UNIVERSITÀ DEGLI STUDI DI BRESCIA

Microwave Engineering Homework 3
June 2, 2022

Student ID:
Name:

Instructions: Please write your answer on a file or piece of paper and return it to me by uploading it in the Assignment Moodle section. I will look at all homework but will consider for evaluation only those retuned **not later than Monday June 10**.
IMPORTANT: This homework is not mandatory so you will still be able to get your full score at the final test even if you can't do it or can't return it on time!

Questions:

1. Consider a power divider with an input port "1" and two output ports "2", and "3" with the following scattering matrix for a reference characteristic impedance of 50Ω:

$$[S] = \frac{1}{2}\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

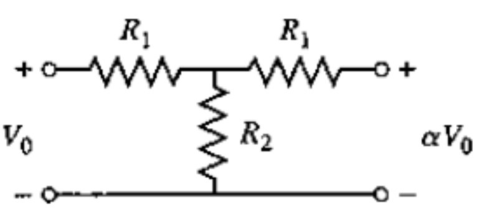
   a. Is the device reciprocal?
   b. Is the device lossless?
   c. Is the device matched at all ports?
   d. Are the two output ports 2 and 3 isolated?

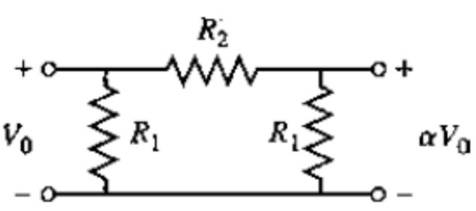
   Now suppose that the device is driven from port 1 by V_1^+=10V and that the output ports are terminated by matched loads. Calculate:

   e. The amplitude of the voltage waves at ports 2 and 3;
   f. The power available at ports 2 and 3;
   g. The power dissipated in the divider.

2. An air-filled rectangular cavity resonator has its first three resonant modes at the frequencies 5 GHz, 6.5 GHz and 7.2 GHz. Find the dimensions of the cavity.

3. Consider the T and π resistive attenuator circuits shown below. Derive the design equations for R_1 and R_2 for each circuit if the input and output are matched to Z_0 and the ratio of input and output voltages is α. If Z_0 =50 Ω, calculate R_1 and R_2 for 3 dB, 10 dB and 20 dB attenuators of each type.





4. Design a composite high-pass filter by the image parameter method with the following specifications: $R_0 = 75\ \Omega$, $f_c = 50$ MHz, and $f_\infty = 48$ MHz. Use the table below to design the filter.