# CE 378 Water Resources Engineering

**Term:** Spring 2010  
CE 378 Water Resources Engineering (3). Three hours  
1:00 to 1:50 M, W and F, room 340 H.M. Comer

**Instructor:** Robert E. Pitt, Ph.D., P.E., BCEE, D. WRE  
**Office:** 215A Bevill (eventually)  
347B H.M. Comer (currently)  
**Office Hours:** M 3 to 5 pm; W 4 to 6 pm, when in town, or by appointment; by email anytime  
**Phone:** (205) 348-2684  
**e-mail:** rpitt@eng.ua.edu (UA) or rpittal@charter.net (home)

**TA:** Redahegn Sileshi (redahegnkas@yahoo.com)

<table>
<thead>
<tr>
<th>Catalog Description</th>
<th>Mechanics of steady and unsteady flow in closed and open conduits, hydrology; water supply and wastewater disposal.</th>
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<tbody>
<tr>
<td>Prerequisites</td>
<td>Dynamics (AEM 264) and Fluid Mechanics (AEM 311).</td>
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<tr>
<td>Co requisites</td>
<td>none</td>
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<tr>
<td>Course Objectives</td>
<td>This course is directed to applications of fluid mechanics, hydrology, and hydraulics as they apply to the discipline of water resources engineering. Topics covered include flow in closed conduits and open channels, hydraulic machinery (pumps), and surface water hydrology and statistical methods. Student projects will be directed to simple designs of sustainable urban water-use and water-control systems. At the successful completion of this course, the student will be able to apply the fundamental principles of conservation of mass, momentum and energy to the practical solution of both analysis and design problems in closed and open conduit flows, and will understand the performance characteristics of pumps. The student will also be introduced to hydrology and to methods of quantification of hydrologic uncertainty.</td>
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| Course Website      | Located at:  
http://unix.eng.ua.edu/~rpitt/Class/Water%20Resources%20Engineering/WREMainPage.htm |
| Required Texts and References | There are no required texts for the class, as much of the reference material is readily available from several sources, including the class website noted above. If you are interested in further study, or to specialize, in this field, then acquiring one of the standard reference textbooks noted below is suggested. |
| Suggested Texts and References | **Standard reference textbooks recommended:**  
- Chin, D.A., *Water Resources Engineering*, Prentice Hall. 2006. 962 pages (addresses all of the major course topics, but only briefly discusses sanitary sewerage design).  
- Mays, L.W., *Water Resources Engineering*, John Wiley & Sons. 2005. 860 pages (doesn’t cover sanitary sewerage design, but does a more through presentation of the other course topics). |
Internet reference material:

The advanced edition is available on-line at:

This book is also available on-line at:

Software:
EPANet 2.00.12 (US EPA) water distribution system design and analysis software (March 5, 2008 most recent version for Windows XP).
http://www.epa.gov/ORD/NRMRL/wswrd/epanet.html

WinTR-55 1.0.09 (USDA) hydrology software (August 5, 2009 most recent version).

SWMM5.00.018 (US EPA) storm drainage and sanitary sewerage system design and analysis software (November 18, 2009 most recent version).
http://www.epa.gov/ednnrmrl/models/swmm/index.htm

Grading
The final grade assigned for this course will be based on the following distribution, subject to slight modifications:

<table>
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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework and term projects</td>
<td>60%</td>
</tr>
<tr>
<td>Final project assignment</td>
<td>30%</td>
</tr>
<tr>
<td>Final class portfolio</td>
<td>10%</td>
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If you complete an assignment as given, and it is correct and presented in a professional manner, you will have done what is expected and will receive an “above average” grade. You will receive an “excellent” grade only for work of an outstanding caliber.

3 major term projects will be due during the term:
- water supply system design
- sanitary sewer design
- storm sewer system design

If any of the major assignments are not turned in, the student will receive an incomplete for the course.

Attendance Policy
Students are expected to attend all lectures. If an absence is unavoidable, the student should contact the instructor before the class meeting. Excessive unexcused absences may
result in grade reductions. The student is expected to be in class and seated at the beginning of the course period.

| Homework Policy | Homework and project assignments will be due on the dates announced in class. Homework turned in up to 2 days late will be assessed an automatic penalty of 20 percent. Homework submitted more that 2 days late will not be accepted. Missed assignments or quizzes will not be able to be made up unless prior arrangements have been made with the instructor, or in the case of a documented emergency.

