COURSE SYLLABUS

GEOL 475 & 775 – Hydrogeology (Fall 2011)
Dept of Geosciences (http://tornado.sfsu.edu/), San Francisco State University

Time and location:
Tuesday: 9:35 am to 12:15 pm – lecture (Room: Thornton 513)
Thursday: 9:35 am to 12:15 pm – lab (Room: Thornton 513)

Professor contact info:
Jason Gurdak, PhD
e-mail: jgurdak@sfsu.edu
office phone: 415-338-6869
office: Thornton 538
web site: http://userwww.sfsu.edu/~jgurdak/

Office hours:
• Tues: 12:15 to 1:00 pm;
• Thurs: 12:15 to 1:15 pm (except 8/25, 9/8, 9/22, 10/13, 10/27, 11/10, and 12/8 because of faculty meeting);
• and by appointment.

Course Overview:
GEOL 475/775 is an in-depth examination of the physical and geologic factors controlling the occurrence, distribution, and movement of groundwater and pore water in the unsaturated zone. This course is designed to provide students the opportunity to learn, practice, and retain the concepts and tools necessary for practicing hydrogeologists.

Course web site:
iLearn (http://ilearn.sfsu.edu).
1. Log into iLearn with your SF State ID and SF State Password.
2. Find and click on the name of the course (Hydrogeology 475).
Note – please read the Technical Requirements page because some internet browsers do NOT work well with iLearn.

Students should become familiar with iLearn and print lecture notes prior to each class. Lecture notes posted on iLearn are not 100% complete and require in-class note taking on the part of the student.

Required Text:
1. Applied Hydrogeology (Fourth Edition) by C.W. Fetter
Computer Skills:
For this course, the expectation is that you will have access to a PC (or Mac) running a relatively current version of Windows (or Mac equivalent), Microsoft Word, Excel, and an internet browser (e.g., Internet Explorer). Please become familiar with Microsoft Word and Excel.

Course Learning Objectives and Goals
The overarching goal of the course is to increase your awareness of processes affecting groundwater and pore water in the unsaturated zone.

1. Learn and retain important fundamental principles related to flow of water in aquifers, including Darcy’s Law and the concept of hydraulic head.
2. Gain practical hands-on experience in measurement of selected hydrogeologic properties.
4. Experience in solving open-ended problems and writing a professional report/paper.

By achieving the specific learning objectives, you will improve your critical thinking skills and your ability to make knowledgeable, well thought-out assumptions and decisions that are necessary to solve real-world and research problems in the field of hydrogeology.

Grading (GEOL 475 / 775)

<table>
<thead>
<tr>
<th>Component</th>
<th>GEOL 475</th>
<th>GEOL 775</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>40%</td>
<td>35%</td>
</tr>
<tr>
<td>Exams (2)</td>
<td>35% (closed book)</td>
<td>30% (closed book)</td>
</tr>
<tr>
<td>Labs</td>
<td>25%</td>
<td>20%</td>
</tr>
<tr>
<td>Final paper</td>
<td>0%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Letter grades will be based on the percentage of possible points earned and are equivalent to the following grade points.

- A = 95-100% = 4.0
- A- = 90-95% = 3.7
- B+ = 86-89% = 3.3
- B = 83-85% = 3.0
- B- = 80-82% = 2.7
- C+ = 76-79% = 2.3
- C = 73-75% = 2.0
- C- = 70-72% = 1.7
- D+ = 66-69% = 1.3
- D = 63-65% = 1.0
- F = <60% = 0.0

Class Topics (see Course Calendar):
1. Administration and introductions
2. Introduction to hydrogeology and groundwater
3. Introduction to Darcy’s Law
4. Unit conversions
5. Water cycle
6. Water budgets
7. Porosity
8. Capillarity
9. Hydraulic head
10. Hydraulic conductivity and Darcy’s Law
11. Heterogeneity
12. Flow nets
13. Well hydraulics: introduction and steady-state solutions
14. Well hydraulics: estimating T and S in a confined infinite aquifer
15. Well hydraulics: estimating T and S in a leaky and water table aquifer
16. Well hydraulics: superposition
17. Well hydraulics: specific capacity and slug tests
18. Infiltration
19. Recharge (modeling using Hydrus-1D)
20. Groundwater modeling (using MODFLOW)
21. Management and remediation of groundwater
22. Groundwater law

