**Feb. 17 2012 EOSC 256 Midterm: Study Topics and Example Questions**
**(Study topics cover most questions. There will be some questions on topics covered in class, homework, or required reading that are NOT on this list.)**

Expect about 20-25 questions. Short answer. Some require calculation (bring a calculator).
*Possibly* a few T/F or multiple choice.

Material through Feb 15 (inclusive) will be on the midterm. I will provide all equations, *but without definitions of the variables in them*. This means you do have to study equations.

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Intensity : what is it, how does it differ from magnitude, how is it obtained (instrumental intensity and community intensity), how it is used (PAGER), Modified Mercalli scale, about how many at MMI (Maximum Mercalli Intensity) = X per year? about how many with MMI = VII or more?

Pre-1900 earthquake hypotheses which were later disproved: give some examples.
Aristotle's hypothesis - what was it? what available observations did it explain?
What observations (seismic and at the surface) demonstrated that faults cause earthquakes? (1906 SAF earthquake survey strain (e.g. HWK 1) and surface rupture (measurably offset features like fences), first motion studies (starting in 1920's), photo evidence of newly created fault scarps (Japan, 1890's)

Reid's theory of elastic rebound, the concept of earthquake cycle (coseismic and interseismic deformation). Old survey evidence and modern (GPS, inSAR) evidence for interseismic strain around faults (e.g. San Andreas, Vancouver Island).

Basics of plate motions and types of faults expected at different types of plate boundaries.

Categories of faults, orientations of fault planes, strike (azimuth) and dip, slip vector.

Earthquake magnitude scales, saturation of magnitude scales (e.g. why Richter Scale fails for large earthquakes), moment magnitude, seismic moment, relation of shaking amplitude and energy (moment) to increments in magnitude. Be able to compute moment and moment or Richter magnitude.

How to determine distance to an earthquake, how to find the approximate location of an earthquake (two ways this is done), what information is needed for the two approaches, which is more often used in real life. Earthquake early warning systems.

Focal mechanisms, fault plane, auxilliary plane, compressive and tensional quadrants. How do you tell a bomb test or a mine collapse from an earthquake?

Different types of seismometers (e.g., strong motion accelerometers, broadband, long-period and short-period seismometers, geophones), how resonant frequency and damping affect amplification and phase (delay) of different shaking frequencies on the seismogram. Basics of how a seismometer works.

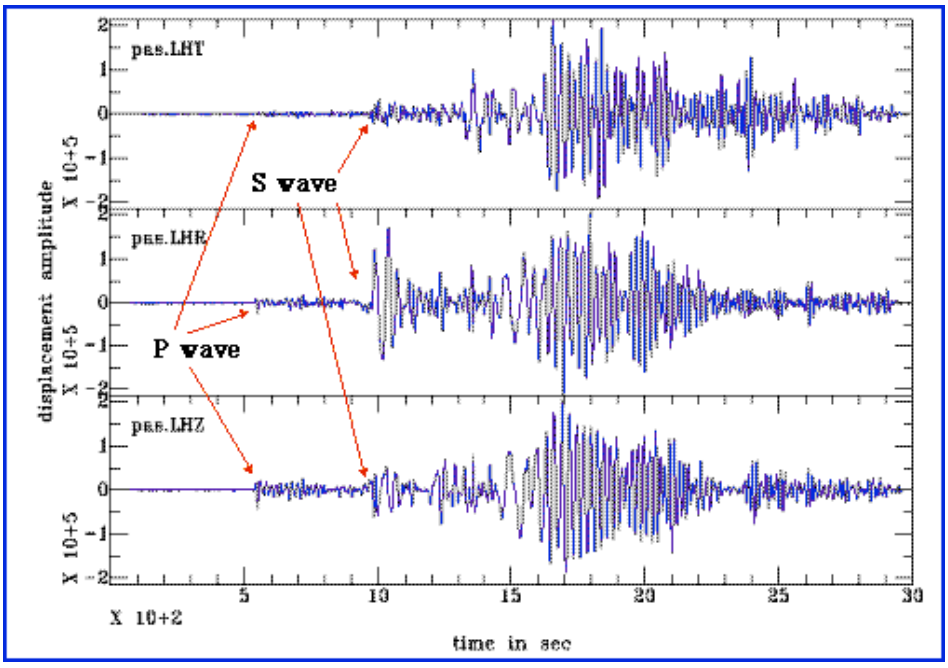
Types of seismic waves, approximate P and S velocities in the crust, how body wave velocities vary inside the Earth, P and S wave shadow zones, what seismic phases are and what they tell us about Earth's interior. Why seismic raypaths are curved inside the Earth.

Gutenberg-Richter magnitude-frequency (how often) relationship, b-value, characteristic earthquakes, Omori's Law.

**Example questions. Equations will be provided with the exam but the parameters in the equations will not be defined. I will provide values of constants (like shear modulus and density) but not things you know (like g).**

1. (a) Which seismometers are sensitive to the widest range of shaking frequencies? (b) How does the sensitivity (amplification) of a seismometer depend on frequency (qualitative answers, think very high, very low, and resonant frequencies)? What if it's damped - what changes?

2. If the P and S wave velocities are 6 km/s and 3.8 km/s, how far from the earthquake focus was this seismometer? (this is a 3-component record, you may use any ONE of the three seismograms below).




4. The USGS PAGER program estimates the number of people affected by an earthquake and is used in emergency response planning. Is this estimate based on earthquake magnitude or earthquake intensity? Explain your answer.

5. Name the main disadvantage to the Richter magnitude scale and explain how this is remedied by the moment magnitude scale.

6. If there were five M 5 or greater (5+) earthquakes in Canada last year, how many M4+ and M 3+ earthquakes should there have been in Canada during that time?

7. Why couldn't you use direct P waves to determine the location of a large quake 110 degrees away from the epicenter?

8. Before elastic rebound theory was proposed, what did most scientists attribute earthquakes to? Name two kinds of observations that finally refuted these ideas for good (and *why*).

9. Here (figure below) is the focal mechanism for a quake that happened earlier this month. *The seismic moment "$M_o$" in Newton meters is just above the beachball*. Tell me (a) the seismic moment (b) what kind of earthquake (c) strikes of and dips the two possible fault planes.

10. Suppose this earthquake slipped on a 10 km square patch of fault. How much slip was there? The shear modulus is 3 x $10^{10}$ Pascals.

11. Would you expect this earthquake to happen at a mid-ocean ridge (tensional plate boundary)? Why or why not?

12. How do you know that this wasn't an underground bomb test?

Best Double Couple:Mo=1.8*10**18