V.L. (1978). "Fluid Transients" - Mc Graw Hill
- Chadwick, A., Morfett, J., Borthwick, M. (2013). Hydraulics in civil and environmental engineering. 5th edition - CRC Press.
- Berlamont J. (s.a.). "Theorie van de verhanglijnen" - Acco
- Chanson H. (2004). "The hydraulics of open channel flow: An introduction" - Elsevier Butterworth Heinemann
- Chow V.T. (1959). " Open channel hydraulics" - Mc Graw Hill
- Tison L. (1953). "Cours d'Hydraulique - 2ième partie" Gent
- Van Rijn L. (1994). "Principles of fluid flow and surface waves in rivers, estuaries, seas and oceans" - Aqua Publications
- Linsley R., Kohler M., Paulus J. (1949). "Hydrology for Engineers" - Mc Graw Hill
- Chow V.T. et al. (1988). "Handbook of applied hydrology" - Mc Graw Hill
- Beven K.J. (2012). "Rainfall-runoff modelling. The primer" - Wiley-VHC
- Verhoest, N. (2014). "Hydrologic modelling" - Course notes Ghent University
- Savenije, H. (2014). "Hydrologie I" - Cursustekst T.U. Delft
- Verhoeven, R. (s.a.). "Waterbeheer en waterbeheersing" - Cursustekst UGent
- Berlamont, J. (2004). Rioleringen - Acco

Course content-related study coaching

The lecturer is available for explanations during and in between the lectures, as well as (by appointment) at other moments.
Coaching is available during the tutorials and the lab exercise.
The project is being prepared in a plenary session (getting acquainted with software) and is subsequently elaborated independently in small groups. The assistants remain available for support.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination, oral examination

Examination methods in case of periodic evaluation during the second examination period

Written examination, oral examination

Examination methods in case of permanent evaluation

Report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible

Extra information on the examination methods

End-of-term evaluation:
- Oral exam with written preparation (partly open book, partly closed book, according to the detailed description made available on Minerva prior to the examination period)
- Written exam on exercises (open book)

Permanent evaluation:
- Project work: evaluation of report, oral presentation and defence
- Practicum: evaluation of report

If the student is illegitimately absent during the oral presentation and defence of the project work or during the practicum, the student cannot pass for this course.

Calculation of the examination mark

The final mark is determined as a weighted result of the following items. The relative weight of the individual items is expressed as a percentage.
End-of-term evaluation:
- Oral exam with written preparation: 50%
- Written exam on exercises: 25%

Permanent evaluation:
- Project work: 15%
- Practicum: 10%

If for one of the abovementioned items a mark of 8 or less on 20 is obtained, the student cannot pass for the entire course. The final mark is in that case the minimum of

9/20 and the abovementioned weighted result.