CE 4333 – Practical Computational Hydraulics in R
Course Syllabus

Time and Location

Time is listed on attached schedule below.
This course is an instructor led special-topic summer course conducted during Summer 2017, at ISA Offices, Tokyo, JAPAN

The syllabus is adjusted to reflect special circumstances related to the international experience. The tabular schedule is a guideline; we will try to follow it closely, but be prepared to adjust to changes in pace dictated by our collective experience.

Instructor

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Office Hours

Open door – we can meet after each day for questions; also in mornings before/during breakfast

Catalog Description and Prerequisites

CE 4333: Special Problems in Water Resources (3:3:0). Individual studies in water resources. May be repeated for credit. *co-requesite CE 3305*

This course is intended to be taken in companion with Fluid Mechanics; students will be building a computer toolkit of many components of fluid mechanics historically relegated to hand calculators.

Textbook

Cleveland T. G., Practical Computational Hydraulics using **R**. *in progress*.

The textbook is located at:
`http://cleveland1.ddns.net/university-courses/ttu-courses/ce-4333/3-Readings/PCHinR/PCHinR.pdf`

Purpose

The course provides engineering students with practical computation tools suitable for hydraulic analysis of typical civil infrastructure systems. Students should be able to use this foundation for understanding and troubleshooting professional hydraulics software. This course provides students with a set of tools that are directly applicable to pipe systems, open channels, aquifers, filters, and simple reactors.

Objectives

Upon completion of this course, students should be able to:

1. Apply fluid properties to analyze and build scripts to solve fluid mechanics problems in **R**.
2. Analyze hydraulic systems to build mathematical structures suitable for programming.
3. Simulate hydraulic behavior using custom built scripts written in **R**.
4. Apply custom simulation models for various geometries for pipe, open channel or porous medium flow.
5. Use custom built models to design a hydraulic system.

Course Schedule

Table 1: CE 3305 Course Schedule – Summer 2016

[ID: Lecture code; each ≈ 1.5 hours in duration;
DATE & TIME: Date and time of scheduled lecture;
TOPIC: Lecture content synopsis;
READING: Relevant book pages.

ID	DATE	TOPIC	READING
1	13 JUN 17	Introduction; Software Install and Verify	pp. 1 - 25
2	14 JUN 17	Algorithms; **R** for programming	pp. 26 - 43
3	15 JUN 17	Integration, Differencing, Newton's Method	pp. 44 - 78
4	19 JUN 17	Tank Drain by Finite-Difference (ODE)	pp. 79 - 86
5	20 JUN 17	Simultaneous Linear Equations	pp. 87 - 112
6	21 JUN 17	Simultaneous Non-Linear Equations by Minimization	pp. 113 - 119
7	22 JUN 17	Simultaneous Non-Linear Equations by Newton-Raphson	pp. 120 - 125
8	26 JUN 17	Pipe Network Hydraulics	pp. 126 - 133
9	27 JUN 17	Pipeline Network Analysis (Algebraic Non-Linear System)	pp. 134 - 144
10	28 JUN 17	Tanks, Pumps, and Valves (Functional Coefficients)	pp. 145 - 153
11	29 JUN 17	Pipeline Transients (Water Hammer)	pp. XX-XX
12	3 JUL 17	Open Channel Hydraulics	pp. XX-XX
13	4 JUL 17	Steady Flow – Water Surface Profiles (ODE)	pp. XX-XX
14	5 JUL 17	Unsteady Flow; Staggered Grids; Upwinding (Hyperbolic PDE)	pp. XX-XX
15	6 JUL 17	Method of Characteristics for Boundary Conditions	pp. XX-XX
16	10 JUL 17	Groundwater Hydraulics	pp. XX-XX
17	11 JUL 17	Steady Groundwater Flow (Elliptical PDE)	pp. XX-XX
18	12 JUL 17	Unsteady Groundwater Flow (Parabolic PDE)	pp. XX-XX
19	13 JUL 17	Flow Nets	pp. XX-XX
20	17 JUL 17	Dissolved Mass Transport Theory	pp. XX-XX
21	18 JUL 17	Analytical Solutions	pp. XX-XX
22	19 JUL 17	Numerical Solutions (Hyperbolic PDE)	pp. XX-XX
23	20 JUL 17	Final Examination	pp. XX-XX

Assessment Instruments

Homework

Homework will be due at the beginning of class on the second class day after it is assigned. You may work in teams and submit as a team assignment. Identify all team members. Homework problem solving approach:

1. State the problem and sketch the system
2. Identify and list the given information
3. Identify and list the unknowns
4. Identify governing equations and state assumptions
5. Solve for unknowns and calculate results
6. Discuss the results

Examinations

There will be one final examination, comprehensive, but similar to homework problems. The examination will be open-notes, open-book.

Grading Policy

Final grades are determined based on performance during the course. Letter grades will be assigned using University standards. The **approximate** weighting of graded material in determining the final grade is as follows[1]:

Item	Percent of Grade
Exercises	50%
Examination	50%

[1] Graded materials with fewer than 100 points will have raw scores normalized to 100 points for calculating the final grade.

ABET Program Outcomes

A subset of the ABET Program Outcomes are addressed in CE 3305, these outcomes are listed below:[2]

- `3[a].` Ability to apply knowledge of mathematics, science, and engineering.
- `3[b].` Ability to design and conduct experiments, as well as to analyze and interpret data.
- `3[e].` Ability to identify, formulate, and solve engineering problems.
- `3[i].` Recognition of need for life-long learning.
- `3[k].` Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- `8[d].` Proficiency in water resources engineering.

Academic Misconduct

Refer to the Texas Tech University Catalog and operating policies (OP 34.12) regarding academic integrity, cheating, and plagiarism. Academic dishonesty will not be tolerated.

Disability Policy

"Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructors office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office at 335 West Hall or 806- 742-2405."

[2]Item 3[b] below is only partially fulfilled – in this course students will analyze and interpret data, design of experiments is beyond the scope of the class.