Experimental Laboratory Topics:
1. Water budgets
2. Bulk density and porosity
3. Darcy’s Law and hydraulic conductivity (K)
4. Flow nets
5. Wells and boring logs
6. Ideal aquifer test
7. Nonideal aquifer test
8. Slug test
9. Recharge modeling
10. Groundwater modeling

Homework (approximately 5):
Homework exercises are designed to provide students experience in solving fundamental and/or practical hydrogeologic problems. Generally, 1 to 3 weeks will be allowed for completion of the homework, depending on the assignment. Generally, graded assignments will be returned within the same time period that the students have to complete the assignment. Grading is based on using the correct approach, the correct answer, good organization (i.e., work should be easy to follow, the answers should be clearly indicated, etc), and conciseness. Electronic copies (email to Jason) of the assignments are required unless otherwise specified. Additionally, when spreadsheets are used, these should be email to the instructor with the following file structure “LastName-HW3-GEOL475-775.xls”. Homework assignments will be posted on iLearn. All assignments are due at the beginning of class or in advance via email.

Exams (2):
The 2 exams will cover the fundamental principles and will be based on material from assigned readings, lectures, labs, and homeworks. Both calculation-based and qualitative questions will be administered. Exams will
be primarily based on material covered since the last exam. Expectations will be reviewed prior to each exam. Bring a calculator and pencil with an eraser. No make-up exams will be administered unless you contact me (email or phone) prior to the exam for documented emergencies in accordance with university policy. GEOL 775 students will have 1 or 2 additional exams problems that are NOT on the GEOL 475 exams.

**Labs:**
The labs will be practical exercises related to the fundamentals of hydrogeology. The lab write-up due dates and guidelines will be announced at the start of each lab period. You will receive a 0 for a particular lab write up if you are not present in the lab, unless you contact me (email or phone) prior to the lab period for documented emergencies in accordance with university policy. The lab reports should be written using Word and Excel (if necessary) and email to Jason before the due date.

**Reading Assignments (see Course Schedule):**
Reading assignments are required to meet the course learning objectives and goals, perform well on the exams, and for your overall success in this course. Reading assignments are to be completed before lecture. You will improve your learning and comprehension if you take written notes while reading the text, work through the example problems (highlighted in gray boxes in Fetter) within each chapter text, and review and understand the Notation terms and units listed at the end of each chapter.

**Late Assignment Policy:**
Late assignments that are NOT excused due to illness or other prior approved circumstances will receive a late penalty, as follows:
- <24 hours late = minus 10 points
- <48 hours late = minus 20 points
- <72 hours late = minus 30 points
I will NOT accept late assignments after 72 hours.

**Attendance Policy:**
Attendance is crucial for this course. If you miss a class, you will miss the learning opportunity, lecture notes, handouts, announcements, assignments, and exams. Lecture notes posted on iLearn are not 100% complete and require in-class note taking on the part of the student. Poor attendance typically results indirectly in a poor grade. Please be on time to class. The beginning of class is reserved for important announcements. Being late for class is a disruption for classroom activities. **Students who miss any classes during the first two weeks of the semester will be administratively withdrawn from the course without prior notification of the instructor for documented emergencies in accordance with university policy.**
**Academic Dishonesty:**

All forms of academic dishonesty, including but not limited to cheating and plagiarism will not be tolerated and will be subject to University academic policy. SFSU defines plagiarism as “a form of cheating or fraud; it occurs when a student misrepresents the work of another as his or her own. Plagiarism may consist of using the ideas, sentences, paragraphs, or the whole text of another without appropriate acknowledgment, but it also includes employing or allowing another person to write or substantially alter work that a student then submits as his or her own.”

**Final paper (required for GEOL 775 students only):**

Geol 775 students will conduct a “literature review” on a topic in hydrogeology. The purpose of the literature review is to:

- Encourage students to independently gain an in-depth understanding of a specific topic in hydrogeology that is not possible with lectures alone;
- Introduce or reaffirm the importance of a literature review to successful university research;
- Provide another opportunity for students to improve writing skills; and
- Introduce the procedure for submitting papers to a peer-reviewed journal.

