**Terrestrial Hydrology**

GEOG C136, 4.0 units

Spring 2019

Professor Laurel Larsen, laurel@berkeley.edu

TTh 9:30-11:00

**Dr. Larsen’s Office Hours:** Wednesday 2:00-3:30 pm, 595 McCone Hall

**GSI:** Zachary Carroll, zacharycarroll@berkeley.edu

**GSI Office Hours:** Thursday 2:00 – 3:30 pm, Davis 305

**Description:**

A quantitative introduction to the hydrology of the terrestrial environment including lower atmosphere, watersheds, lakes, and streams. All aspects of the hydrologic cycle, including precipitation, infiltration, evapotranspiration, overland flow, streamflow, and groundwater flow. An introduction to the chemistry of groundwater and surface water. Development of quantitative insights through problem solving and use of simple models. The course has no sections or labs, but the extra unit comes from the substantial time commitment required in completing one field experiment, one final project, and several computer assignments, many of which may be done in small groups.

**Prerequisites:**

Listed as Chemistry 1A, Math 1A-1B, Physics 7A, or consent of instructor. There will be a lot of math in the class, but mostly it will just be algebra. Chemistry and physics are helpful, but as long as you are comfortable with using equations, the material taught in this course will stand alone.

**Reading:**

You will get the most out of this course and be optimally prepared for exams and assignments if you do the required readings by the date on which they are listed on the course schedule matrix. The textbook is:

Elements of Physical Hydrology, Second Edition (2014)

by George Hornberger, Patricia L. Wiberg, Jeffrey P. Raffensperger, and Paolo D’Odorico.

ISBN: 9781421413730

A copy has placed on reserve in the Earth Science Library in the basement of McCone Hall, available for 2-hr checkouts. Note that the first edition also contains most of the reading material we will cover.

Additional supplemental reading materials will occasionally be posted on bCourses.

**Requirements and Grading Policy**

Hydrology is best learned by grappling with problems. Therefore, the majority of your grade will come from your performance on assignments and a final project. Two midterms, which constitute a relatively low but still important percentage of your final grade, will reinforce learning. You will do best on the midterm by reviewing your notes from lecture, making sure you are comfortable with the assigned exercise, and looking over the review section and examples at the end of the assigned book chapters.

Assignments: 50% (5 or 10 pts each, as specified)

Midterms: 30% (15 pts each)

Final project: 15%

Class participation: 5%

All deliverables will be penalized by one full point each day they are late, unless an approved excuse has been granted in advance from Dr. Larsen or the GSI.

The standard scale for grades is as follows: A+: 97-100%, A: 93-96%, A-: 90-92%, B+: 87-89%, B: 83-86%, B-: 80-82%, C+: 77-79%, C: 73-76%, C-:70-72%, D+: 67-69%, D: 63-66%, D-:60-62%, F: <60%. Quizzes and assignments will be curved if needed. For students taking the class pass/fail, a “pass” given for scores 70% and higher.

**Academic Integrity**

Students are expected to uphold the campus honor code at all times. You are a member of an academic community at one of the world’s leading research universities. Universities like Berkeley create knowledge that has a lasting impact in the world of ideas and on the lives of others; such knowledge can come from an undergraduate paper as well as the lab of an internationally known professor. One of the most important values of an academic community is the balance between the free flow of ideas and the respect for the intellectual property of others. Researchers don’t use one another’s research without permission; scholars and students always use proper citations in papers; professors may not circulate or publish student papers without the writer’s permission, and students may not circulate or post materials (handouts, exams, syllabi—any class materials) from their classes without the written permission of the instructor.

Any test, paper, or report submitted by you and that bears your name is presumed to be your own original work that has not previously been submitted for credit in another course unless you obtain prior written approval to do so from your instructor. In all of your assignments, including your homework or drafts of papers, you may use words or ideas written by other individuals in publications, web sites, or other sources, but only with proper attribution. If you are not clear about the expectations for completing an assignment or taking a test or examination, be sure to seek clarification from your instructor or GSI beforehand. Finally, you should keep in mind that as a member of the campus community, you are expected to demonstrate integrity in all of your academic endeavors and will be evaluated on your own merits. The consequences of cheating and academic dishonesty—including a formal discipline file, possible loss of future internship, scholarship, or employment opportunities, and denial of admission to graduate school—are simply not worth it.

A zero-tolerance policy for cheating or plagiarism in any form will be strictly enforced. Any student caught cheating or plagiarizing will receive a score of zero for that assignment or test and be reported to Student Affairs.

