GEO 3010 – Geophysics (3 credits)
Spring 2018

Lecture: FASB 250, 10:45-11:35 am, M & W
Lab: FASB 250, 2:00-5:00 pm, M or W
Instructor: Fan-Chi Lin (Assistant Professor, Dept. of Geology & Geophysics)

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Phone: 801-581-4373
Email: FanChi.Lin@utah.edu

Office Hours: M, W 11:45 am - 1:00 pm. Please feel free to email me if you would like to make an appointment to meet at a different time.

Teaching Assistants: Elizabeth Berg (eliza.m.berg@gmail.com) FASB 288
Yadong Wang (Yadong.Wang@utah.edu) FASB 288
Office Hours: T, H 1:00-3:00 pm

Website: http://noise.earth.utah.edu/GEO3010/

Course Description: Prerequisite: MATH 1220 (Calculus II). Co-requisite: GEO 3080 (Earth Materials I). Recommended Prerequisite: PHYS 2220 (Phycs For Scien. & Eng. II). Fulfills Quantitative Intensive BS.

Applications of physical principles to solid-earth dynamics and solid-earth structure, at both the scale of global tectonics and the smaller scale of subsurface exploration. Acquisition, modeling, and interpretation of seismic, gravity, magnetic, and electrical data in the context of exploration, geological engineering, and environmental problems.

Two lectures, one lab weekly.

1. Policies

Grades: Final grades are based on following weights:

- Homework (**25 %**)
- Labs (**25 %)**
- Exam 1-3 (**10% each**)
- Final (**20 %**)

Homework: There will be approximately 6 homework sets. Homework must be turned in by **5 pm** of the day they are due. 10 % will be marked off for each day they are late. Homework will not be accepted 3 days after the due day.

Labs: Do not miss labs! In general you will not have a chance to make up missed labs. If for any reason you need to miss a lab (e.g., conference travel; sickness) please discuss this with the TA and me so we can work out an alternate plan.

2. Class Goals

Primary focus of this class is on how geophysical techniques can be used to explore the shallow subsurface of the Earth. In this course we will discuss these various techniques, but we will also broaden the perspective to talk about what geophysics can tell us about the interior structure of the Earth on a global scale (as well as other planets). We will also put this information into context with plate tectonics. With this in mind, at the end of the course, the student will be able to:

- Explain how various geophysical techniques are used to explore the subsurface and what physical properties can be measured with each technique.

- Explain what geophysics can tell us about the structure and composition of the Earth's interior (and other planets) on a global scale.

- Be able to set up and conduct a basic geophysical field experiment.

3. Expectations

Math: In this course everyone is expected to understand basic algebra and trigonometry. Although in the lectures we WILL use some calculus you will not be expected to use calculus in solving the problems on the homework or exams. However, you should still be familiar with the basic concepts of calculus.

Homework Problems: The majority of problems in the homework and labs are physics problems. In order to do well on the problems be sure to include the following in your solutions:

1) What is the problem you are trying to solve?

2) What assumptions are you making? That is, if you are assuming a certain value for a number or using a particular equation, why are you justified in doing this? Be sure to explain in your homework solutions what assumptions you are making.

3) Don't skip any steps. If the problem requires you to do some algebra for example, show me all of the steps you did. It's difficult to assign partial credit to HW assignments when I can't determine how you got from one step to the next.

4) Show all units. Be careful to make sure you are working with the correct units and show all units for each step of the problem.

See the hints below on what you should consider when doing the HW problems.

Note: How to solve many of the problems assigned will not be immediately obvious. Hence, start early! You may not know immediately how to solve the problem but if you are thinking about it for a while you will start to get ideas about how this problem might be solved. I will be available for consultation on HW problems, but don't expect me to tell you how to solve the problem. Remember, one of the goals for this class is for you to become problem solvers. Thus, determining how to solve a given homework problem is ultimately your responsibility.

Hints on Doing Math Problems in Physical Sciences

The following considerations should always be taken when doing physics type problems.

1) Decide what is known (given in the problem) and what is unknown. Some of the unknowns may simply need to be found in reference materials (see step 3). At least one of the unknowns is usually the solution to the problem.

2) Decide which formula or formulas you need to use. This can usually be decided by looking at the known quantities and what the problem asks you to find. These quantities most likely are used in the problem.

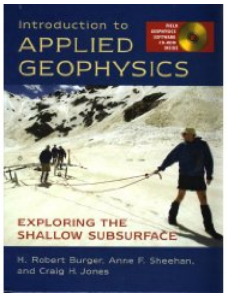
3) Gather any additional information that you may need to do the problem such as physical constants that were not given in the problem.

4) Convert all known quantities into proper units (matching units).

5) Do the units make sense? Do units cancel to give you the answer that you want? If not you are doing something wrong.

6) Does the answer make sense? What did you expect to happen?

