1 Course Scope and Objectives

GEOL575\L is an intermediate to advanced course for graduates and upper level undergraduates focusing on the fundamentals of hydrogeology. The definition of hydrogeology depends to a large degree on who you ask, ranging from a synonym for hydrology (i.e., study of all water, surface and ground, in natural systems) to the largely mathematical study of groundwater flow. For this course, we’ll be somewhere in the middle: we won’t completely ignore surface water, but will be mostly interested in groundwater; and we won’t become mathematicians, but will aim to use and, importantly, understand the mathematical tools at our disposal. We will also touch on methods in field hydrogeology, aqueous geochemistry, and the science of groundwater contamination.

Because water-related fields are a popular career destination for geology majors, a primary objective of this course is to provide students with the practical background to succeed in those positions. At the same time, many students may continue on to advanced degrees where the theory and mathematics are more beneficial, so we will weave these aspects into our discussion. In any given class, you may find that the material is too theoretical or too practical for your interests, but the goal is that, on balance, you will leave this class with broad exposure to, and appreciation of, all aspects of hydrogeological science.

It is worth noting that hydrogeology courses often have a reputation for being difficult. The field incorporates a broad range of challenging topics, including geology, math (there are fields of math that were literally invented for water flow problems), (geo)chemistry, engineering, and computer science. But fear not: I realize that most of you do not have degrees in all of these subjects, and I don’t want anyone to feel intimidated by these apparent challenges. I will take into account the fact you likely do not have strong backgrounds in all of these areas, and we will conquer the challenges together. However, it may also require some background work on your part, especially in the form of doing some additional reading to support your understanding. In the “Readings” section below, I recommend some references that may be useful, and will provide additional resources during the semester. You are also encouraged to contact me if you are struggling with particular topics.

The course will meet twice weekly, on Tuesday for lecture and on Friday for lab. We will not keep strict divisions between lecture and lab, and there will likely be some aspects of lecture, discussion, group work, and lab work on both Tuesdays and Fridays. I strongly
encourage engagement and interaction in the classroom—this helps you learn the material and it helps me gauge your level of understanding (and makes class time more enjoyable for everyone).

**Learning Objectives.** By the end of this course, you will be able to:

- Recognize and describe a wide-range of hydrogeological issues facing modern society;
- Describe key concepts of the hydrologic cycle, including interactions of atmospheric, surface, and groundwater, water budgets, and mass conservation;
- Describe and apply Darcy's law to groundwater flow problems;
- Describe how geologic properties relate to groundwater flow;
- Derive the basic groundwater flow equations, describe their meaning, and apply them to groundwater flow problems;
- Appropriately apply flow equations to well hydraulics problems and aquifer testing;
- Demonstrate knowledge of the basics of groundwater modeling, and apply simple models to groundwater flow problems;
- Demonstrate understanding of multiphase fluid flow theory and how it applies to infiltration and petroleum systems;
- Demonstrate understanding of solute transport in groundwater systems and solve multicomponent flow problems;
- Recognize and describe common water contamination problems, and apply quantitative approaches to investigate contaminated sites.

2 Schedule

The schedule provided below represents an outline of the topics covered in this course, the number of lectures anticipated for each subject, the corresponding reading in the text, and the rough timing. Please note that this is a tentative schedule and may be adjusted based on the pace of the course. Additional readings will be announced in class and on Canvas.

Note that we will not have class on the following days: Sept. 14, Nov. 21, and Nov. 23. Also, on Oct. 5, you should plan on attending the AAPG Expo (on CSUN Campus) in place of lab.
3 Readings

Readings will be assigned from the text; the table above provides relevant text chapters for each topic area. Additional readings will be assigned through Canvas and in class. If you need additional help understanding the topics or if you plan to continue in a hydrogeology-related field, it is recommended that you get another text (or three) for reference. Some suggested texts include:

- Domenico and Schwartz, *Physical and Chemical Hydrogeology* (accessible and topically broad)
- Schey *Div, Grad, Curl, and All That: An Informal Text on Vector Calculus* (accessible text on vector calculus)
- Freeze and Cherry, *Groundwater* (available free online here: [http://hydrogeologistswithoutborders.org/wordpress/textbook-project/](http://hydrogeologistswithoutborders.org/wordpress/textbook-project/))
- Bear, *Dynamics of Fluids in Porous Media* (the classic and very detailed, but a tough read)
- Kresic, *Hydrogeology and Groundwater Modeling* (theory, practice, and modeling)
- Kehew, *Applied Chemical Hydrogeology* (good for chemical transport)
- Gray and Miller *Thermodynamically Constrained Averaging Theory* (mostly beyond scope of the course, but first chapters are useful)
- Bird, Stewart, and Lightfoot *Transport Phenomena* (mostly beyond scope of this course, useful for various fluid mechanics background)
4 Assignments, Workload, and Grading

There will be homework and lab assignments, two mid-term exams (no final exam), a research report, and a water quality mini-project. For the project, you will select a topic, perform research independently, write a report in the style of a conference proceedings paper, and present your findings to the class. There will be “checkpoints” throughout the semester. For example, you will submit a topic by Week 3, a research plan/status update by Week 5, a detailed outline by Week 8, etc. For the water quality project, you will measure the concentration of chemical species in nearby waters and prepare a short report/presentation. More details regarding the assignments will be provided in class and on Canvas.

Final grades will be calculated as follows:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework assignments</td>
<td>20%</td>
</tr>
<tr>
<td>Lab assignments</td>
<td>20%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>15%</td>
</tr>
<tr>
<td>Exam 2</td>
<td>15%</td>
</tr>
<tr>
<td>Research Report</td>
<td>20%</td>
</tr>
<tr>
<td>Water Quality Project</td>
<td>10%</td>
</tr>
</tbody>
</table>

Letter grades will be assigned as follows:

<table>
<thead>
<tr>
<th>Points</th>
<th>Letter Grade</th>
<th>Points</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>93–100</td>
<td>A</td>
<td>73–76.9</td>
<td>C</td>
</tr>
<tr>
<td>90–92.9</td>
<td>A-</td>
<td>70–72.9</td>
<td>C-</td>
</tr>
<tr>
<td>87–89.9</td>
<td>B+</td>
<td>67–69.9</td>
<td>D+</td>
</tr>
<tr>
<td>83–86.9</td>
<td>B</td>
<td>63–66.9</td>
<td>D</td>
</tr>
<tr>
<td>80–82.9</td>
<td>B-</td>
<td>60–62.9</td>
<td>D-</td>
</tr>
<tr>
<td>77–79.9</td>
<td>C+</td>
<td>&lt;60</td>
<td>F</td>
</tr>
</tbody>
</table>

5 Ethics

All students are expected to adhere to CSUN’s policy on academic dishonesty. Cheating and plagiarism will result in the assignment of a zero for the assignment and notification to the Office of Vice President of Student Affairs, which will go on your permanent record and may result in disciplinary action. For more on CSUN’s code of academic dishonesty, please see the following links:

http://catalog.csun.edu/policies/academic-dishonesty/
http://catalog.csun.edu/policies/penalties-for-academic-dishonesty/
http://catalog.csun.edu/policies/student-conduct-code/

Collaborative learning both in class and out is encouraged. This includes discussing the topics and material, and working through problems. Some assignments will be completed in pairs or groups, but most will require that everyone must turn in your own assignment. If you are unsure whether you can collaborate, please ask.

Use of technology in the classroom will be limited to laptops, ipads, notepads, cell phones, etc. for note taking or looking up information requested.