Problem 2.73 Repeat Problem 2.72 for the case where all three transmission lines are $\lambda/4$ in length.

Solution: Since the transmission lines are in parallel, it is advantageous to express loads in terms of admittances. In the upper branch, which is a quarter wave line,

$$Y_{1\,\text{in}} = \frac{Y_0^2}{Y_1} = \frac{Z_1}{Z_0^2}\,,$$

and similarly for the lower branch,

$$Y_{2\,\text{in}} = \frac{Y_0^2}{Y_2} = \frac{Z_2}{Z_0^2}\,.$$

Thus, the total load at the junction is

$$Y_{\text{JCT}} = Y_{1\,\text{in}} + Y_{2\,\text{in}} = \frac{Z_1 + Z_2}{Z_0^2}\,.$$

Therefore, since the common transmission line is also quarter-wave,

$$Z_{\text{in}} = Z_0^2/Z_{\text{JCT}} = Z_0^2 Y_{\text{JCT}} = Z_1 + Z_2 = (50 + j50)\ \Omega + (50 - j50)\ \Omega = 100\ \Omega.$$