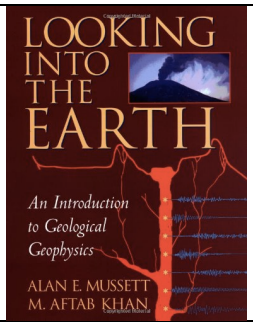
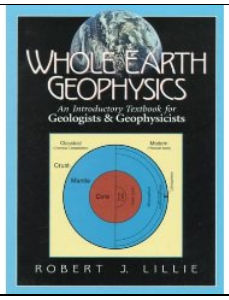
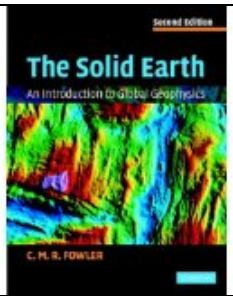
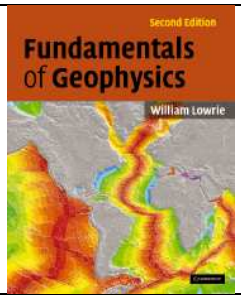
4. Text Book and sources of information:

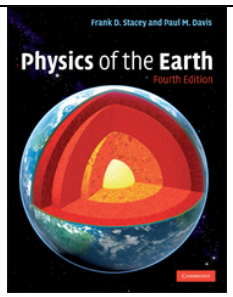


Required Text: **Introduction to Applied Geophysics: Exploring the Shallow Subsurface** (Robert Burger, Anne Sheehan, and Craig Jones). This is the text we will use in this class. It also contains an excellent CD with some software applications.

Lecture notes: Some of the material covered in this class is not part of the book. Notes for these lectures will be available on the course web page (http://noise.earth.utah.edu/GEO3010/).

Textbooks: In addition to our textbook many other good introductory texts exist. See the table below for a short list and description. All of these texts are available in our library.

	Looking into the Earth – An Introduction to Geological Geophysics (Alan E. Mussett and M. Aftab Khan). This book was used in previous versions of this class. It explains geophysics concept with minimum math and equations.
	**Whole Earth Geophysics: An Introductory Textbook for Geologists and Geophysicists** (Robert Lillie). This book was used in previous versions of this class. It has simple explanations and descriptive figures. A good book for students of this class to consult.
	**The Solid Earth: An Introduction to Global Geophysics** (C.M.R. Fowler). Sort of a classic, most geophysicists have taken a class based on this text, but it is a little more advanced than the above two texts.
	**Fundamentals of Geophysics** (William Lowrie). An excellent textbook with detailed information. Is also a more advanced textbook.

	**Physics of the Earth** (Frank Stacey and Paul Davis). Another higher level textbook, but is also a classic.

5. Geophysics – Spring 2015 Schedule (preliminary)

Week 1 (1/8): Introduction to Geophysics; Earth Interior
Lab: Introduction to MATLAB
Week 2 (1/15): Martin Luther King Jr. Day (1/15); Earth Interior
Lab: No Lab
Week 3 (1/22): Seismic Waves and Earthquakes
Lab: The Density of the Earth
Week 4 (1/29): Seismic Refraction (Chapter 3); Review I
Lab: Earthquake Location
Week 5 (2/5): Exam I; Seismic Refraction (Chapter 3)
Lab: Seismic Refraction
Week 6 (2/12): Seismic Reflection (Chapter 4)
Lab: Seismic Reflection I
Week 7 (2/19): Presidents' Day (2/19); Geothermics and Geodynamics
Lab: No Lab
Week 8 (2/26): Geothermics and Geodynamics; Review II
Lab: Seismic Reflection II
Week 9 (3/5): Exam II; Gravity and Isostasy (Chapter 6)
Lab: GPS, Gravity, and Altimetry
Week 10 (3/12): Gravity and Isostasy (Chapter 6); Electrical Resistivity (Chapter 5)
Lab: Gravity – Forward Modeling
Week 11 (3/19): Spring Break
Lab: No Lab
Week 12 (3/26): Electrical Resistivity (Chapter 5); Review III
Lab: Mapping a coal seam
Week 13 (4/2): Exam III; Magnetism (Chapter 7)
Lab: Electrical Resistivity
Week 14 (4/9): Plate Tectonics; Geophysics Research in GG
Lab: Magnetometer
Week 15 (4/16): Yellowstone; Electromagnetic Methods
Lab: Plate Motions
Week 16 (4/23): Review; no class on 4/25; Final exam (4/27; 10:30 am - 12:30 pm)
Lab: No Lab

6. Additional Notes

Statement Concerning Disabilities: "The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations." (www.hr.utah.edu/oeo/ada/guide/faculty).

Faculty and Student Responsibilities: "All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee."

"Faculty… must strive in the classroom to maintain a climate conducive to thinking and learning." PPM 8-12.3, B.

"Students have a right to support and assistance from the University in maintaining a climate conducive to thinking and learning." PPM 8-10, II. A.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).