Microwaves

Series 7

Problem 1

Find the properties of the following 5 two-port components, given by their scattering matrix. Are they reciprocal, lossless, matched, symmetrical? What kind of components are they?

a)
$$\begin{bmatrix} 0 & 250 \\ 0.2 & 0 \end{bmatrix}$$

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$$\begin{bmatrix} 0 & 250 \\ 0,2 & 0 \end{bmatrix}$$
 b) $\begin{bmatrix} 0,6 & j0,8 \\ j0,8 & 0,6 \end{bmatrix}$ c) $\begin{bmatrix} 0 & -j \\ j & 0 \end{bmatrix}$ d) $\begin{bmatrix} 0 & 0,1 \\ 0,1 & 0 \end{bmatrix}$ e) $\begin{bmatrix} 1,5 & j0,1 \\ j0,5 & 0 \end{bmatrix}$

c)
$$\begin{bmatrix} 0 & -j \\ j & 0 \end{bmatrix}$$

d)
$$\begin{bmatrix} 0 & 0,1 \\ 0,1 & 0 \end{bmatrix}$$

e)
$$\begin{bmatrix} 1.5 & j0.1 \\ j0.5 & 0 \end{bmatrix}$$

Problem 2

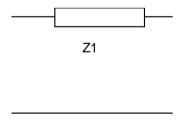
A three port circuit is characterized by the following scattering matrix:

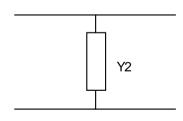
$$\begin{bmatrix} j0,2 & j0,9 & 0,1 \\ 0,1 & j0,2 & j0,9 \\ j0,9 & 0,1 & j0,2 \end{bmatrix}$$

Draw its flowchart, end determine if it is a linear, reciprocal, lossless, matched element. What could be its use?

Problem 3

Prove that the scattering matrix of the following circuits





are given by:

$$\begin{bmatrix} S \end{bmatrix} = \begin{bmatrix} \Gamma_1 & 1 - \Gamma_1 \\ 1 - \Gamma_1 & \Gamma_1 \end{bmatrix} \quad \text{et} \quad \begin{bmatrix} S \end{bmatrix} = \begin{bmatrix} \Gamma_2 & 1 + \Gamma_2 \\ 1 + \Gamma_2 & \Gamma_2 \end{bmatrix}$$

with

$$\Gamma_1 = \frac{Z_1}{Z_1 + 2Z_0}$$
 et $\Gamma_2 = -\frac{Y_2}{Y_2 + 2Y_0}$

The characteristic impedance at the reference planes is Zo