COURSE SYLLABUS

GEOL 5660/6660 Applied Geophysics

Spring 2024 Lecture: MWF 2:30–3:20pm Geol301c

Lab: Wed 3:30–4:55pm Geol301c

Professor: Tony Lowry (Department of Geosciences)

- Geology Bldg Room 106 (Phone: 435-755-6780)
- Email: tony.lowry@usu.edu
- Office Hours: 9:00–11:00 MWF (or by appt)
- http://aconcagua.geol.usu.edu/%7Earlowry/AppGeo/

LEARNING OBJECTIVES

Geo Major Learning Objectives	*IDEA Course Evaluation Learning Objectives*
5: Describe and interpret the properties of Earth's interior and structural features	1. Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, generalizations, theories)
A: Build an understanding of, and model, how the enterprise of science works via inquiry, observation, verification, teamwork, and critical thinking	4. Developing specific skills, competencies, and points of view needed by professionals in the fields most closely related to this course
C: Acquire skills for the study and interpretation of geological materials, history, and features, such as understanding and creating maps, working with subsurface data, field and laboratory methods, and data reduction and analysis	13. Learning appropriate methods for collecting, analyzing, and interpreting numerical information
D: Apply principles of mathematics, chemistry, and physics, as well as computational tools, to the analysis geologic data and solution of problems	

COURSE DESCRIPTION

Most of what we know about the Earth's interior derives from geophysics. It is the primary tool for exploration in the oil and mining industries, and it is also widely used to characterize the subsurface for environmental, engineering and hydrologic investigations. Regardless of what career path you may choose to follow within the solid Earth sciences, you will almost certainly find yourself somewhere down the line looking at a geophysical image and wondering what exactly it is that you're seeing.

This course introduces the field of geophysics and several of its industrial and academic applications. "Geophysics" actually encompasses an incredibly diverse array of math- and physics-based tools for understanding, modeling and imaging Earth processes and properties, but the objectives for this course focus specifically on (1) cursory knowledge of several widely-used tools for imaging structure of the Earth's shallow interior, (2) a basic understanding of how we estimate in situ material properties such as mass density, seismic velocity and electrical conductivity, and (3) an understanding of how we infer desirable quantities such as rock lithology and pore fluid content from geophysical properties.

The course includes a weekly lab in which we will roll up our sleeves and get our hands dirty with geophysical data, some of which we will collect ourselves. Data for the semester project will be collected over the course of ~two field-research forays (with dates and times to be determined by student schedules).

Attendance of the field data collection exercises is required, and costs are included in your $28 course fee. Course fees also enable us to maintain & repair equipment that we use in our fieldwork and purchase consumables.

Course Text (Required):
Auto Access eBook: This course requires all-inclusive digital materials that are provided to you at a lower price than traditional printed materials. These materials are paid for through an "Auto Access Digital Materials" charge placed on your student account when you registered for the course. To access the materials, visit the Canvas course site. For more details, including dates, deadlines, and opt-out info, visit your Bookshelf in Canvas. You may of course opt out of the digital textbook and purchase a physical textbook if you prefer. The textbook is: **Introduction to Applied Geophysics: Exploring the Shallow Subsurface** (Burger, Sheehan and Jones).

Grades will reflect your performance on **Exams (300 pts)**, **Labs & Homework Sets (~250 pts), participation in the field exercises (50 pts),** and a **Final Project (200 pts). 6660 students** will perform additional **Research on a related Semester Project (100 pts)**.
Graduate student projects must use at least one of the geophysical techniques that are the topic of this course and apply the techniques to real data. Ideally the project will relate in some manner to the student's thesis topic, but in some cases this may not be possible. Discussions on a mutually agreeable project will begin in week 2!!!

About the professor:
I am a geophysicist ("Physics of the Earth") who focuses on measuring and understanding how and why planets deform. On Earth, this relates most directly to processes of fault slip, deep ductile flow, earthquakes and volcanoes, but also has implications for mass transfer in the atmosphere, hydrosphere and cryosphere.

SCHEDULE

Week 1 (8 Jan): Introduction to geophysics; introduction to elastic waves and the wave equation
Week 2 (17 Jan): Seismic Methods: Instrumentation, particle motions, body and surface waves; Snell's Law and Huygen's principle (rays and wavefronts)
***Mon 15 Jan:** No Class (MLK holiday)
Week 3 (22 Jan) Mode conversions: Reflection and refraction. Seismic amplitudes. Zoeppritz equations.
Week 4 (29 Jan): Refraction seismic method. Refraction data processing & interpretation.
Week 5 (5 Feb): More on refraction. Reflection method. x^2-t^2 and Dix equation.
Week 6 (12 Feb): More on reflection method. NMO. Practical considerations and data processing.
Week 7 (21 Feb): Seismic reflection interpretation; strengths and weaknesses. Wrap up seismic reflection data processing.
***Mon 19 Feb:** No Classes (President's Day)
Week 8 (26 Feb): Exam I. Ground Penetrating Radar (GPR).
Week 9 (4 Mar): GPS location. Potential field methods: Gravity theory, instrumentation, corrections.

***Mon 11 Mar to Fri 14 Mar: No classes (Spring break)**
Week 10 (18 Mar): Potential field methods: Gravity processing and interpretation. Magnetics theory and instrumentation.
Week 11 (25 Mar): Potential field methods: Magnetics processing and interpretation.
Week 12 (1 Apr): Electrical methods: DC resistivity, induced potential.
Week 13 (8 Apr): Electrical methods: Magnetotellurics, self-potential.
Week 14 (15 Apr): Wireline logging.
Week 15 (22 Apr): Preparing the final field report; wrap-up of geophysical methods.
Finals Week: Final exam on Mon 29 Apr (2:30-4:20) in Geology 301c.

Final Course Projects:
• Written reports on the shared grad/undergrad course project, using the data we collect on field lab dates, will be due on "interim day" between classes and finals (Wed 27 April) at 5:30pm.
• An oral presentation on graduate course projects will be given during the final lab period (Wed 27 April at 3:30); attendees receive 20 pts extra credit.
• A written report on the graduate project will be due Wednesday (3 May) at 5pm.

All web materials (incl. lecture ppt's and lab assignments), updated scheduling, course announcements, data sets and a plethora of other exciting stuff will be made available at http://aconcagua.geol.usu.edu/%7Earlowry/AppGeo/index.html

Late Assignment Policy:
All assignments are due at the date & time specified; late assignments will be accepted only in extenuating circumstances. Usually though your best strategy, if you are not finished on the due date, is to just hand in what you have.

Differences between the 5000 and 6000 level course:
Each 6660 student is expected to do a tailored semester project, to be presented to the rest of the class at the end of the semester and written up in a technical report format.

Notice to veterans and students with disabilities: **Students with ADA-documented physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations. Veterans may also be eligible for services. All accommodations are coordinated through the Disability Resource Center (DRC) in Room 101 of the University Inn, (435) 797-2444 voice, (435) 797-0740 TTY, or toll free at 1-800-259-2966. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print or digital) may be made available with advance notice.**

Other Important Dates and policies

Please note. The USU catalog, registrar's office, and other related websites have all the relevant information regarding USU policies and procedures.
See http://www.usu.edu/registrar/htm/registration/dates
http://catalog.usu.edu/index.php