ES: 110C/N
The Dynamic Earth
a.k.a. *Geophysics*
a.k.a. *Journey to the Center of the Earth*

Course goals
Students will learn:

(1)The fundamental structure of the Earth and how it was discovered
(2)How to apply classical physics to analyzing the solid Earth
(3)The basics of four of the major theoretical tools of geophysics: gravity, elasticity, fluid mechanics and heat transport
(4)Introduction to matlab as a tool for solving geophysics problems

Instructor
Prof. Emily Brodsky, brodsky@es.ucsc.edu, E&MS C370, 9-1854
Office Hours: Th1:30-3:30

TAs:
Szilard Gyalay sgyalay@ucsc.edu Office hours: Tues. 1:30-3:30 E&MS C317 (knock on the door loudly)
Ricky Garza Giron rgarzagi@ucsc.edu Office hours: W1-3 E&MS C317 (knock on the door loudly)
You are welcomed to go to either TA's office hours regardless of which lab you attend.

Class Tutor:
MSI group study and tutoring sessions for this course will be available through Learning Support Services. The tutor will be David Small dtsmall@ucsc.edu

Please see http://lss.ucsc.edu/programs/modified-supplemental-instruction/index.html for more information.

Course Meetings
Tues. and Thurs. 11:40am-1:15PM PhysSci 130
Lab T 5pm-8pm; W 9am-noon E&MS D226
Final Exam: Tues. June 11, 12-3

Requirements
Weekly Labs (due the following lab period)
Weekly Problem Sets (usually due Thurs.)
Midterms + Final Exam

Labs
The lab descriptions will be handed out in lecture on Tuesdays. You are expected to read the handout ***before*** lab and arrive prepared to perform the experiment.

Collaboration Policy
You are required to work together on the labs and may choose to work together on problem sets. I **strongly encourage** you spend time discussing your course work with

other students. You should always begin a problem set on your own and then meet up with your classmates to discuss your progress and stumbling blocks. Do not start a group study session with a blank problem set.

What you turn in must be your own work. In an intense collaboration, it is often hard to tell whose work belongs to whom. A good way to determine whether or not what you are submitting is your own is to ask yourself if you can reproduce the work without help. If I asked you to go to the board and do the problem without any notes, would you be able to do it? This is the test we will apply if we are worried about a collaboration, so please be prepared to demonstrate your knowledge.

Prerequisites
Calculus and Classical Mechanics

Time Required for Course
This lecture + lab course is 7 units and so this course entails a total of 21 hours of work per week. The time in the classroom for lab and lecture combined each week is 6.5 hours. Therefore, you should be spending on average 14.5 hours per week outside the classroom working on this class. That workload will be in the form of problem sets, studying or completing labs. Although the exact time needed will vary week to week, the assignments are designed to roughly conform to this budget.

Co-requisite
Multivariable calculus (ES 111 or Math 22 or 23A)

Textbook
Required:
Turcotte and Schubert, *Geodynamics, 3nd edition*, 2014.
Supplementary Reading:
Lowrie, W., *Fundamentals of Geophysics*, 2nd edition, 2007.
Fowler, *The Solid Earth*, 2nd edition, 2005.
All texts are on reserve in the SEL library.
A previous year's TA's complete lecture notes are also posted online to assist you. TA's will post notes on each lecture after the lecture.

Recommended Software
After week 4, we will be using matlab extensively. You can use the campus floating licenses for free in any computer lab or you can purchase your own copy of the student edition
of matlab for $49 for your own computer. To purchase and download the student version of Matlab, go to the Mathworks store:
https://www.mathworks.com/store/default.do?s_tid=gn_store
Click "Student" under the license options and follow the prompts. The basic package ($49) is adequate for this class, although the $99 version might have more functionality for use in your other classes. The student version has enough functionality for everything we are doing in this class and is useable after the class is over.

You will need a simple calculator (TI 30X) for problem sets and exams.

Grading
Lecture course (110C)
30% Problem sets (each weighted equally – lowest score dropped)
35% Midterm (2/3 of the score is the best exam; 1/3 is the other one.)
35% Final exam

Problem sets and exams are graded based on the accuracy of the answer. You must show a logical and clear solution method *and* the correct answer to receive credit for a problem.

Defined Credit Policy
Credit can be earned for each part of a multi-part problem individually and errors in an early part of the problem will only deduct points in that part of the problem. For instance, suppose a problem has parts **a**, **b**, and **c**. If you make an error in part **a**, and use the value from **a** in an otherwise correct calculation in parts **b** & **c**, you will receive full credit for **b** & **c**, but no credit for **a**. There will be no partial credit awarded within a section. You cannot receive any credit for section **a** if your answer in **a** is incorrect.

Late Policy
Problem Sets are always due 1 week from distribution unless otherwise specified. Sets may be turned in during class or to the TA's mailboxes in the Earth & Marine Sciences office before 5 PM. Please do not miss lab or class to complete assignments.
Labs are due 1 week after distribution. They can be turned in during lab or to the TA's mailboxes in the Earth & Marine Sciences front office before 5 PM on Wednesday.
Once grading is done (which is usually very fast), no late assignments will be accepted except under exceptional circumstances, e.g., medical emergencies.

Labs (110N)
Letter-graded labs (each weighted equally – lowest score dropped)

Based on a typical year, the translation of numerical scores into letter grades is approximately
89%-100% A
75%-88% B
62%-74% C
50%-61% D
<50% F

We will use Canvas for this class so that you can keep track of your grades throughout the term. All assignments and grades will be posted on Canvas. You should automatically have access to Canvas through your MyUCSC account. Please resolve any access problems with the MyUCSC support staff early in the term so that you are not caught without an assignment later.

Tentative Course Outline
4/2 Why do we know the inside of the Earth is different from the outside?
Lab 1: Mystery Planet
4/4 Overview of Earth Structure

4/9 Isostasy
Lab 2: Isostasy and Gravity
4/11 Gravity

4/16 Elasticity
Lab 3: Elasticity
4/18 Flexure

4/23 Midterm #1
Lab 4: Matlab – *Held in computer lab*
4/25 Faults and Friction

4/30 Earthquakes
Lab 5: Earthquake Lab
5/2 Seismic waves

5/7 Fluid Dynamics – intro
Lab 6: Viscosity & Fluid Flow
5/9 Fluid Dynamics

5/14 Viscosity of the mantle
Lab 7: Review
5/16 **Midterm #2**

5/21 Heat transport
Lab 8: Heat flow
5/23 Heat transport/Age of the Earth

5/28: Subsidence of the Oceans
Lab 9: Advection and Convection
5/30: Convection

6/4 The Geodynamo
Lab 10: Review
6/6 Review

Final Exam:
Tuesday, June 11, 12-3 PM