Hydraulics & Hydrology I

Code: MK3VIZ1S6SX17-EN

ECTS Credit Points: 6

Evaluation: exam

Year, Semester: 2nd year, 4th semester

Its prerequisite(s): Civil Engineering Orientation

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 4+2

Topics:

Hydraulics: Elementary fluid mechanics. Understanding of the fundamental principles of hydrostatics and hydrodynamics; the basic ideas of dimensioning of hydraulic structures and hydraulic machinery. Hydrostatics (absolute and relative equilibrium, pressure head diagrams and buoyancy). Application of the Bernoulli equation (laminar and turbulent flow in pipes, losses and pipe systems). The impulse momentum equation, open channel flow (Chezy). Specific energy, supercritical and subcritical flow, hydraulic jump, stilling basins. Gradually varying channel flow. Hydraulic control structures, bridges, culverts. Wave theory. Shock waves in open channels and in pipes. Laminar and turbulent flow, analysis of laminar flow through pipes and porous media, turbulent flow velocity and shear stress distribution, energy loss equation, hydraulically smooth and rough pipes. Hydraulic machinery.

Hydrology: Processes and components of precipitation, evapotranspiration, infiltration and runoff. Quantity and quality of surface and subsurface waters. Anthropogenic impacts on the elements of the water cycle. Overall understanding of physical hydrologic principals, processes and related observation/measurement techniques, calculation methods: including the ability to critically analyse and apply that understanding to new problems. The aspects of hydrology in water management and civil engineering practice. The content provides a good basic background for further studies or work.

Literature:

Compulsory:

- Bruce R. Munson, Donald F. Young, Theodore H. Okiishi: Fundamentals of Fluid Mechanics, John Wiley and Sons (2009), ISBN: 978-0470262849
- Marriott, M.: Nalluri & Featherstone's Civil Engineering Hydraulics: Essential Theory with Worked Examples, 6th Edition, Wiley Blackwell (2016), ISBN: 978-1-118-91563-9
- Andrew Chadwick, John Morfett, Martin Borthwick: Hydraulics in Civil and Environmental Engineering, Fifth Edition, (2013), CRC Press Taylor & Francis Group, ISBN-10: 0415672457
- L. Hamill: Understanding Hydraulics, 3rd edition, (2011), Palgrave Macmillan, ISBN-10: 0230242758
- Wilfried Brutsaert: Hydrology, An Introduction, Cambridge University Press (2005), ISBN: 978-0-521-82479-8
- Martin R. Hendriks: Introduction to Physical Hydrology, Oxford University Press Inc., NY (2010), ISBN: 978-0-19-929684-2
- C.S.P. Ojha, R. Berndtsson, P. Bhunya: Engineering Hydrology, Oxford University Press (2008), ISBN-13: 978-0-19-569461-1

Recommended:

- Cheng Liu, Ranald V. Giles, Jack B. Evett: Schaum's Outline of Fluid Mechanics and Hydraulics (2014), ISBN10 0071831452
- Merle C. Potter, David C. Wiggert: Schaum's Outline of Fluid Mechanics (2008), ISBN10 0071487816
- Jack B. Evett Cheng Liu: 2500 Solved problems in Fluid Mechanics & Hydraulics, First Edition, McGraw Hill (1989), ISBN 0-07-0199783-0

- Kenneth N. Brooks, Peter F. Ffolliott, Joseph A. Magner, Hydrology and the management of watersheds, Fourth Edition, A John Wiley and Sons, Inc. (2013), ISBN-13: 978-0-4709-6305-0/2013
- Tamim Younos, Tammy E. Parece (Ed.): Sustainable Water Management in Urban Environments, The Handbook of Environmental Chemistry Vol47, Springer International Publishing Switzerland (2016), ISBN: 978-3-319-29335-6

