3.8. A bearing made of isotropic bronze ($E = 82.6$ GPa and $v = 0.35$) is subjected to a state of plane strain ($\varepsilon_{zz} = \varepsilon_{zx} = \varepsilon_{zy} = 0$). Determine $\sigma_{zz}$, $\varepsilon_{xx}$, $\varepsilon_{yy}$, and $\gamma_{xy}$, if $\sigma_{xx} = 90$ MPa, $\sigma_{yy} = -50$ MPa, and $\sigma_{xy} = 70$ MPa.

3.20. The lamina of Example 3.6 is composed of glass fibers and an epoxy resin. The fibers have a modulus of elasticity $E_F = 72.4$ GPa, a shear modulus $G_F = 27.8$ GPa, and a Poisson ratio $v_F = 0.30$. The resin has a modulus of elasticity $E_R = 3.50$ GPa, a shear modulus $G_R = 1.35$ GPa, and a Poisson ratio $v_R = 0.30$. The volume fraction of fibers is $f = 0.70$.

a. Determine the coefficients $C_{ij}$ of the lamina stress–strain relations [see Eqs. (m) and (n) of Example 3.6].

b. For a given load, the measured strain components were found to be

$$\varepsilon_{xx} = 500\mu, \quad \varepsilon_{yy} = 350\mu, \quad \gamma_{xy} = 1000\mu$$

Determine the stress components and principle stresses (Mohr’s circle) on the x-y plane.
3.22. A birch wood log has the following elastic constants (FPS, 1999) relative to orthotropic axes \((x, y, z)\):

\[
E_x = 15,290 \text{ MPa}, \quad E_y = 1195 \text{ MPa}, \quad E_z = 765 \text{ MPa}
\]
\[
G_{xy} = 1130 \text{ MPa}, \quad G_{xz} = 1040 \text{ MPa}, \quad G_{yz} = 260 \text{ MPa}
\]
\[
v_{xy} = 0.426, \quad v_{xz} = 0.451, \quad v_{yz} = 0.697
\]

where the \(x\) axis is longitudinal to the grain, the \(y\) axis is radial in the tree, and the \(z\) axis is tangent to the growth rings of the tree. The unit of stress is [MPa]. At a point in a birch log, the components of stress are \(\sigma_{xx} = 7 \text{ MPa}, \sigma_{yy} = 2.1 \text{ MPa}, \sigma_{zz} = -2.8 \text{ MPa}, \sigma_{xy} = 1.4 \text{ MPa}, \) and \(\sigma_{xz} = \sigma_{yz} = 0\).

a. Determine the orientation of the principal axes of stress.

b. Determine the strain components.

c. Determine the orientation of the principal axes of strain.