**Scheduling conflicts:**

Please notify me by the second week of the term about any known or potential extracurricular conflicts (such as religious observances, graduate or medical school interviews, or team activities). I will try my best to help you with making accommodations but cannot promise them in all cases.

**Tentative schedule of lecture and readings**

This schedule is subject to change. The most current version will be on bcourses! The \* denotes days on which an assignment will be distributed.

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| **Date** | **Topic** | **Reading** | **Deadlines** |
| 1/22/2019 | Introduction to physical hydrology, gallery walk |  |  |
| 1/24/2019 | The water cycle and the square chicken: Simple water-balance models of hydrologic processes | Chapter 1, appendices 1 and 2 |  |
| 1/29/2019 | The story of the Mono Lake water balance\* |  |  |
| 1/31/2019 | Precipitation | Chapter 2 |  |
| 2/5/2019 | Evapotranspiration | Chapter 2 | Water balance assignment due |
| 2/7/2019 | Conversation with California State Water Resources Control Board |  |  |
| 2/12/2019 | Hydrologic maps: Watershed delineation, spatial interpolation\* | Online material | Final project statement of interest |
| 2/14/2019 | Fluid statics basics and the Bernoulli equation | Chapter 3 (up to p. 76) |  |
| 2/19/2019 | Principles of open channel flow 1: fluid mechanics | Chapter 4 | Watershed delineation assignment due |
| 2/21/2019 | Principles of open channel flow 2: measuring discharge | Chapter 4 |  |
| 2/26/2019 | Midterm |  |  |
| 2/28/2019 | Strawberry Creek exercise | Online material |  |
| 3/5/2019 | Strawberry Creek exercise\* |  |  |
| 3/7/2019 | Hydrographs | Chapter 5.1-5.3; 10.1-10.3 |  |
| 3/12/2019 | Overland flow | Chapter 10.4-10.5 | Strawberry Creek exercise due |
| 3/14/2019 | Floods and frequency analyses\* | Chapter 5.5; Appendix 3 |  |
| 3/19/2019 | The hyporheic zone | Online material |  |
| 3/21/2019 | Environmental flows | Online material: Lane et al., 2017, JAWRA | Frequency analysis exercise due |
| 3/26/2019 | Spring break |  |  |
| 3/28/2019 | Spring break |  |  |
| 4/2/2019 | Water in porous media | Chapter 8.1-8.3 | Final project proposal |
| 4/4/2019 | Darcy's Law and steady groundwater flow | Chapter 6.1-6.4 |  |
| 4/9/2019 | Midterm |  |  |
| 4/11/2019 | Watershed modeling | Chapter 10.6-10.7 |  |
| 4/16/2019 | Conversation with California State Water Resources Control Board |  |  |
| 4/18/2019 | Infiltration | Chapter 8.4-8.13 |  |
| 4/23/2019 | Flow nets (in-class assignment) | p. 159-185 |  |
| 4/25/2019 | Flow to wells | Chapter 7 and online material | Flow nets assignment due |
| 4/30/2019 | Aquifer tests and aquifer properties | Chapter 7 and online material |  |
| 5/2/2019 | Groundwater contamination and remediation (in-class assignment) | Chapter 7 and online material |  |
| 5/7/2019 | RRR week |  | Groundwater contamination assignment due |
| 5/9/2019 | RRR week |  |  |
| Week of 5/13 | Final project presentation |  | Final project due |

**Partnership with the California State Water Resources Control Board/Final Project:**

Through the semester, we will engage in a partnership with the California State Water Resources Control Board. Early in the semester, our partners at the water board will come to class for a discussion of some of the current issues and major projects they are facing. This discussion will introduce you to some potential options for your **final project**. They will continue to engage with us through the semester, accompanying us for one of our field exercises in Strawberry Creek, and then returning after Spring Break to discuss some of the data-intensive work they are doing in hydrology.

More details about your final project will be distributed later in the semester, but the intent is to get you working (in a group) on some of the real-world water resource challenges faced in California. Your project may be a field project, or it may involve an analysis using publicly available water data.

Several interim project deadlines apply:

February 12: In this class, which follows the initial discussion with our partners, you will submit a brief statement of interest that suggests one or more topics you may be interested in pursuing for your final project. Project groups will be matched shortly after this date.

April 2: Brief (~1-page) project proposal, outlining the details of your project. This description should clearly articulate the question and hypotheses that your project is addressing, the dataset and methods you will be using, and an anticipated timeline for completion. The proposal should also include a background section describing the motivation for the research, with at least 3 peer-reviewed journal articles cited.

Week of May 13: Final project and presentations due. Details will be distributed later in the semester.