

457.309 Hydraulics and Lab.

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Description:

This course studies fundamental theories of water motion and dynamics to be the basis of the design and analysis of the social infrastructures (river and hydraulic structures, water supply system, dam, power plant, bridges, etc). Further, in this course, students will learn all the capabilities necessary for the acquisition, analysis, and interpretation of the science and engineering data by on-hand experiments and numerical simulations of rivers and water resource structures. In the first part of this course, equipment and methodology for the measurement of fluid and water are introduced. Then, dynamics of water flowing in the pipe are discussed, and then methodologies for the analysis of the complex flow in the pipe networks are to be introduced. Main part of this course will be focused on the derivations of flow equations of uniform and non-uniform flow in the open channels. Methods for the analysis of practical problems in the open channels will also be treated in depth.

Text:

Seo, I.W., Lecture Note of Hydraulics and Lab., Seoul National University, 2020,

Web: ehlab.snu.ac.kr

Reference:

1. Street, R.L., Watters, G.Z., and Vennard, J.K., 1996, Elementary Fluid Mechanics, 7th ed., J. Wiley & Sons, New York, N.Y.
2. Munson, B.R., Okiishi, T.H., Huebsch, W.W., and Rothmayer, A.P., 2013, Fluid Mechanics, 7th ed., J. Wiley & Sons, New York, N.Y.

Prerequisites:

Elementary Fluid Mechanics and Lab.

Contents:

1. Introduction
2. Fluid Measurements
3. Error Analysis
4. Steady Flow in Pipes
5. Pipe Problems
6. Uniform Flow in Open Channels
7. Varied Flow in Open Channels
8. Lift and Drag in Incompressible Flow

Grade:

Class Participation	5%
Homework Assignments	20%
Lab. Report	15%
Mid Term Exam.	30%
Final Exam.	30%

Weekly plan:

Week	Lecture Title	Contents	Pages
1	LC 0 Course Orientation	Course description	18
	LC 1 Introduction	Introduction and motivation	32
2	LC 2 Fluid Measurements	Measuring fluid and water motions	55
3	LC 3 Error Analysis	Errors in measurements	24
4	LC 4 Steady Flow in Pipes (1)	Fundamental equations and laminar flow in pipes	34
5	LC 5 Steady Flow in Pipes (2)	Velocity and friction of turbulent flows	44
6	LC 6 Steady Flow in Pipes (3)	Evaluating pipe friction factors	58
7	LC 7 Pipe Problems (1)	Single pipes and pumped pipeline	43
8	LC 8 Pipe Problems (2)	Hardy Cross method to solve pipe network problems	44

9	LC 9 Uniform Flow in Open Channels (1)	Open channels and momentum equations	20
10	LC 10 Uniform Flow in Open Channels (2)	Chezy and Manning equations, channel efficiency	39
11	LC 11 Varied Flow in Open Channels (1)	Concepts of Non-uniform flow, specific energy and hydraulic jump	52
12	LC 12 Varied Flow in Open Channels (2)	Gradually varied flow equation	31
13	LC 13 Varied Flow in Open Channels (3)	Solution of GVF problems	39
14	LC 14 Lift and Drag in Incompressible Flow	Forces on submerged objects	28
15	Summary/Final Examination		-

Lab. session:

Lab session includes four laboratory experiments and two computer experiments.

A. Lab. Experiment:

- (1) Measurement of velocity profile using ADV in the open channel
- (2) Measurement of bottom shear stress using Preston-static tube in the open channel
- (3) Measurement of energy losses in pipes
- (4) Experiment of hydraulic jump in the open channel

B. Computer Experiment:

- (1) Numerical analysis of pipe network problem
- (2) Numerical analysis of the gradually varied flow in the open channel