457.560 Advanced Environmental Hydraulics I: River Mixing Theory

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Objectives:

This course deals with the fluid mechanics to problems of pollutant transport and mixing and in the water environments. This course is suitable to graduate students of Earth Science and Civil & Environmental Engineering majors in any level as well as practicing hydraulic and environmental engineers for their practices. The students will obtain a deep understanding of basic theories as well as the future technology in the environmental hydraulic engineering.

Description:

This course deals with the analysis and prediction of the mixing and transport phenomena of various pollutants introduced into river environments. In the first part of this course, fundamental theory and analytical methods for the diffusion and dispersion of the substance are discussed in greater detail. In the latter part, practical problems and field studies in rivers and estuaries are covered. Numerical modeling techniques of hydrodynamics and solute transport in rivers are also treated.

Contents:

1. Introduction to Environmental Hydraulics (88)
2. Advection-Diffusion Equations (149)
3. Turbulent Diffusion (106)
4. Shear Flow Dispersion (155)
5. Mixing in Rivers (152)
6. River Water Quality Modeling (59)
7. Field Studies of Mixing in Rivers (213)
8. Mixing in Estuaries (151)
9. Numerical Models for River Mixing (147)

Text:

1. Fischer, H.B. et al., 1979, Mixing in Inland and Coastal Waters, Academic Press, New York, N.Y.

Reference:

1. Crank, J., 1975, The Mathematics of Diffusion, 2nd Ed., Oxford Science.

2. Fischer, H.B. edt., 1979, Transport Models for Inland and Coastal Waters, Academic Press, New York, N.Y.

3. Thomann, R.V. and Mueller, J.A., 1987, Principles of Surface Water Quality Modeling & Control, Harper & Row.

4. Rutherford, J.C., 1994, River Mixing, John Wiley & Sons.

5. Shen, H.H. edt., 2002, Environmental Fluid Mechanics – Theories and Applications, ASCE.

6. Chanson, H., 2004, Environmental Hydraulics of Open Channel Flows, Elsevier.

Prerequisites:

Elementary Fluid Mechanics and Lab.
Hydraulics and Lab.

Grade:

Homework Assignments	30%
Term Project	30%
Final Exam.	40%

Lecture Calendar:

Week	Contents	Assignments/Exam.
Week 1	Introduction to Environmental Hydraulics (I)	
Week 2	Introduction to Environmental Hydraulics (II)	HW #1 (Outfall-water intake)
Week 3	Advection-Diffusion Equation (I)	HW #2 (Diffusion coefficient and peak concentration)
Week 4	Advection-Diffusion Equation (II)	
Week 5	Turbulent Diffusion	HW #3 (Analytical solution)
Week 6	Shear Flow Dispersion (I)	Term project proposal presentation
Week 7	Shear Flow Dispersion (II)	HW #4 (Dispersion within lanes)
Week 8	Mixing in Rivers (I)	HW #5 (Longitudinal dispersion)
Week 9	Mixing in Rivers (II)	HW #6 (Moment method and routing procedure)
Week 10	River Water Quality Modeling	HW #7 (DO concentration profile)
Week 11	Field Studies of Mixing in Rivers (I)	HW #8 (Analytical solution)
Week 12	Field Studies of Mixing in Rivers (II)	
Week 13	Mixing in Estuaries	
Week 14	Numerical Models for River Mixing	
Week 15	Term project final report presentation	Final Exam.