1, 2 refer to T-network to π-network conversion

3. The bridged-T network.

Z matrix

With port 2 open-circuited,

$$Z_{11} = Z_1 // (Z_1^{'} + Z_2) + Z_2^{'} = \frac{Z_1 (Z_1^{'} + Z_2)}{Z_1 + (Z_1^{'} + Z_2)} + Z_2^{'} = \frac{Z_1 Z_2 ' + (Z_1 + Z_2^{'})(Z_1^{'} + Z_2)}{Z_1 + Z_2 + Z_1^{'}}.$$

$$Z_{21} = \left. \frac{V_2}{I_1} \right|_{I_2 = 0} ; V_2 = Z_2 ' I_1 + Z_2 \frac{Z_1 I_1}{Z_1 + Z_1^{'} + Z_2} ; Z_{21} = Z_2 ' + Z_2 \frac{Z_1}{Z_1 + Z_1^{'} + Z_2}.$$

Y matrix

With port 2 short-circuited, $Y_{11} = Y_{in} = 1/Z_{in}$, thus it can be found from previous homework,

$$Y_{11} = \frac{1}{Z_{in}} = \frac{(Z_1^{'} + Z_1)(Z_2 + Z_2^{'}) + Z_2 Z_2^{'}}{Z_1 Z_1^{'}(Z_2 + Z_2^{'}) + Z_1^{'} Z_2 Z_2^{'}}.$$

$$Y_{21} = \left. \frac{I_2}{V_1} \right|_{V_2 = 0} = -\frac{1}{Z_1^{'}} - \frac{Z_2 // Z_2^{'}}{Z_1 + Z_2 // Z_2^{'}} \frac{1}{Z_2} = -\frac{1}{Z_1^{'}} - \frac{Z_2 Z_2^{'}}{Z_1 (Z_2 + Z_2^{'}) + Z_2 Z_2^{'}} \frac{1}{Z_2} = -\frac{Z_1 (Z_2 + Z_2^{'}) + (Z_1 ' + Z_2) Z_2^{'}}{Z_1 Z_1^{'}(Z_2 + Z_2^{'}) + Z_1^{'} Z_2 Z_2^{'}}$$