Hydrogeophysics
Syllabus: Spring 2015

Geol 4270/5270 [3 credits]

Time and Place:
Tuesday/Thursday: 9:35am-10:50am Room GEOL 213

Instructor: Dr. Andrew Parsekian
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Office Hours: Monday 10:30 – 11:30 AM, Wednesday 3:00 – 5:00 PM (please make an appointment)
Phone: 766-3603
Course Website: http://geofaculty.uwyo.edu/aparseki/hgp_seminar.html

Course Summary
The field of hydrogeophysics seeks to estimate parameters that control groundwater flow, contaminant transport, spatial distribution of water and various other hydrologic properties using geophysical measurements. This seminar combines literature review, discussion and practical writing to introduce students to the field of hydrogeopyhsics. This course is appropriate for any graduate student (and select advanced undergraduates) with interest in hydrogeology, geophysics, engineering and related fields. This course fills the need for students to: 1) acquire skills at reading technical peer-reviewed publications deeply to extract key content, 2) refine their scientific writing abilities, and 3) gain a breadth of knowledge about current key topics in the field of hydrogeopyhsics. This course places emphasis on critical analysis of scientific writing to develop student's own analytical abilities.

Learning Objectives
Upon completion of this course, students will be able to:
- produce a grant proposal-style document describing a hydrogeophysics science research project of their own creative design;
- write a manuscript in the style of a review paper covering a specific subtopic of hydrogeophyics;
- develop critical thinking abilities to analyze scientific writing, and;
- describe seminal publications from the past, the state-of-the-science and future research directions.

Goals/Rationale
This course is an introduction to the big picture concepts as well as the specific methodologies employed by the hydrogeophysics research community with a particular focus on being able to answer the following questions:
- how are geophysics and hydrology are linked in this field?
- from a broad geoscience perspective, what is the role of a hydrogeophysicist in the science process?
- expert or generalist: how is the optimal geophysical method chosen for a hydrologic science question (and who is best suited to make this choice)?

We will emphasize knowledge of many of the physical measurements used in this field, but a key goal is to be able to efficiently read, analyze and review some of the key journal articles that have a hydrogeophysics research component using critical thinking concepts. To achieve this goal, the course is organized into three logical units of readings that 1) give an introduction to the methods and physical principals, 2) review material properties obtained from geophysical measurements and finally 3) cover

example applications. Within these units are also classes dedicated to specific abilities such as writing a review, preparing a student grant proposal

Expectations for all students
Students are expected to:

- spend three hours outside of class for every hour of classroom time,
- read assigned papers and complete article cover sheets for each class,
- actively participation in class discussions, and;
- complete all assigned work on time.

Key assignments

- (Due 5PM, March 13) One written "review article" on a hydrogeophysics topic of the students' choice that must be approved by the instructor. This review will require 2000 – 3000 words maximum (1500 – 2000 words maximum for undergrads) to cover not including figures and references. The first unit is dedicated to covering a wide breadth of basic topics; students should select a topic for the review article by the end of this unit and conduct self-guided reading in that area beyond the weekly assigned papers. This assignment will be evaluated against a rubric that will be provided before the due date.
- (Due 5PM, May 1) One written proposal in the style that is required by any one of the several applicable student-level research grant opportunities offered by scientific societies (GSA, AAPG, AGU, AIPG, and others). This should be of appropriate quality that students would expect to submit their proposal at the next available deadline. If the proposal will actually be submitted, students may use the appropriate format for whatever grant solicitation is most appropriate. If you cannot or do not wish to submit the proposal, you must follow the AGU Horton Hydrology grant guidelines. All submissions will be evaluated against the AGU Horton grant review criteria.
- Graduate students will be expected to complete cover sheets for <u>each</u> paper assigned, undergrads must chose <u>at least one</u> article per week to prepare a cover sheet for. For undergrads, attendance will be counted for the cover sheet credit on days when covers sheets are not submitted. All cover sheets will be assessed on the following scale: 0 = unsatisfactory, unprepared; 2 = acceptable; 5 = excellent comprising up to half of the class preparedness grade.

