CE 576 Environmental Flows
Spring 2009

Course information

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Goals: To develop quantitative models of problems in environmental fluid mechanics, to develop thinking skills, to communicate effectively and function on teams

Prerequisites: Elementary fluid mechanics

Tentative outline:

1. Conservation laws
   1.1. Conservation of mass
   1.2. Conservation of momentum
   1.3. Application: Zebra mussel transport in rivers

2. Pipe flows
   2.1. Laminar flow
       2.1.1. Flow in a tube or slot
       2.1.2. Application: Groundwater
       2.1.3. Application: Particle settling and sediment transport
   2.2. Turbulent flow
       2.2.1. Characteristics of turbulence
       2.2.2. Law of the wall
       2.2.3. Application: Friction in pipes and conduits, municipal hydraulics
       2.2.4. Application: Friction in an open channel, open channel flow
       2.2.5. Application: Flow in vegetated channels

3. Unsteady flow
   3.1. Simple flows and the diffusion estimate \( \delta \sim (Dt)^{1/2} \)
   3.2. Application: River mixing
       3.2.1. Dispersion of a slug
       3.2.2. Superposition of solutions

4. Waves
   4.1. Linear wave theory
   4.2. Applications: Surface gravity waves, waves in lakes
5. Boundary layers
   5.1. The need for boundary layers
   5.2. Idealized examples
   5.3. Approximate analysis of boundary layers
   5.4. Applications
      5.4.1. Jets and plumes
      5.4.2. Oxygen transport in a lake boundary layer
      5.4.3. Salt wedges
      5.4.4. Biofilms

Requirements and policies:

The grade will be based on homeworks (20%), two midterms (20% and 25%), and a final exam (35%). Optional exercises will be given to reinforce lecture material; as incentive, individuals may submit the exercises for extra credit (~5%). The homeworks will be done in teams of three or four students that the instructor will assign. Your team will have the following responsibilities in completing homeworks:

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%. Homeworks that fail 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.