

***SYLLABUS***  
**GROUNDWATER HYDROLOGY (476K)**  
**AQUIFER TESTING (191W)**  
**PHYSICAL HYDROGEOLOGY (391C)**  
**Fall Semester, 2011**

Instructor: Jack Sharp, EPS 3.150, JGB (GEO) 6.110 ([jmsharp@jsg.utexas.edu](mailto:jmsharp@jsg.utexas.edu))

Office hours: M & W 11-12 or by appointment

Teaching assistants:

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T 8-10 - 27660

W 1-3 - 27665

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W 8-10 - 27675

M 5-7 - 27685

Objectives: This course:

1. reviews the basic principles of groundwater hydrology/physical hydrogeology from geological, physical, mathematical, and geotechnical points of view;
2. (in 191W or the 476K lab) reviews or introduces students to basic computational and interpretative methods used in analyzing groundwater systems; scientific paper writing and presentation, and
3. examines at promising new areas of hydrogeologic research through lectures, assigned readings, and a student-selected project/term paper.

Meeting times:

The lecture is from 10:00-11:00 AM MWF in JGB/(GEO) 3.222.

A weekly literature/research discussion meeting for the graduate students in 391C will be arranged.

Laboratory: 476K labs and 191W will meet in EPS 2.104.

Texts: Two required texts:

1. Sharp, John M., Jr., 2011, A Glossary of Hydrogeological Terms: Department of Geological Sciences, The University of Texas, Austin, Texas, 72p.

2. Sharp, J. M., Jr., 2011, Hydrogeology Notes: Department of Geological Sciences, The University of Texas, Austin, Texas, 424p.

Inquiring students will supplement the above materials with pertinent portions of the texts listed on the additional references. Additional papers may be assigned during the semester.

Other talks/opportunities. Hydrogeology talks are given in a number of other venues - technical sessions and other seminars within the Department (including periodic hydrogeology brown bag seminars), at the

BEG or UTIG, in other UT Departments (especially Petroleum and Geosystems Engineering, Civil Engineering, and Geography), at other agencies (e.g., USGS), and still other venues (e.g., Austin Geological Society, SIPES, etc.).

I will keep you informed of these other opportunities that help UT hydrogeology unique. Classroom instruction and assignments should not be the only source of your (scientific) education. If you know of other pertinent seminars/talks, please bring them to the attention of the class.

Field trips: Optional field trips will be offered. These may include some of the following ½ or 1-day field trips:

1. Carbonate aquifers and karst: the local Edwards aquifer
2. Sediments and sedimentary rocks
3. Igneous rocks and fractured media
4. A longer 4+day trip to Trans-Pecos Texas may also be offered.

Because of student schedules and the size of this class, these are not required, but extra credit is given for attendance. The exams will have optional questions that those who participate in the field trips may choose to answer.

Laboratory: All 476K students must attend one of the laboratory sessions. Graduate students who have not had several previous classes in physical hydrogeology should take Geology 191. Graduate students who take 191W generally do better in the exams, have higher class rankings, and are more satisfied with the course. Geology 191W meets concurrently with the 476K labs.

391C Graduate discussion: This consists of literature reviews of articles selected by faculty and student, an annotated bibliography, and a short (3-page) research proposal. Undergraduates are welcome to attend. The discussion session times will be arranged

Office hours: Formal office hours are: 11:00-noon - Monday and Wednesday or by appointment or feel free to come in and chat whenever the door to my office is open. *Informal* office hours:

1. when there are hydro speakers at Tech Sessions (typically, we take them out for a few beverages or dinner afterwards).
2. after the Hydrogeology Brown Bag Seminar (1:00PM on Fridays).
3. I will have a few 5:00 PM meeting times to review or discuss tests, etc.

Lecture topics: The projected order of topics is below. Revisions to the syllabus will be announced in class as needed.

Grading:

	<u>476K</u>	<u>391C</u>	<u>191</u>
2 examinations	50%	60%	-
Final examination**	(25%)	(30%)	-
Lab problem sets –	25%	-	100%
Term paper – writing *	25%	-	-
Literature reviews	-	10%	-
Annotated bibliographies	-	10%	-
Research proposal	-	20%	-

Grading policy: A (>90.5%); A- (89.5 -90.4%); B+ (88.0- 89.4%); B (80.5 -87.5%); B- (79.5 – 80.4%); C+ (78.0- 79.4%); C (70.5 -77.5%); C- (69.5 – 70.4%); D (59.50 -69.4%); F (< 59.4%).

