###### Final Exam

This is an open book exam. You can use any means available to answer the questions, except copying from fellow students.

The exam is due at 5:00 pm on **Friday, December 13**. You can bring a paper copy to me in my office, or slip it under the door (or in my mailbox), or send as an email attachment. Your matlab scripts also should be emailed to me for grading.

Good Luck!

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. [5 pts] What is elasticity (choose one)?

A 2nd order tensor that describes deformation

A 4th order tensor that is equivalent to the spring constant in Hooke’s Law.

A scalar that describes body forces.

A 2nd order tensor that describes surface force per unit area.

2. [5] Where in the mantle do we find the strongest anisotropy?

3. [10] A medium exhibits velocities (in m/s) for waves propagating in the *x*1, *x*2 and *x*3 directions as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | *x*1 | *x*2 | *x*3 |
| *VP* | 5600 | 5600 | 4900 |
| *VSH* | 3350 | 3350 | 2950 |
| *VSV* | 2950 | 2950 | – |

(a) What kind of anisotropy does this represent?

(b) If the density is a uniform 2300 kg/m3 and ** = 0.7, derive the Voigt matrix describing the elasticity tensor.

(c) Give an example of a reasonable interpretation of the structure and lithology of this medium (including an explanation of why you think it’s reasonable).

4. [20] Using the matlab script for (approximate: piecewise constant) Cartesian ray tracing that has been provided on the website, make a new m-script that (1) loops over different values of the ray parameter *p* from 0.2 to 0.1; (2) records the distance and time for ray-tracing in both Cartesian and spherical coordinates in vector arrays, and (3) compares the two on plots of ray parameter versus distance and ray parameter versus time. Where do the differences start to become significant?