Name:

Homework 2

Due 16 Sept 2019

1. For the following prescribed displacements, sketch the deformed and un-deformed shape of a rectangle.

   (a)

   $$u = 1.5x$$
   $$v = 2y$$

   (b)

   $$u = 1.3x + 0.3y$$
   $$v = 0.2x + 1.2y$$

2. Determine the strain and rotation tensors from the given displacements

   (a)

   $$u = 1.5x$$
   $$v = 2y$$
   $$w = z$$

   (b)

   $$u = 2x + 3yz$$
   $$v = xy + z^2$$
   $$w = xyz$$

   (c)

   $$u = xy^2$$
   $$v = y^2 + z^2$$
   $$w = y^3 z$$

3. Determine the displacement field from the given strain tensors (assume no rotation is present)

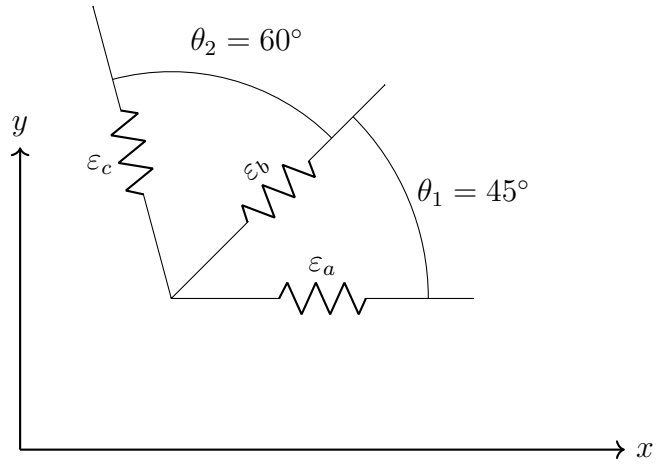
   (a)

   $$e_{ij} = \begin{bmatrix} k & 0 & 0 \\ 0 & k & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

(b)

$$e_{ij} = \begin{bmatrix} kx^2 & z & y \\ z & ky & x \\ y & x & z \end{bmatrix}$$

4. Rosette strain gages are commonly used in tensile tests to measure strain in different directions. For the rosette configuration shown below, strain is measured as $\varepsilon_a = 0.005$, $\varepsilon_b = 0.008$, and $\varepsilon_c = 0.002$. Find e_x, e_y, and e_{xy}. Note that ε_a is aligned with the x-axis.



(a) Rosette strain gages are generally precision manufactured, so the angles between individual gages on a rosette are very accurately controlled. However, the strain gages are usually attached by hand, and may not be perfectly aligned with the loading axis. Find e_x, e_y, and e_{xy} if ε_a is NOT aligned with the x-axis.

Hint: You may choose the angle of mis-alignment. Try to choose an angle that makes the problem less difficult.

(b) The manufacturer of these strain gages is under pressure from investors to sell more rosettes. As a clever new engineer for Rosettes, Inc., how would you improve the rosette design to sell more rosettes?

5. Find the principal strains and their directions for the following states of strain

(a)

$$e_{ij} = \begin{bmatrix} 2 & -1 & 0 \\ -1 & -3 & 1 \\ 0 & 1 & 6 \end{bmatrix}$$

(b)

$$e_{ij} = \begin{bmatrix} 4 & 2 & -1 \\ 2 & 3 & 2 \\ -1 & 2 & 5 \end{bmatrix}$$