GG304: Physics of the Earth and Planets

Instructor: Robert Dunn 808 POST, dunnr@hawaii.edu
Text: Fundamentals of Geophysics, by W. Lowrie
Office hours: after class, by appointment
Lectures: TTH 10:30-11:45 in 703 POST
Lab: M 1:30-4:20 in 703 POST

The Earth’s shape, orbit, interior structure, and geological evolution are all the result of the interaction between Earth’s materials and the physical laws of gravity, electromagnetism, and heat flow. In this class we will explore these interactions to understand the basic physics of the Earth and other planets. We will achieve this by examining and utilizing observations of gravity, geoelectromagnetism, heat flow, and seismic wave propagation.
Preliminary Schedule:

**Week 01**: Introduction to Geophysics + Planets & Orbits  
**Week 01**: Material Properties of the Earth and Planets  
**Week 02**: Gravity Fields and Earth’s Gravity, Geoid, Tides  
**Week 03**: Gravity Field Data Processing and Interpretation  
**Week 04**: Magnetic Fields and Geomagnetic Surveying  
**Week 05**: Magnetic Field Data Processing and Interpretation  
**Week 06**: Heat Flow and Planetary Rheology  
**Week 07**: Elasticity, Earthquakes, and Seismology + Mid-Term  
**Week 08**: Seismic Refraction Theory and Methods  
**Week 09**: Seismic Refraction Data and Earth’s Structure  
**Week 10**: Seismic Reflection Theory and Methods  
**Week 11**: Spring Break 03/18 - 03/22  
**Week 12**: Seismic Reflection Data and Earth’s Structure + Mid-Term  
**Week 13**: Electric Fields and Geoelectrical Surveys  
**Week 14**: Geoelectrical Data Processing and Interpretation  
**Week 15**: GPR  
**Week 16**: Geodetic Techniques / Acoustic Mapping Techniques  
**Week 17**: Term Review  
**Week 18**: Final Exam

**Course Structure:** Two lectures and one lab per week. Lecture: includes class participation; small group activities; problem solving; Lab: Lab and outdoor activities with required lab report.

**Grading:** We will have homework, lab assignments, two in-class midterms, and one final exam. The relative weightings of homework, lab assignments, exams, and class participation are: Exams 25%; Homework Assignments 25%; Laboratory Assignments 25%; Class/Lab Participation 25%.

**Assignments:** Homework and Lab assignments will be assigned approximately weekly, and are due at the beginning of class exactly 1 week after they are assigned (unless otherwise stated).

**Format:** Neatness, clarity of expression, and completeness are essential to obtain full credit on exams, labs, and homework. Please make sure to:

1. Write out the equations, or derive new ones, that you will use to solve the problem, and explain (in words) your reasoning. Specify known and unknown information.
2. Draw illustrative figures that describe the problem.
3. Show clearly how you solved the problem.
4. Check your answer – does your solution make physical sense? Check units. Explain why you think your answer is correct.

**Lab write-up:** Follow the instructions on the lab, and make sure that your lab is clear. Also: (1) *Matlab Codes.* Include a copy of your code at the end of your lab write-up, but don’t bury the answers to the questions within the code. What you did should be clear from your lab write-up –
don’t expect a reader to pick through your code. (2) Completeness. How much detail to include? A good rule of thumb is to include just enough information so that a reader could take your data and reproduce what you did using the information that you provide. Be concise and complete. (3) Format. Your lab write-up should consist of neatly written answers to the questions, in the order in which they are asked. Please do not skip sections or intersperse your answers to questions with code. Present your results with in the proper format for scientific writing – with labeled sections “Introduction”, “Methods”, “Results”, and “Discussion and Conclusions” (unless the lab instructions indicate otherwise). (4) Figures: All figures that you include should be clearly labeled (Fig. 1., Fig. 2A, Fig. 2B, etc.) and these labels should be used when referring to the figure in the text. Figures should be clearly labeled on their axes, and multiple lines included in the same plot should be clearly distinguished by labels or legends. Please include units in your labels. It is ok to handwrite axes labels and Figure names, but they should be neat and clear.

Cooperation: Collaboration is encouraged in order to discuss approaches to solving problems. However, do not copy answers to problem sets or labs – work out the problems on your own and write out the solutions by yourself.

Late Homework and Lab Assignments: 0 credit.

Questions: Questions are welcome and help everyone. Please ask questions freely!

Learning Objectives: The Department of Earth Sciences has established the following undergraduate student learning objectives. All of these objectives are relevant targets for the curriculum of GG304.

1. Students can explain the relevance of geology and geophysics to human needs, including those appropriate to Hawaii, and be able to discuss issues related to geology and its impact on society and planet Earth.
2. Students can apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in geology and geophysics.
3. Students use the scientific method to define, critically analyze, and solve a problem in earth science.
4. Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
5. Students can evaluate, interpret, and summarize the basic principles of geology and geophysics, including the fundamental tenets of the sub-disciplines, and their context in relationship to other core sciences, to explain complex phenomena in geology and geophysics.

Disability Access: If you have a disability and related access needs the Department will make every effort to assist and support you. For confidential services students are encouraged to contact the Office for Students with Disabilities (known as “Kokua”) located on the ground floor (Room 013) of the Queen Lili‘uokalani Center for Student Services: KOKUA Program; 2600 Campus Road; Honolulu, Hawaii 96822. Voice: 956-7511; Email: kokua@hawaii.edu; URL: www.hawaii.edu/kokua