UNIVERSITÀ DEGLI STUDI DI BRESCIA

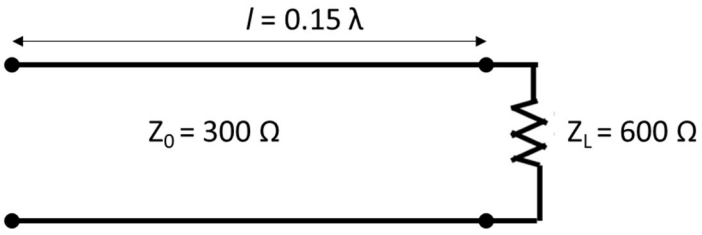
Microwave Engineering Final Test
June 16, 2020

Student ID:
Name:
Instructions: You have 1.5 hours to complete the test. Please write everything with blue or black ink pen so that all your work can be read easily. You can use your calculator. If you don't have a calculator, you can leave the formulas in expression forms and still get full score for the questions/exercises. Use of course notes or internet resources will invalidate the results of the test. Use of your cell phone is allowed only for scanning test and emailing the file at the end of the exam.
VERY IMPORTANT: Please WRITE YOUR FULL NAME AND STUDENT ID on the first sheet you scan. If you forget to include your name, I will not be able to put your material on record and therefore the test will NOT BE VALID!

Questions:

1. A lossless transmission line filled with air and characteristic impedance $Z_0 = 300\ \Omega$ is connected to a load $R_L = 600\ \Omega$. Assuming the length of the transmission line is $l = 0.4\lambda$ and the operating frequency is 500 MHz calculate:

a. The reflection coefficient Γ at the load;
b. The SWR;
c. The input impedance of the transmission line;
d. Design a quarter wave transformer to match the transmission line with the load R_L.
e. What is the percent bandwidth of the transformer if we assume SWR ≤ 1.5?



2. A rectangular waveguide filled with polyethylene ($\varepsilon_r = 2.25$, $\tan\delta = 0.0004$) is used to transmit signals at a carrier frequency of 10GHz.

a. Calculate the dimensions of the waveguide so that the cutoff frequency of the dominant TE mode is lower than the carrier by 25% and the frequency of the next mode is at least 25% higher than the carrier;
b. Suppose now to transform the waveguide into a cavity with length d. Calculate the quality factor Q assuming perfectly conducting walls and losses due only to the dielectric filling the cavity.

3. Consider the equal split three ports resistive power divider in figure. If port 3 is matched, calculate the change in output power at port 3 (in dB) when:

a. port 2 is connected to a matched load;

b. port 2 is connected to a load having a mismatch of Γ = 0.3.