CE 422/522 Open Channel Flow
Spring 2015

Catalog Description: (3 units) Specific energy, momentum and energy principles; Uniform flow and gradually varied flow versus rapidly varied flow; Hydraulic structures: spillways, culverts, bridges; Differential equations governing unsteady flow in open channels; Simple surface waves in subcritical and supercritical flows; Introduction of kinematic, diffusion, and dynamic wave methods; Simplified methods of flow routing.

Prerequisite(s): CE 218.

Course Objectives: It aims to provide an introduction of fundamental principles governing steady and unsteady flow in open channels and apply these theories to solve practical problems such as analyzing flood waves, understanding flood routine in reservoirs, sizing stable channels, designing bridges, culverts, energy dissipater, and spillways.

ABET outcomes:
Primary
A. Apply mathematics, science and engineering principles
C. Ability to design a system, component, or process to meet desired needs
K. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Secondary
E. Ability to identify, formulate, and solve engineering problems
G. Ability to communicate effectively
J. Knowledge of contemporary issues
L. Pass the FE exam as the first step towards professional registration

Instructor: Jennifer G. Duan, Ph.D., P.E.
Class time & place: Tues, Thurs 9:30-10:45am @ Modern Language 410
Office Hours: Fridays 10:00-12:00pm
Review Sessions: TBA
Office: CE 324E, Civil Engineering Building, 1209 E. 2nd Street. Voice: 626-5946
E-mail: gduan@email.arizona.edu

Textbook: “Open Channel Hydraulics” by Terry W. Sturm, 2010 (ISBN 978-0071267939). Other materials will be supplied through course D2L website

Website: https://d2l.arizona.edu (follow instructions to the CE429/529 site)

Evaluation (CE 422 Students)
Homework 10%
Projects (3) 30% (10% each)
Midterm Exam (1) 25%
Final Exam 30%
Presentation 5%

**Evaluation (CE 522 Students)**

Homework 10%
Three Projects (3) 25% (7%, 8%, and 10%)
Mid-term Test 25%
Final Exam 25%
Graduate Project 10%
Presentation 5%

Graduate students will need to complete a technical report or paper in addition to all other requirements. Exams will be open book, and you will be allowed to bring only the textbook. Tests dates are approximate and will follow the termination of the topics assigned to the test.

Homework assignments will be posted at D2L site each Thursday and will be due on the following Thursday at the start of class. No late assignments will be accepted, including assignments turned in during or at the end of the class.

**Tentative Schedule**

**Week #1:**
L.1. Introduction (Syllabus, office hour)

**Week #2:**
L.2. Ch 1: Basic Principle
L.3. Ch 2.1: Specific Energy
**Homework #1**

**Week #3:**
L.4. Ch 2.2: Critical flow depth
L.5. Ch 2.3: Weirs
**Homework #2**

**Week #4:**
L.6. Ch 3.1: Hydraulic Jump
L.7. Ch 3.2: Momentum Principle
**Homework #3**

**Week #5:**
L.8. Ch 3.3: Supercritical flow transition
L.9. Ch 4.1: Uniform flow
**Homework #4**

**Week #6:**
L.10. Ch 4.2: Uniform flow computation
L.11. Ch 4.3: Compound Channel
**Homework #5**
Week #7: L.12. Ch 5.1: Gradually Varied Flow  
L.13. Ch 5.2: Water Surface Profile Computation  
**Homework #6**

Week #8: L.14. Ch 5.3: Natural Channel  
L.15. HEC-RAS: Steady Flow Basics  

**Project #1:** Steady Flow Hydraulics of the Rillito River

Week #9: L.16: **Mid-term Exam**  
L.17: Ch 6.1: Hydraulic Structure: Spillways  
**Homework #7**

Week #10: L.18: Ch 6.2: Hydraulic Structure: Culverts  
L.19: Ch 6.3: Hydraulic Structure: Bridge  

**Project #2:** Culvert and Bridge design in the Rillito River

Week #11: L.20. Ch 7.1: St. Venant Equation  
L.21: Ch 7.2: Simple Wave Analysis  
**Homework #8**

Week #12: L.22. Ch 9.1: Hydrologic Routing  
**Homework #9**

Week #13: L.23. Ch 9-2: Kinematic Wave Routing  
L.24. Ch 9-3: Diffusion Routing  

**Project #3:** Diffusion wave model of the Rillito River

Week #14: L.25. Ch 9-4: Muskingum-Cunge Method  
**Homework #10**

Week #15: L.26. Advanced Computational Models  
L.27. Student Presentation

Week #16: L.28. Student Presentation

**Final Exam:** Tuesday May 8, 2012 8:00 a.m. - 10:00 a.m. in Modern Language 410

**Projects and Project Teams**

A public domain computational model, HEC-RAS, will be employed to demonstrate how to apply these theories to engineering practice. Graduate students will need to complete a technical report or paper in addition to all other requirements.
A written report is required for each project. It should be typed in a professional format (double spaced), and it should include your objectives, introduction, description of the system, a brief review of theory, some discussion of the design process, a description of the final design and alternatives, results and conclusions, and references. *A guideline for project reporting will be posted on the D2L site.*
Academic Integrity

Principle Integrity and ethical behavior are expected of every student in all academic work. This Academic Integrity principle stands for honesty in all class work, and ethical conduct in all labs and clinical assignments. This principle is furthered by the student Code of Conduct and disciplinary procedures established by ABOR Policies 5-308 through 5-404, all provisions of which apply to all University of Arizona students.

