Problem 2.72 Determine Z_{in} of the feed line shown in Fig. P2.72. All lines are lossless with $Z_0 = 50\ \Omega$.

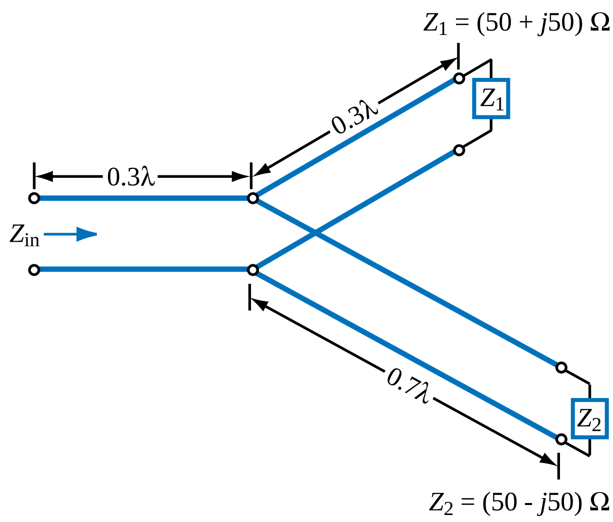

Figure P2.72: (a) Circuit of Problem 2.72.

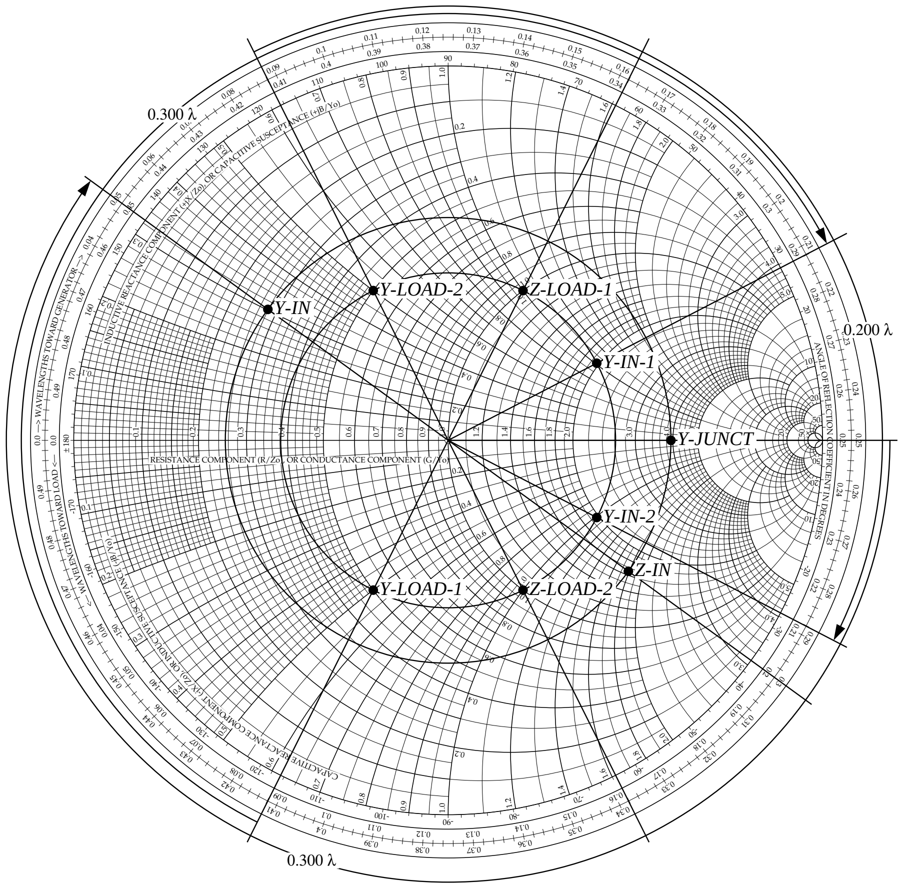

Figure 2.72: (b) Solution of Problem 2.72.

Solution: Refer to Fig. P2.72(b).

$$z_1 = \frac{Z_1}{Z_0} = \frac{50 + j50\ \Omega}{50\ \Omega} = 1 + j1$$

and is at point *Z-LOAD*-1.

$$z_2 = \frac{Z_2}{Z_0} = \frac{50 - j50\ \Omega}{50\ \Omega} = 1 - j1$$

and is at point *Z-LOAD*-2. Since at the junction the lines are in parallel, it is advantageous to solve the problem using admittances. y_1 is point *Y-LOAD*-1, which is at 0.412λ on the WTG scale. y_2 is point *Y-LOAD*-2, which is at 0.088λ on the WTG scale. Traveling 0.300λ from *Y-LOAD*-1 toward the generator one obtains the input admittance for the upper feed line, point *Y-IN*-1, with a value of $1.97 + j1.02$. Since traveling 0.700λ is equivalent to traveling 0.200λ on any transmission line, the input admittance for the lower line feed is found at point *Y-IN*-2, which has a value of $1.97 - j1.02$. The admittance of the two lines together is the sum of their admittances: $1.97 + j1.02 + 1.97 - j1.02 = 3.94 + j0$ and is denoted *Y-JUNCT*. 0.300λ from *Y-JUNCT* toward the generator is the input admittance of the entire feed line, point *Y-IN*, from which *Z-IN* is found.

$$Z_{\text{in}} = z_{\text{in}} Z_0 = (1.65 - j1.79) \times 50\ \Omega = (82.5 - j89.5)\ \Omega.$$