All homework will be electronically submitted to the course TA who will conduct the initial assignment grading. Excellent examples of course work may be posted on the class website as examples for future students. |

| Exam/Quiz Policy | The exams will consist of take-home project assignments. Students will work individually, as they will have different design objectives and locations. |

| Other Course Policies | **Computer Use Requirement:**
This course has a "C" designation and hence will partially fulfill core curriculum requirements established by The University of Alabama. Water resources engineering is a field in which solutions to problems are very often multi-valued rather than single-valued. For example, solutions can consist of an entire vector or matrix of values, or they can be x-y graphs showing the relationship between two variables. Computer software, and particularly spreadsheets such as Microsoft’s Excel, is very well suited to developing tabular and graphical solutions to problems of the types encountered in this course. Students are required to employ software in the completion of homework and design assignments. Failure to do so on any particular assignment will result in an automatic 20 percent grade reduction for that assignment. Failure to use computers on a recurring basis will result in a non-passing grade for the course.

All design project assignments are required to be typed using a word processor, with extensive use of the “equation editor” and computer generated tables and graphs. Photographs from digital cameras, or scanned prints, may also be needed for some assignments. Scanned photos or field sheets should be saved as reduced size jpgs (200 dpi is suitable) to reduce the total file size of the resulting document. |

| Course Portfolio | The Department requires every student in every class to develop a course outcome portfolio. Through the course portfolio, each student is to demonstrate their achievement of the specific program outcomes addressed in each course (see the “Contribution to Program Student Outcomes” section of this syllabus). Graded work from the course (e.g., graded projects and other work.) may be used to illustrate achievement of the outcomes. Several assignments in the course will address specific outcomes. If a student does well in these assignments, they would be suitable examples for inclusion in the graduation portfolio. The portfolios will be turned in to the instructor at the last class period and will be handed back on the date of the final exam.

The intent of this requirement is to assist students with the development of a well-organized program outcome achievement portfolio required for graduation.

The portfolio must be organized with tabs indicating each outcome separately (e.g., T3, T5, T6, and P2). Behind each tab, a summary of how the attached assignments meet the outcome, along with the student work demonstrating command of the respective outcome
should be neatly presented. All materials must be three-hole punched, but do not use a
tree-ring binder. Rather, the portfolio materials must be secured with appropriately
sized binder clips. A cover page is required and must include the student’s name, the
course number and title, and the term the course was taken.

| Portfolio Grading | The portfolio grade is approximately 10% of the total course grade. If the portfolio is not
submitted (or incomplete), the student will receive an incomplete for the class. |
|-------------------|--------------------------------------------------------------------------------------------------|
| Academic Misconduct | Any act of dishonesty in any work constitutes academic misconduct. The university
Academic Misconduct Disciplinary Policy will be followed in the event of academic
misconduct and will be handled by the Dean’s office. |
| Accommodations | Reasonable accommodations are made on an individualized basis. It is the responsibility
of persons with disabilities, however, to seek available assistance and make their needs
known. The University has designated the Office of Disability Services as the campus
coordinating office for the provision and delivery of services and reasonable
accommodations that ensure the University's programs, services, and activities are
accessible to students with disabilities. The Office of Disability Services is available to
assist any student who has a qualified and documented disability. Please contact the
Office of Disability Services at 348-4285 for additional information. |
| Schedule/Topic Outline | Topics that will be addressed during this course will include the following. Also shown
are the general text pages for the topics in Chin. Numerous supplemental handouts and
Internet references will also be used. Durations shown are approximate and may be
adjusted as the semester progresses. In addition, a few review modules are also included
on the class website that will not be covered in class, but are available for the student’s
independent review and use.

There are a total of about 42 class sessions scheduled for the term (schedule shown
subject to adjustment):

**Introduction (Chin pgs 1 - 9)**
- **Module 1**: Historical Urban Water Systems
  1 class

**Flow in Closed Conduits (Chin pgs 10 – 40)**
- **Module 3a**: Continuity, Momentum and Energy (Bernoulli)
- **Module 3b**: Darcy Weisbach
- **Module 3c**: Hazen Williams
- **Module 3d**: Manning
- **Module 3e**: Comparison of methods
  5 classes

**Pipe Networks (Chin pgs 40 – 48; 64-89)**
- Demonstration of pipe network flow in hydraulics lab (after class hours period)
- **Module 4a**: Water demand
- **Module 4b**: Water distribution system design
- **Module 4c**: EPANET2 computer lab demonstration for design problem
  3 classes

