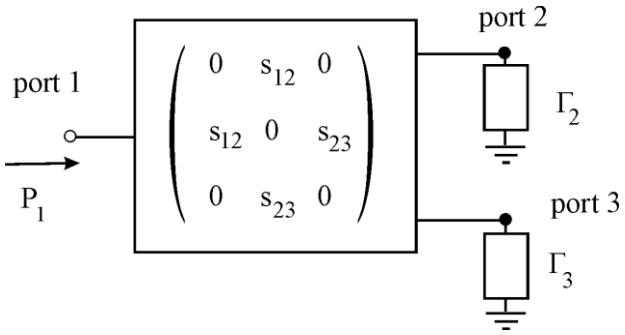
ECE 457- Microwave Devices and Circuits

Fall 2026

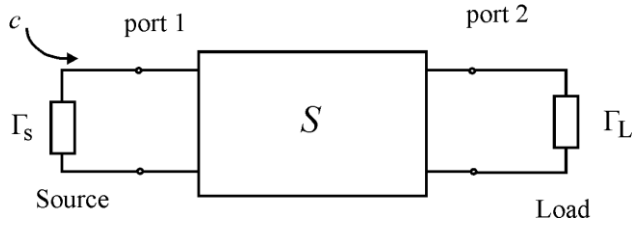
Homework #5- Microwave Network Analysis Due:

Wed Nov 11th

1. Use signal flow graphs to find the power ratios P_2/P_1 and P_3/P_1 for the mismatched three-port network shown below. Note: P_1 is the incident power at port 1, with P_2 and P_3 as the power absorbed in the terminations at port 2 and 3 respectively.

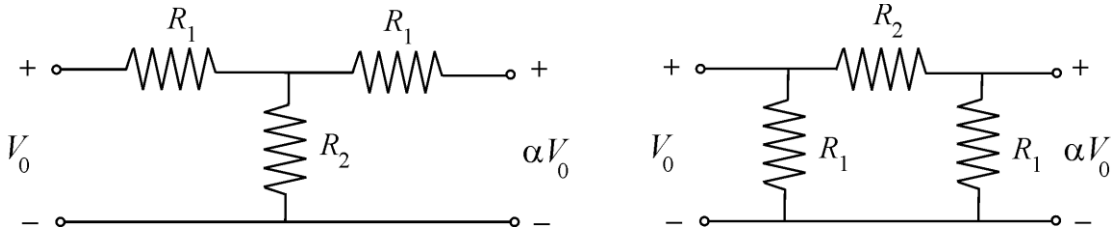


2. Consider the two-port circuit shown below with scattering parameters $\{S_{ij}\}$, load Γ_L and source Γ_s.



Find the *voltage gain*, A_v, of the circuit (i.e., the ratio of the output voltage across the load to the input voltage) as a function of the *s*-parameters of the two-port and the load Γ_L.

3. Consider the "T" and "Π" resistive attenuator circuits shown below. If the input and output ports are matched to Z_0, and the ratio of the output voltage to the input voltage is α, derive the design equations for R_1 and R_2 for each circuit. If Z_0=50 Ω, compute R_1 and R_2 for 3 dB, 10 dB, and 20 dB attenuators of each type.



4. Pozar 4.18

A four-port network has the scattering matrix shown as follows. If ports 3 and 4 are

connected with a lossless matched transmission line with an electrical length of 45°, find the resulting insertion loss and phase delay between ports 1 and 2.

$$[S]=\begin{bmatrix} 0.2\angle 50^\circ & 0 & 0 & 0.4\angle -45^\circ \\ 0 & 0.6\angle 45^\circ & 0.7\angle -45^\circ & 0 \\ 0 & 0.7\angle -45^\circ & 0.6\angle 45^\circ & 0 \\ 0.4\angle -45^\circ & 0 & 0 & 0.5\angle 45^\circ \end{bmatrix}$$

5. Pozar 4.29

The *ABCD* parameters are useful for treating cascades of two-port networks in terms of the total port voltages and currents, but it is also possible to use incident and reflected voltages to treat cascades. One way of doing this is with the *transfer*, or T-, *parameters*, defined as follows:

$$\begin{bmatrix} a_1 \\ b_1 \end{bmatrix}=\begin{bmatrix} T_{11} & T_{12} \\ T_{21} & T_{22} \end{bmatrix}\begin{bmatrix} b_2 \\ a_2 \end{bmatrix},$$

Where a_1, b_1 and a_2, b_2 are the incident and reflected voltages at ports 1 and 2, respectively. Derive the T-parameters in terms of the scattering parameters of a two-port network. Show how the T-parameters can be used for a cascade of two two-port networks.