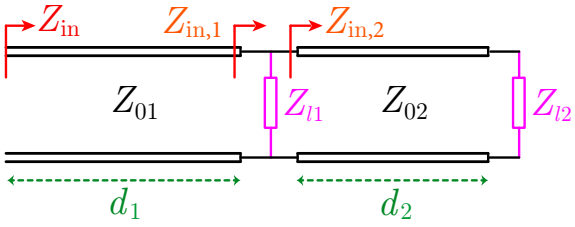
2020-2021, EE303 – Recitation 11

Question 1
Consider a combination of two loads and two lossless transmission lines.



The transmission lines are described as follows:

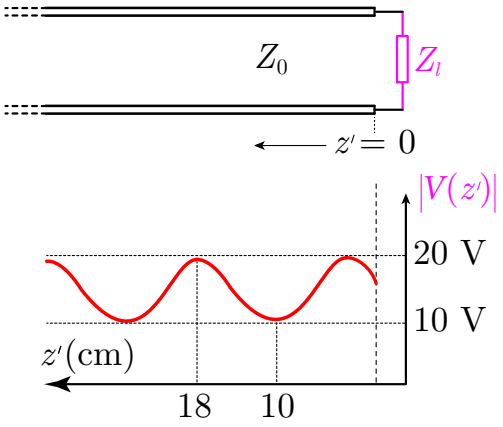
$$\bullet \ Z_{01} = 100\ \Omega, \quad d_1 = \lambda/4, \qquad \bullet \ Z_{02} = 200\ \Omega, \quad d_2 = 5\lambda/8 \tag{1}$$

Given the load impedances $Z_{l1} = (100 - j200)\ \Omega$ and $Z_{l2} = (100 + j100)\ \Omega$, do the following.

- In the *second* transmission line, find the positions (measured from the load) of the first maximum and the first minimum of the voltage pattern.
- Find VSWR in both transmission lines.
- Find the input impedance of the overall combination, i.e., Z_{in}.

* Extra question: Is it possible to make VSWR in the first line *unity* by selecting a suitable Z_{l1} without changing any other item?

Question 2
Consider a lossless transmission line terminated by a load Z_l with a given voltage pattern. Assume that the phase velocity is 3×10^8 m/s along the line.



- Find the wavelength and VSWR in the line.
- Find the magnitudes of the incident and reflected voltage waves.
- Find the reflection coefficient at the load (Γ_l).
- Find the load impedance if the characteristic impedance of the transmission line is $Z_0 = 200\ \Omega$.
- If the load involves a single inductor or capacitor (in addition to a resistor), find the value of the inductance or capacitance.
- Find the impedance value measured at $z' = 8$ cm.

Question 3
A series combination of a 30 Ω resistor and a $1/(80\pi)$ nF capacitor is connected to a lossless transmission line as a load at 1 GHz. The characteristic impedance of the transmission line is 50 Ω, while the phase velocity is 3×10^8 m/s. Find the impedance values measured at $z' = 7.5$ cm and $z' = 15$ cm. Also find how the values change if the frequency is increased to 2 GHz.