PreLab 6: Multiport Networks

<table>
<thead>
<tr>
<th>Assigned</th>
<th>September 26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due</td>
<td>Weeks of October 3 and 10, in Lab</td>
</tr>
</tbody>
</table>

Goal: to learn how to analyze linear multiport networks.

PRELAB 6 – ECEN 4634 (Undergraduate Lab)

1. Problem 2, Chapter 4 in lab notes, page 90.

2. Problem 6, Chapter 4 in lab notes, page 90.

3. Problem 15, Chapter 4 in lab notes, page 92.

4. The S-parameters for a measured matrix are given below. Find the return loss at port 1 and the insertion loss between ports 2 and 4 when the other ports are matched. What do you think is the function of this network?

\[
\begin{bmatrix}
0.01 & \frac{2}{\sqrt{3}} & e^{j1.5} \frac{1}{\sqrt{3}} & 0 \\
\frac{2}{\sqrt{3}} & 0.01 & 0.01 & e^{j1.64} \frac{1}{\sqrt{3}} \\
e^{j1.5} \frac{1}{\sqrt{3}} & 0.01 & 0.01 & \frac{2}{\sqrt{3}} \\
0 & e^{j1.64} \frac{1}{\sqrt{3}} & \frac{2}{\sqrt{3}} & 0.01
\end{bmatrix}
\]

If this element were ideal, what should the ideal S-parameter matrix look like? Determine if the ideal network is (a) matched; (b) reciprocal; and (c) lossless.

5. (a) Perform an odd and even mode analysis of a branch-line coupler to solve for:
   - the odd and even mode reflection coefficients at the input port, and
   - the odd and even mode transmission coefficients at the isolated port.
   - Show that in both cases the two coefficients add up to zero for an ideal coupler.

(b) Simulate an ideal branch-line coupler at 3GHz using NI/AWR Microwave Office and plot all relevant S-parameters on a single graph. What is the bandwidth of the coupler?

Additional PRELAB 6 – ECEN 5634 (Graduate Lab Only)

6. Problem 9, Chapter 4 in lab notes, page 91.