P1.74.

At a point in a loaded body, the stress relative to an x, y, and z coordinate system are shown in Eqn. (1).

$$\boldsymbol{\sigma} = \begin{bmatrix} \sigma_x & \tau_{xy} & \tau_{xz} \\ \tau_{yx} & \sigma_y & \tau_{yz} \\ \tau_{zx} & \tau_{zy} & \sigma_z \end{bmatrix} = \begin{bmatrix} 40 & 40 & 30 \\ 40 & 20 & 0 \\ 30 & 0 & 20 \end{bmatrix} \text{MPa} \tag{1}$$

Determine the normal stress σ and the shearing stress τ on a plane whose outward normal is oriented at angles of 40°, 75°, and 54° with the x, y, and z axes, respectively.

P1.77.

The state of stress at a point in a member relative to an x, y, and z coordinate system is given by Eqn. (2).

$$\boldsymbol{\sigma} = \begin{bmatrix} \sigma_x & \tau_{xy} & \tau_{xz} \\ \tau_{yx} & \sigma_y & \tau_{yz} \\ \tau_{zx} & \tau_{zy} & \sigma_z \end{bmatrix} = \begin{bmatrix} -100 & 0 & -80 \\ 0 & 20 & 0 \\ -80 & 0 & 20 \end{bmatrix} \text{MPa} \tag{2}$$

Calculate,

(a) the principal stresses by expansion of the characteristic stress determinant.

(b) the octahedral stresses and the maximum shearing stress.

P1.86.

Find the normal and shearing stresses on an oblique plane defined by

$$\left\{ l = \sqrt{\frac{3}{13}}, \quad m = \sqrt{\frac{1}{13}}, \quad n = \sqrt{\frac{9}{13}} \right\}.$$

The principal stresses are $\sigma_1 = 40\,\mathrm{MPa}$, $\sigma_2 = 15\,\mathrm{MPa}$, and $\sigma_3 = 25\,\mathrm{MPa}$.

P2.3.

A displacement field in a body is given by Eqn. (3).

$$u = c\left(x^2 + 10\right) \tag{3a}$$
$$v = 2cyz \tag{3b}$$
$$w = c\left(-xy + z^2\right) \tag{3c}$$

Determine the state of strain on an element position at $(0, 2, 1)$. *Note:* $c = 10^{-4}$.

P2.5.

The strain distribution in a member is shown in Eqn. (4).

$$\varepsilon_x = a_0 + a_1 y^2 + y^4 \tag{4a}$$
$$\varepsilon_y = b_0 + b_1 x^2 + x^4 \tag{4b}$$
$$\gamma_{xy} = c_0 + c_1 xy\left(x^2 + y^2 + c_2\right) \tag{4c}$$

What relationships connecting the constants a, b, and c make the foregoing expressions possible?

P2.7.

Find the normal strain in the members $\overline{AB}$ and $\overline{CB}$ of the pin-connected plane structure shown in Fig. 1 if point B is moved leftward 2.5 mm. Assume that axial deformation is uniform throughout the length of each member.

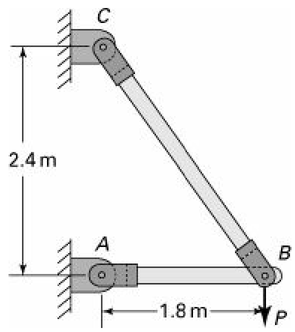

Figure 1: Pin-connected plane structure