Geology 789N: Recent Advances in Geology – Mineral Physics
University of Maryland, Spring 2007

Course Description
Mineralogy of the Earth's interior: elasticity and equations of state; vibrational and electronic properties of minerals; phase transitions; transport properties.

Lectures
Tu, Th 3:30-4:45
PLS 1115

Instructor
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Office hours: by appointment

Class Website
http://www.geol.umd.edu/~ajc/GEOL789N/
The syllabus and other relevant class materials will be posted on the website.

Honor Code
"The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html."

Course Requirements and Grades
Assignments 1/3
Term Paper 1/3
Participation 1/3
The topic of the term paper will be related to the subject matter of the course, and is to be chosen by the student. The topic must be discussed with the instructor for approval by April 19. The papers are due May 14. Students will be asked sometimes to lead the class discussion, and will present their term paper topics near the end of the semester.

Textbook
Introduction to the Physics of the Earth's Interior, 2nd. Edition, by Jean-Paul Poirier (Cambridge University Press, ISBN 0-521-66392-X), will be the textbook for the course. Other readings (articles, etc.) may occasionally be assigned.

Course Outline

We will approximately follow the sequence of topics presented in the textbook, with some significant exceptions. For example, we will begin with the final chapter. After that, we will cover chapters 1-6 nearly in order. Thus enlightened, we will then re-examine the final chapter. A likely set of topics follows.

- Earth's interior
  - Seismological models
  - Mineralogical models
  - Thermal and dynamical models
  - Mineral properties required for these models
- Thermodynamics review
  - As needed
- Elasticity
  - Stress / strain
  - Single crystal elastic constants
  - Anisotropy
  - Aggregate moduli
  - Coupling to thermodynamics and equation of state
- Vibrational properties
  - Linear chain model
  - Debye model of solids
  - Kieffer model
  - Debye-Waller factor
  - Isotope fractionation
- Anharmonicity
  - Grüneisen parameter
  - Thermal expansion
- Equations of state
  - Finite strain
  - Mie-Grüneisen equation of state
  - Shock waves
  - Ab initio methods
  - High pressure elasticity
- Electrons in crystals
  - Similarities and differences with vibrational waves
  - Insulators, semiconductors, metals
  - Electronic contribution to heat capacity

Defects and related properties
- Vacancies
- Impurities

Phase transitions
- Thermodynamics
- Reaction rates
- Melting models

Transport properties
- Thermal conductivity
- Diffusion
- Creep

Back to Earth's interior