



LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Strömning i naturliga vatten **Environmental Hydraulics**

VVRN40, 7,5 credits, A (Second Cycle)

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED W

Date of Decision: 2023-03-27

General Information

Main field: Water Resources Engineering.

Elective for: MWLU2, V5-vr, W5-vr

Language of instruction: The course will be given in English

Aim

The objective of the course is to provide a fundamental understanding of the phenomena and processes that govern the water flow in the environment with the special purpose of providing the students with knowledge to analyze the conditions for and consequences of human activities. Activities refer primarily to discharge of pollutants to different water bodies, but the interaction between structures and water flow is also discussed. A brief overview of basic sediment transport is included as well.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- in detail understand the basic processes that govern transport and mixing of different types of pollutants in natural flows
- be able to interpret and formulate advanced mathematical models to describe the transport of pollutants in natural waters, both based on general mass balance equations and more detailed descriptions employing the advection-diffusion equations
- understand in a comprehensive manner interaction between water flows and different types of structures in nature, including the effect of sediment transport

Competences and skills

For a passing grade the student must

- be able to analyze the effects of human activities in natural waters with emphasis on discharge of different pollutants
- be able to design different types of technical solutions to achieve satisfactory mixing conditions in connection with discharge of pollutants to receiving waters
- be able to assess the impact on structures and activities in nature due to flowing water
- be able to estimate sediment transport due to flowing water and the effect on the bottom topography

Judgement and approach

For a passing grade the student must

- be able to present the basis for analyses and calculations, including simplifications and assumptions made, when formulating mathematical models
- in quantitative terms be able to communicate the results of analyses performed to a qualified group of stakeholders
- be able to critically review studies and reports dealing with problems within environmental hydraulics

Contents

An overview of water flow in the environment – phenomena and processes related to such flow. Transport processes and spreading of pollutant. Balance equations for water and pollutants in surface water systems with instantaneous mixing. Piston flow and nominal retention time. Basic mechanisms for mixing such as diffusion (laminar and turbulent), dispersion, and advection. The general transport (advection-diffusion) equation – formulation and special cases. Mixing in rivers, lakes, and coastal areas. Jets and plumes (free shear flows). Near- and far field mixing. Diffusers and other technical solutions for pollution discharge. Field measurement techniques. Case studies concerning pollution discharge and environmental impact. Density-driven flows including stratification and horizontal spreading of pollutants. Temperature and oxygen conditions in natural waters together with governing equations. Interaction between structures and water flow. Basic sediment transport and boundary layer theory. Bed load and suspended load. Some commonly used sediment transport formulas.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)

Assessment: Written examination and home assignments.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Assumed prior knowledge: VVR145/VVRA05, VVR120/VVRF10 or corresponding course in basic hydraulics/fluid mechanics.

The number of participants is limited to: No

The course overlaps following course/s: VVR176

Reading list

- Jönsson, L. 2004. "Receiving water hydraulics," Department of Water Resources Engineering, Lund, Sweden.
- Larson, M. 2009. "Background material in environmental hydraulics," Department of Water Resources Engineering, Lund, Sweden. (a compilation of papers and excerpts from different sources).

Contact and other information

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Course homepage: <http://www.tvrl.lth.se/utbildning/courses/>