MCE 571 – Homework # 4

1. Consider the state of stress given by components

$$[\sigma_{ij}] = \begin{bmatrix} 1 & 0 & -4 \\ 0 & 3 & 0 \\ -4 & 0 & 5 \end{bmatrix}$$

a) Find the stress vector, $\boldsymbol{T^n}$, acting on a plane with outward unit normal vector

$$\mathbf{n} = \frac{1}{2}\mathbf{e_1} - \frac{1}{2}\boldsymbol{e_2} + \frac{1}{\sqrt{2}}\mathbf{e_3}$$

b) Find the magnitude of the stress vector

c) Determine *N*, the magnitude of the component of $\boldsymbol{T^n}$ parallel to $\boldsymbol{n}$.

d) Determine *S*, the magnitude of the component of $\boldsymbol{T^n}$ perpendicular to $\boldsymbol{n}$.

2. Consider the state of stress given by

$$[\sigma_{ij}] = \begin{bmatrix} 5 & -3 & 8 \\ -3 & 7 & 1 \\ 8 & 1 & 9 \end{bmatrix}$$

a) Find the three principal stresses.

b) Find the orientation of the three principal axes with respect to the (x, y, z) axes by specifying the unit normal vectors for each axis. Show that they are orthogonal and form a right-handed triad.

c) Find the octahedral shear stress, the mean normal stress and the von Mises stress.

d) the spherical and deviatoric stress associated with this stress state.

e) the three stress invariants of both the stress tensor and the deviatoric stress tensor.

f) the stress vector $\boldsymbol{T^n}$ acting on a plane characterized by the outward unit normal vector

$$\mathbf{n} = \frac{1}{\sqrt{3}}(\mathbf{e_1} + \boldsymbol{e_2} - \mathbf{e_3})$$

g) the normal and shear stress components acting on the plane defined in f).