



with the constitutive parameters defined by

$$\begin{aligned}\epsilon &= \epsilon_0 \left[ 1 - \frac{\omega_p^2}{(\omega^2 - \omega_c^2)} \right] \\ \epsilon_g &= \epsilon_0 \left[ \frac{-\omega_p^2 \omega_c}{\omega(\omega^2 - \omega_c^2)} \right] \\ \epsilon_z &= \epsilon_0 \left[ 1 - \frac{\omega_p^2}{\omega^2} \right]\end{aligned}$$

Write the constitutive relation as  $\overline{E} = \overline{\overline{\kappa}} \cdot \overline{D}$  with

$$\overline{\overline{\kappa}} = \overline{\overline{\epsilon}}^{-1} = \begin{pmatrix} \kappa & i\kappa_g & 0 \\ -i\kappa_g & \kappa & 0 \\ 0 & 0 & \kappa_z \end{pmatrix}$$

Determine the constitutive parameters  $\kappa$ ,  $\kappa_g$ , and  $\kappa_z$ .

#### **Problem P2.4**

Show that a linearly polarized wave can be decomposed into a right-hand circularly polarized wave and a left-hand circularly polarized wave.