ECE 435 Kempel
Homework Set #1
Fall 2002

Due: 9/11/02

All homework must be completed NEATLY!!! (If I can't read it, I can't grade it!)

1. A 4-port network has the following scattering matrix

$$\begin{bmatrix} 0.1\angle 90^{o} & 0.6\angle -45^{o} & 0.6\angle 45^{o} & 0 \\ 0.6\angle -45^{o} & 0 & 0 & 0.6\angle 45^{o} \\ 0.6\angle -45^{o} & 0 & 0 & 0.6\angle -45^{o} \\ 0 & 0.6\angle 45^{o} & 0.6\angle -45^{o} & 0 \end{bmatrix}$$

(a) Is this network lossless?
(b) Is this network reciprocal?
(c) What is the reflection coefficient at port 1 if a short circuit is placed at the terminal plane of port 3 and all other ports are match loaded?

2. The scattering matrix for a two-port network is given below, what are the equivalent impedance parameters if the characteristic impedance is 50Ω?

$$\begin{bmatrix} 0.3 + j0.7 & j0.6 \\ j0.6 & 0.3 - j0.7 \end{bmatrix}$$

3. Consider two 2-port networks, $[S^{A}]$ and $[S^{B}]$, show that the over-all S_{21} of the cascade network is given by $S_{21} = \dfrac{S_{21}^{A} S_{21}^{B}}{1 - S_{22}^{A} S_{11}^{B}}$.

4. For a lossless 2-port network: (a) if the network is reciprocal, show $|S_{21}|^{2} = 1 - |S_{11}|^{2}$ and (b) if the network is nonreciprocal, show that it is impossible to have unidirectional transmission (e.g. $S_{12} = 0$ and $S_{21} \neq 0$).