

Advanced Water Resources Engineering
908-443 / 908-543

Spring 2005
17:30 – 20:00 Thursday

INSTRUCTOR: Dr. Mike Horst
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OFFICE HOURS: by appointment, immediately prior to or at the end of class
WEB PAGE: none

TEXT: *Water Resources Engineering*, by David A. Chin

Supplement: *Introduction to Hydrology*, by Viessman & Lewis
Supplement: *Design Hydrology and Sedimentology for Small Catchments*, by Barfield & Haan
Supplement: *Open Channel Flow*, by Henderson

GOALS: This course is an extension of Water Resources Engineering, with a focus on engineering applications to hydraulics and hydrology. We apply the concepts gained in Fluid Mechanics (hydrostatics, conservation laws) and Water Resources Engineering (hydrology, closed conduit & open channel flows) to develop design and/or analytical solutions for various situations encountered in professional practice. The course will be broken into 2 segments: the first part of the semester (4-5 weeks) will be spent on practical hydrologic engineering concepts and analysis (hydrology) – the second part of the semester (9-10 weeks) will be spent on hydraulic engineering problems – specifically open channel flow situations including: water surface profiles, bridge/culvert hydraulics, bridge scour, introduction to unsteady flow.

GRADING:

Homework	(20%)
Design Projects	(60-80%)
Final Exam	(0-20%)

Explanation of Grading System:

Homework (20%): Puzzle and problem-solving skills are the hallmark of a successful engineer. You will be expected to complete homework puzzles before the next class period. You may work on the home problems with your colleagues, but the work you turn in must be your own. You will be expected to follow the College of Engineering Homework Format guidelines for all work done for this course; neatness and clarity are essential to conveying technical information to others. A description of the desired format is shown below.

Late homework will not be accepted without prior arrangement with the instructor.

Design Projects (60-80%): There will be a number of design projects throughout the semester. These projects will be presented in the form of a letter from a client to an engineering company that you work for. You will be expected to develop a design and/or analytical solution to the client's problem, and then respond to the client with a letter report.

Final Exam (0-20%): The final exam (if given) will allow you to integrate and synthesize the material covered in this class.

Graduate Credit: To receive graduate credit for this course, the student will be assigned a specific research topic from which he/she will prepare a detailed technical report and give a 10-15 minute presentation to the class.

DESIGN PROJECTS

In this course, you will complete a number of open-ended design problems. These design problems are larger assignments that integrate material covered in this class, from prior classes, and from experiences outside the class.

The open-ended design problems are set up so that the students act as design engineers for a consulting company. The project is presented to the students in the form of a letter from one of the firm's clients, which states the problem and provides some (but possibly not all) of the information required to develop an engineering solution. Students may work in teams of two or three to solve the client's problem, but each student is required to turn in a separate solution. The solution is in the form of a formal report from the student to the client (including a cover letter), backed up with detailed engineering calculations so that a knowledgeable peer could verify the design approach and procedures used.

The number and nature of the open-ended design projects will depend on course direction and student interests. Possible topics include:

- Developing a site-specific unit hydrograph which is then used to determine a design flow rate and volume for a dam or bridge design
- Determining a design flow for an un-gaged watershed using synthetic unit hydrograph theory and regression equations
- Designing a simple water-slide / splash pool
- Sizing a bridge to pass a predetermined flow rate
- Unsteady flow routing from a dam breach and determination of corresponding flood inundation levels.