In general, you may choose the topic, but I must approve it. **The deadline for you to email me your topic is October 23 by 11:59pm (approximately semester halfway point).** I offer several interesting “cutting edge” topics below as examples. **The papers will be due on December 15 by 11:59 pm, which is our scheduled final exam day (note – we will not have a final exam).**

**Hydrogeology 775 - Requirements for the paper:**

1. Papers should consist of about 7 to 10 pages (1.5 line spacing) including the abstract, title page, and “literature cited” section. The paper should include at least 7 articles in the literature cited section.
2. Papers should be submitted in electronic format (Word).
3. The format of the literature review should be similar to that in a topic-review article found in a peer-reviewed journal. I can provide examples if you are unfamiliar with it.
4. Follow the general format and submission requirements of the journal *Ground Water* as though you were submitting your paper for publication ([http://www.ngwa.org/Professional-Resources/publications/GW/Pages/Prepare-a-research-paper.aspx](http://www.ngwa.org/Professional-Resources/publications/GW/Pages/Prepare-a-research-paper.aspx)).
   a. A journal-paper style abstract should be included.
   b. References should be in the format used by *Ground Water*.
   c. The headings and sub-headings style of *Ground Water* should be used.
   d. In general, your review should include the following sections: Abstract, Introduction, Literature Review (with sub-headings as appropriate), Conclusion, and References Cited. Your
discussion on the “state of the art” can be incorporated in the literature review section or written into a separate section.

5. You must include a discussion on the state of the art on your topic, as well as suggested areas for future research (and reasons for the recommendations).

6. Grading will be based on technical content, organization, and writing (readability, grammar, spelling, structure, etc). I will provide tips on scientific writing throughout the semester.

Suggested Paper Topics (of the many possible):

- Satellite-based remote sensing techniques for measurement of hydrogeologic properties, such as GRACE satellite.
- Fate and transport of particular contaminants (e.g., pesticides, nitrate, volatile organic compounds, perchlorate, pharmaceuticals and personal-care products, etc).
- Effects of climate change on subsurface hydrologic processes (i.e., infiltration, recharge, contaminant fate and transport, discharge, etc).
- Traditional and innovative methods for groundwater measurement and monitoring.
- Vadose-zone processes (infiltration, recharge, preferential flow and transport, causes and effects of soil clogging on water and contaminant flow and transport).
- Groundwater topics in regional-scale flow and transport of contaminants or water-resources management.
- Groundwater-modeling approaches.
- Water resource or contaminant issues facing a specific aquifer in California or the Western United States. Aquifers may include the Central Valley aquifer, California Coastal aquifer system, Basin and Range aquifer system, Rio Grande Aquifer system, Columbia Plateau, etc. You can’t choose the High Plains “Ogallala” aquifer, though.

**Important Dates (fixed):**

1. Drop deadline (see University Administration below): September 6
2. Exam 1: Thursday October 6
3. Exam 2: Thursday November 17
4. GEOL 775 students: email Jason final paper topic: Oct 13
5. Final paper due (for GEOL 775 students only): Thurs Dec 15 by 11:59 pm
6. University-wide Holiday dates relevant to GEOL 475/775:
   - Tuesday November 22 (Fall Recess)
   - Thursday November 24 (Fall Recess)
University Administration:

SFSU Disability Policy:
Students with disabilities who need reasonable accommodations are encouraged to contact the instructor. The Disability Programs and Resource Center (DPRC) is available to facilitate the reasonable accommodations process. The DPRC is located in the Student Service Building and can be reached by telephone (voice/TTY 415-338-2472) or by email (dprc@sfsu.edu).
Syllabus and Course Calendar are Subject to Change:
This syllabus and schedule are subject to change. All major changes will be announced at class and via email. If you are absent from class, it is your responsibility to check on announcements made while you were absent.

