CE 555 GROUNDWATER HYDROLOGY
Tu-Th 2:30-3:45pm
223 Thomas

INSTRUCTOR: Dr. Patrick Reed
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OFFICE HOURS: Friday 9am-11am or by appointment

REQUIRED TEXT: Ghislain de Marsily, Quantitative Hydrogeology: Groundwater Hydrology for Engineers, Academic Press, Inc., New York, 1986.

GRADING:		
	Participation	15%
	Project/Critique	30%
	Bi-Weekly Quizzes	60%

Letter grades will be based on the weighted average specified above and assigned as follows:

- A = 94-100%
- A- = 90-93%
- B+ = 87-89%
- B = 84-86%
- B- = 80-83%
- C+ = 76-79%
- C = 70-75%
- D = 60-69%
- F < 60%

I reserve the right to adjust your grades. Your grade will only improve if adjustments are necessary. Feel free to contact me during office hours or by appointment if you have grade-related questions or concerns.

COURSE GOALS:

I intend for this course to assist you in developing a qualitative and quantitative understanding of using mathematical models to simulate groundwater in complex hydrologic settings.

IN CLASS PARTICIPATION:

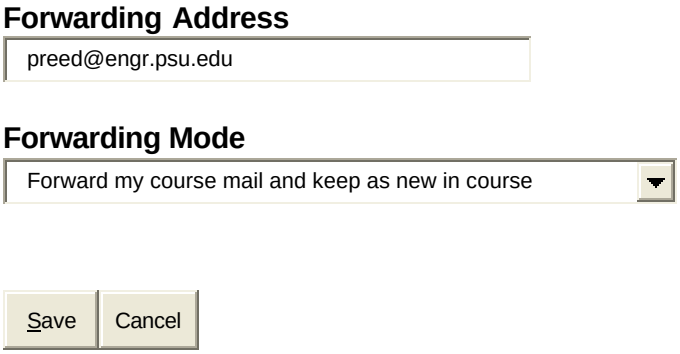
Please bring your text, a calculator, and scrap paper to each class. You will be participating in the solution and discussion of in-class example problems. You will hand in your signed attempt to solve the problems; simply attempting the solution will result in full participation credit for the day. These in-class exercises will require that you **complete the assigned readings** prior to the beginning of each class.

ON-LINE CLASS PARTICIPATION:

All course emails and web postings will be made using the ANGEL course management software. You will need to regularly login (**https://cms.psu.edu/frameIndex.htm**) to check course announcements, download in-class example solutions, and access posted homework solutions.

Important: When you 1st login into the system you must configure "My Settings" to forward course emails to your primary email account as follows:

Step 1: Login into system
Step 2: Click "My Settings"
Step 3: Click "System Settings"
Step 4: Type your PSU Email under "Forwarding Address" and set "Forwarding Mode" as shown below:



Step 5: Click "Save". You now should receive all course announcements in your primary email account as well as your ANGEL account.

BI-WEEKLY QUIZZES:

Every other Thursday quizzes will be given from material taken from the course reading and lectures. These quizzes will have an in-class component focusing on brief derivations, definitions, and concepts of from the assigned reading. The in-class portion of these quizzes will be **closed book** (all required formulas will be supplied). The take home portion of these quizzes will provide you with the opportunity to work more detailed problems. These quizzes should reflect your individual effort and are not intended to be group exercises.

These quizzes are meant to improve your understanding of the material covered and aid my assessment of how well the class understands topics. This course has no midterm or final exams.

PROJECT/REVIEW

You will individually be required to complete either a 10-page critical literature review or a modeling project using the GMS Modflow software package. You will be given detailed descriptions of each of these project options before the mid-term of this semester.

ACADEMIC INTEGRITY

The University's statement on academic integrity, from which the following statement is drawn, is available at **http://www.psu.edu/dept/oue/aappm/G-9.html**

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

All students are expected to act with civility, personal integrity; respect other students' dignity, rights and property; and help create and maintain an environment in which all can succeed through the fruits of their own efforts. An environment of academic integrity is requisite to respect for self and others and a civil community.

Academic integrity includes a commitment to not engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty include cheating or copying, plagiarizing, submitting another persons' work as one's own, using Internet sources without citation, fabricating field data or citations, "ghosting" (taking or having another student take an exam), stealing examinations, tampering with the academic work of another student, facilitating other students' acts of academic dishonesty, etc.

Students charged with a breach of academic integrity will receive due process and, if the charge is found valid, academic sanctions may range, depending on the severity of the offense, from F for the assignment to F for the course.

COURSE SCHEDULE (subject to change, if topics require more lecture time)

WEEK/DATE	TOPIC	LEC	READING	QUIZ DATES
1 / Aug. 31	NO CLASS, FRIDAY SCHEDULE			None
1 / Sept. 2	Intro/The Water Cycle	1	Ch1: 1-12	
2 / Sept. 7	Fluid-Solid Relations in Porous Media	2	Ch2: 13-38	
2 / Sept. 9	Review of Vectors	3	Clark Handout	Q1 in class/assign.
3 / Sept. 14	Review of Linear Algebra	4	Heath Ch2 Handout	
3 / Sept. 16	Darcy's Experiment	5	Ch4: 58-74	Q1 assign. due
4 / Sept. 21	Permeability—Anisotropy & Heterogeneity	6	Ch4: 75-82	
4 / Sept. 23	Aquifer Systems	7	Ch6: 116-134	Q2 in class/assign.
5 / Sept. 28	Flow Equations—Continuity and the Diffusion Equation	8	Ch3: 39-52; Ch5: 85-90	
5 / Sept. 30	Flow Equations—Saturated and Unsaturated Mediums	9	None	Q2 assign. due
6 / Oct. 5	Flow Equations—Confined and Unconfined Flow Systems	10	None	
6 / Oct. 7	Boundary Conditions	11	Ch6: 135-142	Q3 in class/assign.
7 / Oct. 12	Steady Flow Solutions & Applications	12	Ch7:143-161	
7 / Oct. 14	Steady Flow Solutions & Applications	13	Same	Q3 assign. due
8 / Oct. 19	Unsteady Flow Solutions & Applications	14	Ch8: 162-179	
8 / Oct. 21	Unsteady Flow Solutions & Applications	15	Ch8: 190-198	Q4 in class/assign.
9 / Oct. 26	Stream Function, Potential Flow, Flow Nets	16	Cherry Handouts	
9 / Oct. 28	Flow Nets and Superposition	17	Same	Q4 assign. due
10 / Nov. 2	Modeling: Benefits & Pitfalls	18	Ch12: 396-402; Modeling Papers Heath Ch 11 Handout	
10 / Nov. 4	Introduction to Finite Difference Methods (FDM)	19	Lapidus Ch 2 Handout	Q5 in class/assign.
11 / Nov. 9	Example FDM Formulations: 1-D Confined & Unconfined Flow	20	Lapidus Ch 4 Handout	
11 / Nov. 11	Von Neumann Stability Analysis	21	Vichnevetsky Handout	Q5 assign. due
12 / Nov. 16	Von Neumann Stability Analysis	22	Same	
12 / Nov. 18	Example 2-D FDM Formulations	23	None	Q6 in class/assign.
13 / Nov. 23	NO CLASS			
13 / Nov. 25	NO CLASS			
14 / Nov. 30	Example 3-D MODFLOW Formulations	24	None	Q6 assign. due
14 / Dec. 2	STUDENT PRESENTATIONS			
15 / Dec. 7	STUDENT PRESENTATIONS			
15 / Dec. 9	STUDENT PRESENTATIONS			

NO FINAL EXAM