TENTATIVE LIST OF TOPICS

The content of this course is dictated partly by student interests. Some potential topics include:

Hydrology

- Rainfall/runoff relationship
- Losses
- Unit hydrograph development
- Synthetic unit hydrographs
- Regression analysis
- Statistics
- Hydrologic modeling program (HEC-1 and/or HEC-HMS)

Hydraulics

- Water surface profiles
- Looped networks
- Bridge hydraulics
 - Ineffective flow areas
 - Overtopping analysis
 - Multiple openings
- Culvert hydraulics
- Bridge scour
- Introduction to unsteady flow
- Hydraulic modeling program (HEC-RAS)

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Tentative Course Schedule

Date	Topic
January 20	Introduction, Hydrology review (rainfall, loss rates)
January 27	Hydrology - unit hydrographs, hydrograph convolution, S-Curves
February 3	Hydrology – site specific hydrographs, synthetic unit hydrographs
February 10	Hydrology – regression equations, HEC-HMS
February 17	Hydrology – HEC-HMS, GeoHMS
February 24	Hydraulics - fluid mechanics review (conservation of mass, momentum, energy)
February 31	Hydraulics – manning’s equation, specific energy, Water surface profiles
March 3	Hydraulics – hydraulic jump, direct step, standard step
March 10	Hydraulics – standard step cont’d, HEC-RAS
March 17	Spring Break - No Class
March 24	Hydraulics - HEC-RAS
March 31	Hydraulics – HEC-RAS, bridge hydraulics
April 7	Hydraulics – HEC-RAS, bridge hydraulics cont’d, scour
April 14	Hydraulics – HEC-RAS, culverts, multiple openings
April 21	Hydraulics – unsteady flow – dam break problem
April 28	Presentations, review

Rowan Engineering Homework Format

All homework problems, unless otherwise directed by your instructor, should follow the Rowan Engineering Format. This format is used for most professional engineering work. Unless otherwise directed by your instructor, you should use engineering paper or the equivalent for all homework assignments.

- 1) **Headers:** The five boxes at the top of each sheet of engineering paper that you use for a homework assignment should contain the following information from left to right:
 - a) put the staple (which is the required homework binder) in the first (small) box
 - b) print your full name in the second (large) box. *If this is a team homework*, then print the team leaders name in the fourth box and the names of each *participating* team member below this box.
 - c) print the date that the assignment was completed in the third (large) box
 - d) print the course name or number in the fourth (large) box
 - e) print the page number / total number of pages in the fifth (small) box
- 2) **Writing Mechanics:** All homework should be:
 - a) carefully printed and not written in cursive
 - b) printed in pencil and not in ink
 - c) neat and clean, *i.e.* printed on the lines with no smudges or cross-outs
- 3) **Calculations:** All homework calculations should:
 - a) include at least one complete sample for every type of calculation presented
 - b) include all units for each term in each equation and the units must balance
 - c) use the appropriate number of significant figures (usually three) for all numbers
 - d) clearly indicate the final solution by boxing it in with a rectangle
- 4) **Problem Order:** Problems should be presented
 - a) in the order assigned (one, two, three, etc.)
 - b) with a new problem starting on a new page of engineering paper
 - c) with the designated problem number, from textbook or professor, under box 2.
 - d) using only the front side of each sheet of engineering paper
- 5) **Problem Essentials:** Problem solutions should include the following items in order:
 - a) homework problem number listed at beginning of problem
 - b) the given information - the information that will be used to solve the problem
 - c) the required information - the information or solution that we are looking for
 - d) a straight-edge diagram or diagrams that clearly illustrate the problem
 - e) the solution of the problem including all required steps and calculations
- 6) **Evaluation:** Double-check all of your calculations to make sure that:
 - a) all of your math is correct, *i.e.* you made no errors in using the calculator or computer
 - b) all of your equations are correct, *i.e.* you made no errors in manipulating equations
 - c) all of your units balance, *i.e.* you derived the correct units for the desired solution
- 7) **Computers:** Homework Assignments using Computers
 - a) Show sample calculations (with units) for each spreadsheet calculation. A printout of a spreadsheet is not sufficient because of the difficulty in inferring formulas from the numbers. Spreadsheet formulas can be printed in addition to the sample calculation using the commands: Tools, Options, View tab, click in Formulas box under Window Options.
 - b) Do not printout raw data from data acquisition experiments. A graphical presentation of this data is sufficient unless otherwise requested from the professor.