**Pump performance and selection (Chin 48 - 64)**
- **Module 5**: Pumps and storage
  2 classes

**Flow in open channels (Chin 97 – 127; 127 – 145; 202 - 231)**
  5 classes
Demonstration of open channel flow in hydraulics lab (after class hours period)

**Module 6a:** Manning’s specific energy
**Module 6b:** Water surface profiles
**Module 6c:** Design for stable open channels
**Module 6d:** Stream buffers and land development

**Design of sanitary sewers (Chin pgs 231 - 255)**
**Module 7:** Sanitary sewer design

**Probability and statistical methods (Chin pgs 271 - 328)**
**Module 8:** Probability and statistics

**Surface water hydrology (Chin pgs 334 - 424)**
**Module 9a:** Rainfall and runoff introduction
**Module 9b:** Runoff calculations with WinTR55
**Module 9c1:** WinTR55 demonstration in computer lab for design problem
**Module 9c2:** WinTR55 ponds document
**Module 9d:** Detention pond design with routing

**Design of storm sewer systems (Chin pgs 479 - 541)**
**Module 10a:** Storm sewer system design
**Module 10b:** Gutters and inlet design
**Module 10c:** Getting started with SWMM5 storm and sanitary demonstration in computer lab for design problems
**Module 10d:** Sediment movement in sewers

**Culvert design (Chin pgs 185 - 202)**
**Module 11:** Culvert hydraulics

Adobe Acrobat pdf versions of the course PowerPoint presentations and supplementary material are available from the course website, located at:
http://unix.eng.ua.edu/~rpitt/Class/Water%20Resources%20Engineering/WREMainPage.htm. Students can print out copies of these materials from the website.

The anticipated schedule for the computer lab sessions will be announced.

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<tr>
<th><strong>Midterm Exam Date(s)</strong></th>
<th>The major assignment due dates will be announced in class with sufficient time for completion.</th>
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</table>
| **Final Exam Date:**     | **First class:** January 11, 2010  
**Class holiday (MLK day):** January 18, 2010  
**Spring break:** March 13 through 21, 2010  
**Honor's day holiday:** April 9, 2010  
**Last day of class:** April 30, 2010  
**Final exam:** May 6, 2010; 11:30 am to 2 pm |

| **Homework Format** | Homework will be submitted in a professional and complete style. Almost all problems will require neatly sketched figures. Grades will be reduced for poor organization and inappropriate use of significant figures. See note on computer use for this class. |
A plus/minus grading system will be in effect for undergraduate students.

## Contribution to Program Student Outcomes

As required for the accreditation of our BSCE and BSConE programs the following student learning outcomes have been established. These outcomes describe what students are expected to know or be able to do at the time of graduation. At a minimum, the outcomes that have been checked below will be fully or partially addressed, perhaps at a lower level, in a significant and direct manner in this course. Other outcomes may be addressed to a lesser extent.

| Outcome F1: (Level 3) This class Level 3 | Solve problems in mathematics through differential equations, probability and statistics, calculus-based physics, general chemistry, and one additional area of science. The course assignments, quizzes and exams utilize mathematical and scientific skills and tools. |
| Outcome T1: (Level 4) This class Level 3 | Apply material science, mechanics of solids, and mechanics of fluids. Fluid flow in pipes and channels and design of these systems uses fundamentals of fluid mechanics. |
| Outcome T3: (Level 3) This class Level 3 | Apply relevant knowledge, techniques, skills, and modern engineering tools to identify, formulate, and solve engineering problems, including BSCE – problems in at least four technical areas appropriate to civil engineering or BSConE – problems in construction processes, communications, methods, materials, systems, equipment, planning, scheduling, safety, economics, accounting, cost analysis and control, decision analysis, and optimization. This class applies relevant knowledge in water resources engineering to actual design problems. The construction process and planning/scheduling considerations are also important aspects of the class design problems. |
| Outcome T6: (Level 5) This class Level 5 | Design a system or process in more than one program-relevant civil or construction engineering specialty field to meet desired needs, within realistic constraints such as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability. Students in this course perform and document (through formal reports) designs of water supply networks, sanitary and storm sewer systems, and culverts. |
| Outcome P2: (Level 4) This class Level 4 | Organize and deliver effective written, verbal, graphical and virtual communications. Formal design reports are written by the students in this class for each of the major assignments. These reports are written and use graphical presentations. |
| Outcome P3: (Level 3) This class Level 3 | Demonstrate the ability to learn through independent study, without the aid of formal instruction. Certain design problems will require the student to collect needed information to supplement the assignment. In addition, the advanced design assignments will require independent study beyond the formally presented class material. |