Note: Information pertinent to the exams, schedule revisions, and announcements of opportunities (talks, job interviews, etc.) will be presented in class lectures. Guest lecturers in hydrogeology will present

material in class that will be included on exams. We try to take advantage of the visitors to our program.

\* 476K is a substantial writing component class. The term paper draft, outline, and final paper are 25%, but there are also writing components in the laboratory.

\*\* The optional final is comprehensive and can substitute for your lowest term examination or if you missed one of the term exams.

For each exam, be sure to bring pens & pencils, a ruler, and calculator, if you need one. Most of the test calculation problems will be simple enough to do without a calculator, but...?

## THE 10 COMMANDMENTS OF HYDROGEOLOGY

(courtesy of Mike Campana, but slightly modified here)

Thou shall:

1. not assume isotropy, homogeneity, or a uniform hydraulic gradients without field evidence.
2. not assume that wells or streams fully penetrate or that flow systems are 2-dimensional without field evidence.
3. not use regional data to make site-specific judgments.
4. not use color graphics to enhance lousy science.
5. not employ geostatistics to obfuscate poor interpretations or weak conclusions.
6. not rely on stochastic methods to disguise insufficient field data.
7. not place geochemical or isotopic interpretations above hydraulic interpretations.
8. never regard geophysics or a numerical model as the truth.
9. never use a contouring program to make a water-table (unless you hand contour it first to be sure that the program output is believable).
10. never use more than 3 significant digits.

## LECTURE/COURSE SCHEDULE FOR 2011 (subject to revision)

("He listens well who takes notes" - Dante Alighieri)

<i>DATE:</i>	<i>TOPIC:</i>	<i>READINGS:</i>
		** will be on library reserve * will be handed out in lecture
BASIC CONCEPTS		
Aug. 24	The hydrological cycle	1-14
26	Porosity	15-36
29	Darcy's law LAB: Porosity	37-54 Darcy, 1856**
31	Permeability	55-72
Sep. 2	Permeability and flow nets	73-98
5	<i>Labor Day - no class</i>	-
7	Flow nets & Regional flow systems LAB: Aquifer short reports & Regional flow and groundwater exploration assignments will be given in lecture. The labs will not meet formally this week.)	89-114
9	Storativity; Safe yield; sustainability, & groundwater law	(Pierce et al.) * 287-302
12	Karst LAB: Darcy's Law	GSA Special Paper 404, p. 123-136**
14	<u>Case history</u> - Cuatrocienégas Basin	(Wolaver et al.) *
16	<u>Case history</u> - Zacatón	(Gary et al.)*
BASIC PHYSICS		
19	Concept of storativity; subsidence LAB: Permeability ( <b>Due:</b> aquifer short reports –assigned 7 September))	115-134
21	<u>Case History</u> - Subsidence Tidal and barometric efficiencies	135-140 (Wilson et al.) *
23	Continuity Equation	
26	Pumping tests LAB: Flow nets	141-166
28	Pumping tests	
30	Infitrometer & piezometer tests	

**Due:** 476K term paper rough draft and outline by 5:00PM

Oct. 1	<i>Water New Years Day</i>		
3	Vadose (Unsaturated) Zone LAB: Consolidation	167-174	
5	Fractured media	177-194	
7	<u>First exam</u> (this will have to be a larger room, if none is available at this time, the exam will have scheduled in the evening., so plan ahead. If an evening exam, the class period will be a time for review and answering any questions you might have.)		
9-12	No classes: GSA No LABs		
14	Free convection <b>Due:</b> 476K term paper rough draft student edits by 5:00PM	195-200	
17	Free convection LAB: Pumping Tests	Simmons et al. *	-
19	Fresh-water / salt-water systems	201-206	
21	Mass Transport <b>Due:</b> 391C annotated bibliographies	207-222	
24	Diffusion and dispersion LAB: Vadose Zone	223-242	
26	Diffusion & dispersion – Mass transport reactions		
28	Geostatistics	413-424	
31	Students will help select for 2-3 day lectures sets on the following topics: Energy Transport – geothermal systems Fractured rock systems* NAPL/petroleum migration Hydrogeology of sedimentary basins Regional flow in semi-arid systems Urbanization effects* (Geophysics – covered in this semester's hydrogeophysics class) (Karst – covered in next semester's karst hydrogeology class) LAB- tbd (based upon lecture set choices)		
Nov. 2	-		
4	-		
7	LAB: Regional Flow ( <b>Due</b> before 10:00 AM; 2 copies. Assigned on 7 September)		
9	-		