Grades
There are no exams in this course. Your grade will be assigned based on preparedness for class, a mid-term review paper and a final grant proposal. If people are routinely unprepared to participate in the discussion, we will institute a reading review quiz at the beginning of each class that will replace your class preparedness grade entirely. The class will come to a consensus on what weight they desire the mid-term and class preparedness assessments to have in a 10% window adding to a total of 100%. Assignments turned in later than 5PM on the Thursday of the indicated week will be penalized 5% per day. No assignments will be accepted after 5PM on May 5th.

- 20% (+/- 10%) Class preparedness, participation, and coversheets.
- 40% (+/- 10%) Mid-term review paper
- 40% Final grant proposal

Topics by week

<u>UNIT 1 – Introduction and Background</u>

1. Intro/reading published scientific literature (Jan 14 & 16)
    a. *What is hydrogeophysics*
    b. *Why hydrogeophyiscs (and why not)*
    c. *The big-picture perspective: how will hydrogeophysics change the world?*

   d. *Making article cover sheets*
   e. *Time management*
   f. *Reading strategies for content*
   g. *Basic hydrologic principles & concepts*
   h. Robinson et al., 2008 (for Thursday's class)
2. Review papers: GPR and ERT (Jan 21 & 23)
   a. Knight 2001 *GPR*
   b. Binley and Kemna 2005 *ERT*
3. Review papers: Seismic and EM (Jan 28 & 30)
   a. Fitterman et al., 1986 *EM*
   b. Steeples, 2005 *Seismic*
4. Review papers: Gravity and NMR (Feb 4 & 6)
   a. Ramillien et al., 2008 *Gravity*
   b. Legchenko and Valla (2002) *NMR*
   c. How to write a review paper

UNIT 2 – Measuring properties of the subsurface

5. Water content/porosity (Feb 11 & 13)
   a. Topp et al., 1980
   b. Archie 1941
6. Hydraulic conductivity (Feb 18 & 20)
   a. Binley et al., 2005
   b. Weller et al., 2010
7. Field measurements of properties (Feb 25 & 27)
   a. Dlubac et al., 2013
   b. Turreson 2006

UNIT 3 – Applications and case studies

8. Surface hydrology (Mar 4 & 6)
   a. Ward et al., 2012
   b. Toran et al., 2010
9. *Review paper due* (Mar 11 & 13)
   a. Workshop in class Mar 11
   b. Free time to complete paper Mar 13
10. NO CLASS – SPRING BREAK (March 17 & 21)
11. Hydrostratigraphy (Mar 25 & 27)
   a. Schulmeister et al., 2003
   b. Dogan et al., 2011
   c. How to write a proposal
12. Contaminant transport (Apr 1 & 3)
   a. Singha et al., 2005
   b. Singha et al., 2007
13. Water in cold regions (Apr 8 & 10)
   a. Kleinberg and Griffin 2005
   b. Bradford et al., 2005
14. Airborne & remote sensing hydrogeophysics (Apr 15 & 17)
   a. Kirkagaard et al., 2010
   b. Famiglietti et al. 2011
15. Ecohydrogeophysics (Apr 22 & 24)
   a. Robinson et al., 2012
   b. Robinson et al., 2010

16. *Wrap up (Apr 29 & May 1)*
    a. *Workshop in class Apr 29*
    b. *All work due by 5PM May 1*

Important note: The course instructor may revise this syllabus during the semester according to the specific needs of the class.

Academic Dishonesty: University Regulation 6-802, revision 2, defines academic dishonesty as "an act attempted or performed which misrepresents one's involvement in an academic task in any way, or permits another student to misrepresent the latter's involvement in an academic task by assisting the misrepresentation." Plagiarism on written assignments is academic dishonesty and will not be tolerated. Please familiarize yourself with the University Regulations if you are unsure about what constitutes Academic Dishonesty.

Disabilities. If you have a physical, learning, or psychological disability and require accommodations, please let us know as soon as possible. You will need to register with, and provide documentation of your disability to, University Disability Support Services (UDSS) in SEO, Room 330, Knight Hall, 766-6189, TTY: 766-3073.