1. (5pt) Given Young's modulus $E_Y = 193$ GPa and Poisson's ratio $\nu = 0.34$, find the following elastic constants:

   (a) Lame constants,

   (b) bulk modulus and shear modulus.

2. (5pt) The component of strain at a point in a steel material are

$$\epsilon_{11} = 36 \times 10^{-6}, \quad \epsilon_{22} = 40 \times 10^{-6}, \quad \epsilon_{33} = 25 \times 10^{-6},$$
$$\epsilon_{12} = 12 \times 10^{-6}, \quad \epsilon_{13} = 30 \times 10^{-6}, \quad \epsilon_{23} = 0,$$

   find the components of stress tensor. $\lambda = 120$ GPa, $\mu = 80$ GPa.

3. (20pt) A cube (of linear dimension l), made from an elastic material of given E_Y and ν, is placed in an absolutely rigid cavity that completely surrounds the cube from five sides. Determine the deformation of the cube if a pressure p is applied on its free side.

4. (10pt) The Luxor Obelisk is a 23 meters high obelisk standing at the center of the Place de la Concorde in Paris, France. It was originally located at the entrance to the Luxor Temple, in Egypt. The obelisk is made from granite ($E_Y = 60$ GPa for compression, $\nu = 0.25$). For the purpose of the present problem the obelisk can be treated as a parallelepiped, with one side much longer then the other two, standing on a horizontal plane. Find the difference between the height of the obelisk while it is standing vertically in the gravitation field, and its length when it was transported. Neglect the relativistic length contraction. The density of granite is $\rho = 2750$ kg/m^3. Hint: the problem has been discussed in class, check your lecture notes.

5. (honors only) Determine the deformation of a solid sphere (radius R, density ρ, Young's modulus E_Y, and Poisson's ratio ν) in its own gravitational field. Find the pressure at the center of the sphere. Find the regions where the material is compressed and where it is stretched. Hint: use the symmetry of the problem and appropriate coordinates.