Schedule

1st week Registration week	
2nd week: **Lecture:** Elementary fluid mechanics. **Practice:** Selected Problems in Fluid Mechanics	3rd week: **Lecture:** Understanding of the fundamental principles of hydrostatics and hydrodynamics; the basic ideas of dimensioning of hydraulic structures and hydraulic machinery. Hydrostatics (absolute and relative equilibrium, pressure head diagrams and buoyancy). **Practice:** Calculus - practice problems (Hydrostatic Pressure and Force; Center of Mass; Hydrostatic Equation; Pressure and fluid statics, Buoyant force example problems.
4th week: **Lecture:** Application of the Bernoulli equation (laminar and turbulent flow in pipes, losses and pipe systems). The impulse momentum equation, open channel flow (Chezy). **Practice:** Fluid Mechanics Problem Solving on Bernoulli Equation; Chezy and Manning equations	5th week: **Lecture:** Specific energy, supercritical and subcritical flow, hydraulic jump, stilling basins. Gradually varying channel flow. Hydraulic control structures, bridges, culverts. Wave theory. Shock waves in open channels and in pipes. **Practice:** Analytical solution to problems of hydraulic jump in horizontal triangular channels; Hydraulic jumps in rectangular channels; Classic energy problem in open-channel flow
6th week: **Lecture:** Laminar and turbulent flow, analysis of laminar flow through pipes and porous media, turbulent flow velocity and shear stress distribution, energy loss equation, hydraulically smooth and rough pipes. Hydraulic machinery. **Practice:** Pipe Flow Calculations; Reynold's Number Calculation	7th week: Study trip: Tisza Dam (Kisköre Dam); *Fish Ladder*
8th week: 1st drawing week / 1st test	
9th week: **Lecture:** Introduction to hydrology and hydrogeology: the focus of hydrology. The role of hydrology in the society and economy. Physical forms of water. The hydrologic cycle and the water budget. Water balance equation. The effect of the climate change on the elements of the hydrological cycle. **Practice:** Solving examples for water balance equation	10th week: **Lecture:** Precipitation: forms and types of precipitation. Theories of precipitation formation. Quantity variables – in time and space. Rain characteristics. Evaporation: the physics of evaporation. Evaporation of open water surface, soil and vegetation – evaporation, transpiration and evapotranspiration **Practice:** Calculation of average areal precipitation with different methods and calculation of precipitation extrema. (Montanari method). (Homework No 1.)
11th week:	12th week: **Lecture:** The runoff process. The importance of the

Lecture: Infiltration: process and characteristics. The infiltration curve. Water forms in the soil. Characterization of ground-water regimes. Physical, chemical and bacteriological properties of ground water. Potential pollution sources impacting sub-surface waters. **Practice:** Calculation of infiltration through porous medium – Darcy's law	watershed. Watershed characteristics. The time of concentration, runoff ratio. Type of surface waters. Hydrology of streams (potamology). Cross- and longitudinal sections of streams and their valleys. Stream characterization. Type and characteristics of lakes. **Practice:** Watershed delineation. (Homework No 2.) Performing the double transformations for rainfall-runoff calculations.
13th week: Hydrology in the water management and civil engineering practice. Study trip	**14th week:** **Lecture:** Streamflow regimes. Frequency and duration. Relation between water level and discharge – QH curve. Permanent and non-permanent rating curves. Flash floods. **Practice:** Calculation of frequency and duration curves (Homework No 3.).
15th week: 2nd drawing week / 2nd test	

Requirements

Participation at **lectures and practice classes** are **compulsory**. Students must attend lectures and may not miss more than three lectures during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the staff of the department. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring a calculator and the printed materials of the lectures to each lecture and practice. Active participation is evaluated by the teacher in every class. Active student's participation should be required.

Students have to **submit all the two tests and the five homework tasks** as scheduled minimum at a sufficient level. During the semester there are two tests – the 1st test is in the 8th week and the 2nd test in the 15th week – and there are five homework tasks. In order to get the signature minimum point of tests and home works has to be taken (Summa minimum 61 points from 100 points). The minimum and the maximum points related to the tests and home works can be obtained are the follows:

Tests:				
1. Test:	Maximum:	**100 points**	Minimum:	**60 points**
2. Test:	Maximum:	**100 points**	Minimum:	**60 points**

Homeworks:				
1. Homework:	Maximum:	**20 points**	Minimum:	**10 points**
2. Homework:	Maximum:	**20 points**	Minimum:	**10 points**
3. Homework:	Maximum:	**20 points**	Minimum:	**10 points**
4. Homework:	Maximum:	**20 points**	Minimum:	**10 points**
5. Homework:	Maximum:	**20 points**	Minimum:	**10 points**
	Sum:	**100 points**		**50 points**
Summa points:	Maximum:	**100 points**		**61 points**

Where Summa = 45% of sum points of the 2 tests + 10% of sum points of the 5 Homework tasks/

If the score of the test is below 60, the student once can take a retake test covering the whole semester material:

Score	Grade
0-60	fail (1)
61-70	pass (2)
71-80	satisfactory (3)

81-90	good (4)
91-100	excellent (5)

The course ends with oral exam.

88 – 100	points:	excellent	(5)