This Code of Academic Integrity (hereinafter "this Code") is intended to fulfill the requirement imposed by ABOR Policy 5-403.A.4 and otherwise to supplement the Student Code of Conduct as permitted by ABOR Policy 5-308.C.1.

Failure to follow the code of academic integrity will result in failing the course and be reported to the Dean of Students’ office.

Prohibited Conduct: Conduct prohibited by this Code consists of all forms of academic dishonesty, including, but not limited to:

1 Cheating, fabrication, facilitating academic dishonesty, and plagiarism as set out and defined in the Student Code of Conduct, ABOR Policy 5-308-E.6, E.10, and F.1
2 Submitting an item of academic work that has previously been submitted without fair citation of the original work or authorization by the faculty member supervising the work.
3 Violating required professional ethics rules contained or referenced in the student handbooks (hardcopy or online) of undergraduate or graduate programs, or professional colleges.
4 Violating health, safety or ethical requirements to gain any unfair advantage in lab(s) or clinical assignments.
5 Failing to observe rules of academic integrity established by a faculty member for a particular course.
6 Attempting to commit an act prohibited by this Code. Any attempt to commit an act prohibited by these rules shall be subject to sanctions to the same extent as completed acts.

Student Responsibility

Students engaging in academic dishonesty diminish their education and bring discredit to the academic community. Students shall not violate the Code of Academic Integrity and shall avoid situations likely to compromise academic integrity. Students shall observe the generally applicable provisions of this Code whether or not faculty members establish special rules of academic integrity for particular classes. Students are not excused from complying with this Code because of faculty members’ failure to prevent cheating.
## ABET 2010 Criteria Course Classification Form

<table>
<thead>
<tr>
<th>Course Number</th>
<th>CE 422</th>
<th>Course Name</th>
<th>Open Channel Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required? Circle:</td>
<td>YES / NO</td>
<td>Semester/Instructor</td>
<td>Spring 2012/ Jennifer G. Duan</td>
</tr>
<tr>
<td>Homework Frequency?</td>
<td>weekly</td>
<td>Exam Frequency?</td>
<td>One mid-term and One final exam</td>
</tr>
<tr>
<td>Course Project? Circle:</td>
<td>YES / NO</td>
<td>Labs or Case Studies?</td>
<td>Circle: YES / NO</td>
</tr>
</tbody>
</table>

For each of the following ABET outcome criteria, please list the level (High, Medium, Low, or blank if not applicable) contained in this course. The criteria descriptions that will be used by the College in the ABET evaluation are attached. Please describe the relevant course activities that you can use to justify why you think your course meets the criteria. **No course is expected to address all of these criteria and it would be rare to have more than 2 or 3 criteria at a high level (except a capstone course).** Be conservative in your judgment. For the ABET evaluation, we will assess student performance for criteria that are judged High. If you judge your course as High in a criteria, then the course should include a large percentage of effort (class time, homework, projects) devoted to the criteria. Note that 2 extra table entries are available for departments to specify their own criteria.

<table>
<thead>
<tr>
<th>Outcome criteria</th>
<th>Level</th>
<th>Relevant Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Apply mathematics, science and engineering principles</td>
<td>H</td>
<td>This course requires students to apply energy and momentum principles to solve practical engineering problems, such as flood encroachment analysis, channel design</td>
</tr>
<tr>
<td>B. Ability to design and conduct experiments and interpret data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Ability to design a system, component, or process to meet desired needs</td>
<td>H</td>
<td>It requires students to size the geometries of stable channels, culverts, bridges, spillways, and detention basins.</td>
</tr>
<tr>
<td>D. Ability to function on multidisciplinary teams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Ability to identify, formulate, and solve engineering problems</td>
<td>M</td>
<td>Through several field case study, students understand the engineering problems, and the solutions to those problems.</td>
</tr>
<tr>
<td>F. Understanding of professional and ethical responsibility</td>
<td></td>
<td>No specific content. But, engineering ethical responsibility is stressed through the class.</td>
</tr>
<tr>
<td>G. Ability to communicate effectively</td>
<td>M</td>
<td>A presentation is required at the end of the semester to allow students practice communication skills.</td>
</tr>
<tr>
<td>H. The broad education necessary to understand the impact of engineering solutions in a global context</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Recognition of the need for and an ability to engage in life-long learning</td>
<td></td>
<td></td>
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<tr>
<td>J. Knowledge of contemporary issues</td>
<td>M</td>
<td>The course project is an on-going study for our local flood control district.</td>
</tr>
<tr>
<td>K. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>H</td>
<td>The course requires students to use modern computer software, such as HEC-RAS, for homework and projects.</td>
</tr>
<tr>
<td>L. Pass the FE exam as the first step towards professional registration.</td>
<td>L</td>
<td>The material, such as culvert design, in the class is to prepare students for PE exam.</td>
</tr>
<tr>
<td>M. Be proficient in the major areas of civil engineering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Optional: Comment on the overall strengths and shortcomings of the courses that are prerequisites to this course: