Prob. 1 A 3D stress state is given: $\sigma_{xx} = \sigma_x = 30\text{ MPa},\ \sigma_{yy} = \sigma_y = -18\text{ MPa},\ \sigma_{zz} = \sigma_z = -36\text{ MPa},\ \sigma_{xy} = \tau_{xy} = 36\text{ MPa},\ \sigma_{yz} = \tau_{yz} = 24\text{ MPa},$ and $\sigma_{zx} = \tau_{zx} = 12\text{ MPa}$ (All in MPa). Consider a special plane whose unit normal satisfies the relation $l_0 = m_0 = n_0 = 1/\sqrt{3}$, determine

a) the three angles of the normal direction of the plane, $\alpha$, $\beta$, and $\gamma$.

b) the stress vector on the plane.

c) the magnitude of the stress vector (the length of the stress vector on the plane).

Prob. 2 For the same 3D stress state as in Prob. 1: $\sigma_{xx} = \sigma_x = 30\text{ MPa},\ \sigma_{yy} = \sigma_y = -18\text{ MPa},\ \sigma_{zz} = \sigma_z = -36\text{ MPa},\ \sigma_{xy} = \tau_{xy} = 36\text{ MPa},\ \sigma_{yz} = \tau_{yz} = 24\text{ MPa},$ and $\sigma_{zx} = \tau_{zx} = 12\text{ MPa}$ (All in MPa).

a) Plot the characteristic equation.

b) Determine the three principal stresses.

c) Determine the directions of the three principal stresses.