

## **EART 162: Planetary Interiors**

Monday and Wednesday 5:00-6:45 EMS D250

<http://people.ucsc.edu/~igarrick/EART162>

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Office hours: Tue 1-2, Wed. 3-4 or by appointment.

**Course Goals:** To provide an introduction into how we use remote-sensing observations and geophysical modeling to obtain a quantitative understanding of the structure and evolution of planetary interiors.

**Text:** Turcotte and Schubert, [Geodynamics \(2nd or 3rd edition\)](#). Not all parts of the course are covered in detail in this book. Reading will also be assigned in class.

### **Grading:**

33% Weekly homeworks

33% Midterm

33% Final

### **Prerequisites:**

One of: 110C, 111, Math 22, Math 23 A-B; and

One of: 113, Phys 6C, Phys 5C.

I am going to assume familiarity with ordinary differential equations. Some use will be made of vector calculus (div, grad, curl) and partial differential equations.

### **Plagiarism:**

Collaboration on homework assignments is permitted and encouraged. But the work that you hand in must be your own i.e. if I ask you to reproduce your work on the board without your notes, you must be able to do so. If you are ever unsure about the appropriate level of collaboration, please ask.

If you use the textbook or other outside sources (such as web sites) then you must cite the source that you use.

### **Preliminary Course Outline:**

Week 1 (Jan 4): Introduction, solar system formation, cosmochemistry, gravity

[Lecture slides](#) [Homework 1](#) (due Wed. Jan. 13) [Homework 1 solutions](#)

Week 2 (Jan 11): Gravity (continued), moments of inertia

[Lecture slides](#)

Required reading: T&S Chapter 5.1 to 5.10

Supplemental reading:

[MIT OpenCourseWare chapter on gravity](#)

Research paper: [Titan shape, gravity and moment of inertia paper](#) [Supplement](#)

[Article on rigid body rotation](#)

Research paper: [Article on Mercury's spin state and internal structure](#)

Research paper: [Lunar gravity from GRAIL](#)

[Homework 2](#) (due Wed. Jan. 20) [Homework 2 solutions](#)

**No class Monday January 18 (holiday)**

Week 3 (Jan 25): Isostasy and flexure

[Lecture slides](#) [Homework 3](#) (due Wed. Jan. 27) [Homework 3 solutions](#)

Required reading: T&S Chapter 5.12, 5.13

Supplemental reading:

[MIT OpenCourseWare section 5.5](#)

Week 4 (Feb. 1): Heat generation and heat transfer

[Lecture slides](#) [Homework 4](#) (due Wed. Feb. 3) [Homework 4 solutions \(IGNORE QUESTION ONE\)](#)

Required reading: T&S Chapter 4.1 to 4.8, 4.10, 4.11, 4.13

The rest of T&S Chapter 4 is optional, but encouraged, in particular 4.15 and 4.18.

[Lunar heat flow paper](#)

Supplemental reading:

[MIT OpenCourseWare sections 5.1-5.3](#)

**No class Monday February 15 (holiday)**

**MIDTERM: Feb. 10** - Mix of short and long multi-part quantitative questions, similar to homeworks, based on weeks 1-4 and HWs 1-4. Bring a calculator.

Week 5 (Jan 18): Stress and strain, material properties, equations of state

[Lecture slides](#)

Required reading: T&S Chapters 2.1 - 2.5, 2.7

Chapter 3 up to 3.16

Chapter 7.1 - 7.5

Supplemental reading:

[Somes notes on equations of state](#)

Week 6 (Feb. 8): Seismology and shock waves

[Lecture slides](#) [Homework 5](#) (due Wed. Feb. 17) [Homework 5 solutions](#)

Supplemental reading:

[Lunar core paper](#)

[MIT OpenCourseWare chapter 4](#)

[MIT OpenCourseWare section 5.6](#)

Week 7-8 (Feb. 15): Fluid dynamics and convection

[Lecture slides](#) [Homework 6](#) (due Wed. Feb. 24) [Homework 6 solutions](#)

T&S: Chapter 6, and Chapter 4.28

[Lunar Rayleigh-Taylor instability paper](#)

[Lunar upwelling paper](#) (optional)

**No class Monday February 16 (holiday)**

Week 8-9: Magnetism and dynamos

[Lecture slides](#) [Homework 7](#) [Solutions](#)

Reading: [MIT OpenCourseWare chapter 3](#)

Optional reading: [Why does Venus lack a magnetic field?](#)

Week 9-10 (Feb. 22): Love numbers, planetary shapes and tidal processes revisited

[Lecture slides](#) [Homework 8](#) (due Friday March 11 by 5 pm) [Solutions](#)

In class reading:

[Mars core size and Love number paper](#)

[Io tidal heating paper](#)

[Homework 9](#) (exam prep - optional) [Solutions](#)

**Last class Wednesday March 9.**

**Final exam: Monday March 14, 7:30 pm. All inclusive, but slightly weighted towards HWs 5-7. Similar format to midterm. Bring a calculator**