<table>
<thead>
<tr>
<th>Week #</th>
<th>Date</th>
<th>Topic may change. Watch for updates.</th>
<th>Fetter Textbook Reading</th>
<th>Lab Manual #</th>
<th>Lab Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug 23</td>
<td>Intro, Units, Water Cycle; Water budget Water Budgets</td>
<td>Chpt 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Aug 25</td>
<td></td>
<td>Chpt 2</td>
<td>1</td>
<td>Water budget 1</td>
</tr>
<tr>
<td>2</td>
<td>Aug 30</td>
<td>Soil processes, and water relations Infiltration, ET</td>
<td>Chpt 3.1-3.2</td>
<td>2</td>
<td>Water budget 2</td>
</tr>
<tr>
<td>2</td>
<td>Sept 1</td>
<td></td>
<td>Chpt 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sept 6</td>
<td>Porosity / Capillarity</td>
<td>3.1-3.2; 6.1-6.3</td>
<td>6</td>
<td>Bulk density, Porosity</td>
</tr>
<tr>
<td>3</td>
<td>Sept 8</td>
<td>Darcy's Law</td>
<td>4.1-4.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sept 13</td>
<td>Hydraulic Head</td>
<td>4.1-4.8</td>
<td>7</td>
<td>Darcy's Law and K</td>
</tr>
<tr>
<td>4</td>
<td>Sept 15</td>
<td>Hydraulic Conductivity / Heterogeneity</td>
<td>3.4-3.5; 3.11-3.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sept 20</td>
<td>Potentiometric surface, Flow Nets</td>
<td>3.7-3.8; 4.11-4.12; 4.9-4.14</td>
<td>No lab</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sept 22</td>
<td>No class today - Work on Homework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sept 27</td>
<td>No class today - Work on Homework</td>
<td></td>
<td>8</td>
<td>Flow nets</td>
</tr>
<tr>
<td>6</td>
<td>Sept 29</td>
<td>Flow Visualization, Aquifer Storage</td>
<td>7.1-7.3; 3.9-3.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Oct 4</td>
<td>Groundwater Flow Eqn (Material including October 4th lecture and lab)</td>
<td>Chpt 4.7-4.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Oct 6</td>
<td>EXAM 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Oct 11</td>
<td>Well &amp; boring logs; Well Hydraulics 1 - Predict Head Steady and Transient</td>
<td>Chpt 5</td>
<td>9</td>
<td>Ideal aquifer test</td>
</tr>
<tr>
<td>8</td>
<td>Oct 13</td>
<td>Well Hydraulics 2 - Estimate Transmissivity and Storage</td>
<td>Chpt 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Oct 18</td>
<td>Well Hydraulics 3 - Leaky / Unconfined</td>
<td>Chpt 5</td>
<td>10</td>
<td>Nonideal aquifer test</td>
</tr>
<tr>
<td>9</td>
<td>Oct 20</td>
<td>Well Hydraulics 4 - Superposition / Specific Capacity</td>
<td>Chpt 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Oct 25</td>
<td>Well Hydraulics 5 - Slug Testing</td>
<td>Chpt 5</td>
<td>11</td>
<td>Slug-test data</td>
</tr>
<tr>
<td>10</td>
<td>Oct 27</td>
<td>Well Hydraulics 5 - Slug Testing - Cont'd</td>
<td>Chpt 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Nov 1</td>
<td>Recharge</td>
<td>Chpt 6.7</td>
<td></td>
<td>Hydrus lab</td>
</tr>
<tr>
<td>11</td>
<td>Nov 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Nov 8</td>
<td>Recharge - Cont'd / Preferential flow</td>
<td>Chpt 6.7</td>
<td></td>
<td>Hydrus lab</td>
</tr>
<tr>
<td>12</td>
<td>Nov 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Nov 15</td>
<td>Hydrus modeling - Cont'd</td>
<td></td>
<td></td>
<td>No lab</td>
</tr>
<tr>
<td>13</td>
<td>Nov 17</td>
<td>EXAM 2 (material including Nov 15)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Nov 22</td>
<td>No Class: Fall Recess</td>
<td></td>
<td></td>
<td>No Lab</td>
</tr>
<tr>
<td>14</td>
<td>Nov 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Nov 29</td>
<td>Groundwater modeling</td>
<td>Chpt 13</td>
<td></td>
<td>GW Modeling</td>
</tr>
<tr>
<td>15</td>
<td>Dec 1</td>
<td>Groundwater modeling</td>
<td>Chpt 13</td>
<td></td>
<td>GW Modeling</td>
</tr>
<tr>
<td>16</td>
<td>Dec 6</td>
<td>Groundwater modeling</td>
<td>Chpt 13</td>
<td></td>
<td>GW Modeling</td>
</tr>
<tr>
<td>16</td>
<td>Dec 8</td>
<td>Last class: GW management &amp; Law</td>
<td>Chpt 11</td>
<td></td>
<td>GW Modeling</td>
</tr>
<tr>
<td>17</td>
<td>Dec 13</td>
<td>No lecture</td>
<td></td>
<td></td>
<td>Final lab report due today</td>
</tr>
<tr>
<td>17</td>
<td>Dec 15</td>
<td>No Final Exam. Final papers (GEOL 775 students only) due today.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>