11	<i>Veterans Day</i>
14	LAB- tbd (based upon lecture set choices)
16	-
18	-
21	L AB- tbd (based upon lecture set choices) <b>Due:</b> 476K term paper/project final (2 copies <u>before</u> 5:00PM, attach copy of the edits)) <b>Due:</b> 391C GSA grant applications.
23	-
24-25	<i>Thanksgiving vacation &amp; A&amp;M game</i>
28	Make-up LAB- tbd (based upon lecture set choices)
30	Review
Dec. 2	<u>Second exam</u> (this will have to be a larger room, if none is available at this time, the exam will have scheduled in the evening., so plan ahead. If an evening exam – the class period will be a time for review and answering any questions you might have.)
5	Grades available
Dec. 7	OPTIONAL FINAL (0900-1200 at a site to be designated).

Note the final is optional.

- If you are satisfied with your tentative grade, you may skip the final.
- If you missed an exam, you must take the final.
- If you are dissatisfied with your grade on one of the other two exams or your class ranking, the final will substitute for your lowest grade.

Final will consist of: 50 multiple choice – 50 points & 5 (out of 8) short answer/discussion/calculation problems – 50 points

Other (I apologize – I know that we all know or can infer these but there are UT directives that you are to be informed of the following):

1) *the honor code* (how it applies to each class, and develop a more thorough description of what constitutes acceptable practices in our classrooms.):

“The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity and responsibility. Each member of The University is expected to hold these values through integrity, honest [*sic*], trust, fairness, and respect toward peers and community.”

No plagiarism or copying of others work for tests, term papers, pop quizzes, or laboratory problem sets is acceptable. Plagiarism or copying is subject to dismissal from the class with a zero grade. An explanation of plagiarism can be found at <http://registrar.utexas.edu/catalogs/gi09-10/index.html>.”

Group learning can be beneficial, so I encourage you to work with each other on occasion, and not always in isolation. However, if it assigned to 3 of your team up to analyze, for example, the data from a

Guelph permeameter or the Theis curve matching, you owe it to yourself to do the calculations yourself again from scratch.

2) *students with disabilities*: “The University of ... [Texas] provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, <http://www.utexas.edu/diversity/ddce/ssd/>.”

One year, I had a deaf student who was assigned two signers.

3) *classroom etiquette*: (Chana Lee, reported in the Chronicle of Higher Education, 27 March 1998): “Please do not hold conversations with classmates when the professor or another student is speaking. Also refrain from passing notes, reading ... [e.g., The Daily Texan], or participating in disruptive classroom behavior. Your undivided attention is a must. An atmosphere of mutual respect is in order....”

4) *religious holidays*: “By UT Austin policy, you must notify me [your instructor] of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.”

5) *writing component class*: “This course [i.e., 476K] carries the Writing Flag. Writing Flag courses are designed to give students experience with writing in an academic discipline. In this class, you can expect to write regularly during the semester, complete substantial writing projects, and receive feedback from your instructor to help you improve your writing. You will also have the opportunity to revise one or more assignments, and to read and discuss your peers' work. You should therefore expect a substantial portion of your grade to come from your written work.”

There will be a short paper on a selected aquifer as the second laboratory session. This is followed by a term paper selected from a list of topics. The term paper is expected to be approximately 20+ pages long and follow a specified format. The final paper will be submitted both electronically and in hard copy. 2 paper copies of the outline and 3 of the draft are required. Each paper will have a student editor (drawn at random) and a professional editor (me and/or a TA) review the draft. In addition there will be short written reports summarizing a selected aquifer (due on 19 September) and a synopsis of a regional flow system (due on 7 November).

The UT Undergraduate Writing Center (UWC) asked that I provide you this on the syllabus:

“The UWC is a service that can help your students write more effectively--and more independently. Because we share your commitment to improving undergraduate writing, we ask that you: 1) encourage but not require students to come to the UWC. While requiring a visit works in the short term to get students through our door, the actual goals of the writing consultation suffer: students do not engage in the writing process or effectively work toward becoming better writers; ...2) download and refer your students to helpful writing handouts from our main website: <http://uwc.utexas.edu/handouts/>.”

6) *use of lap tops*: I have had complaints from students that the clatter of people typing on their laptops is very distracting or that the person next to or in front of the a student was answering email or playing video games (especially in large, beginning classes), which also caused distractions. Recall Tom Sawyer, Joe Harper, and the tick! Also, it can be distracting to whoever is lecturing. We can discuss this if you wish. If you have a disability that requires you to use a laptop or a recording device, please see me.