CE 576 Environmental Flows  
Spring 2012

Course information

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Goal: To develop quantitative models of problems in environmental fluid mechanics

Prerequisites: Elementary fluid mechanics, calculus, differential equations

Approach: We will work through a few journal articles that illustrate the principles to be addressed. Students are welcome to propose articles for possible discussion.

Tentative outline:

1. Conservation laws
   1.1. Conservation of mass
   1.2. Conservation of momentum

2. Channel flows
   2.1. Laminar flow
      2.1.1. Flow in a tube or slot
      2.1.2. Application: Connection to groundwater
      2.1.3. Application: Horizontal convection
      2.1.4. Application: Particle settling
   2.2. Turbulent flow
      2.2.1. Characteristics of turbulence; friction in pipes
      2.2.2. Law of the wall; analysis of measurements
      2.2.3. Turbulence modeling for engineering

3. Mixing in rivers
   3.1. Basic solutions and superposition
   3.2. Estimating mixing parameters
      3.2.1. Empirical formulas
      3.2.2. Dye studies
   3.3. Other mixing models
      3.3.1. Cells-in-series model
      3.3.2. Dead-zone model
      3.3.3. Aggregated dead-zone model
4. Mixing in lakes
   4.1. Physical processes
      4.1.1. Thermal stratification
      4.1.2. Turbulence in a stratified fluid
      4.1.3. Internal waves
   4.2. Models of mixing
      4.2.1. Mixed-layer model
      4.2.2. Oxygen transport in a lake

5. Boundary layer flows
   5.1. Jets and plumes
   5.2. Oxygen transport in a lake boundary layer
   5.3. Salt wedge

Requirements and policies:

The grade will be based on homework (30%), one midterm exam (30%), and a final exam (40%). Optional exercises will be given to reinforce lecture material; as incentive, individuals may submit the exercises for extra credit (~5%). The homework will be done in teams of two or three students that the instructor will assign. Your team will have the following responsibilities in completing homework:

1. Designate a coordinator, recorder, and one or two checkers for each homework. Rotate these roles for every homework.
2. Agree on meeting times and the individual work to be done before the meetings.
3. Do the required individual preparation.
4. Meet and work. The **coordinator** keeps everyone on task and makes sure everyone is involved. The **recorder** prepares the final solution, and the **checkers** check the solution and ensure that everyone understands the solution and strategy.
5. Submit the assignment and review the returned homework.

Late homework without a valid excuse given in advance of the deadline will be penalized 40%. Homework that fails to rotate the recorder will be penalized 25%. To facilitate group work and promote individual accountability, students will periodically rate everyone’s effort (not academic ability), and the ratings will be factored into the individual grades. Students will also be asked to comment on group functioning throughout the term. The groups will be reshuffled if a majority of students would like to.

Disabilities

If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me soon. Please request that a Disability Resources staff send a SAAR form verifying your disability and specifying the accommodation you will need.