ECE 5317/6351

Microwave Engineering

Fall 2019

Homework #6

Text: *Microwave Engineering* by David M. Pozar, 4th edition, Wiley, 2011.

Problems from the Pozar book (4th Ed.):

4.4, 4.7, 4.11, 4.12, 4.13.

Extra Problem 1

A lossless reciprocal two-port device has an S matrix of the following form:

$$[S] = \begin{bmatrix} \frac{j}{\sqrt{2}} & S_{12} \\ r & S_{22} \end{bmatrix},$$

where r is a positive real number. Find the values for all four of the S_{ij} parameters.

Extra Problem 2

An input transmission line of characteristic impedance Z_{01} splits off into three identical output transmission lines having characteristic impedance $Z_{02} = 3Z_{01}$. This represents a four-port system. Find all 16 of the S parameters for this system. Note: Many of the 16 S_{ij} parameters will be identical. There should be only four values that are distinct.

Notes:

In Prob. 4.4, to find the incident and reflected waves, use transmission line theory to relate the incident voltage wave and the reflected voltage wave to the total voltage and current at each port.

In Prob. 4.7, find the Z matrix and the Y matrix for each of the two networks (so you will have four final matrices).

In Prob. 4.11, please do only the shunt element case (the series element case was done in the class notes).

In Prob. 4.12, there are several pssible approaches. You can try deriving this result using the ABCD or T matrix concepts. Another approach is to write down equations for the waves in the three different regions, and relate them using the S matrix equations. Another approach is to use the "wave bounce" method. That is, consider how an initial wave penetrates through device A, and then partially transmits through device B, while also bouncing back and forth between devices A and B, partially transmitting at each bounce. You should be able to sum the resulting geometric series to collect all of the transmitted waves together into a net transmitted wave (which then represents S_{21}).

In Prob. 4.13, part (b), try to reach a contradiction by assuming that the matrix is unitary and also that $S_{21} = 0$.