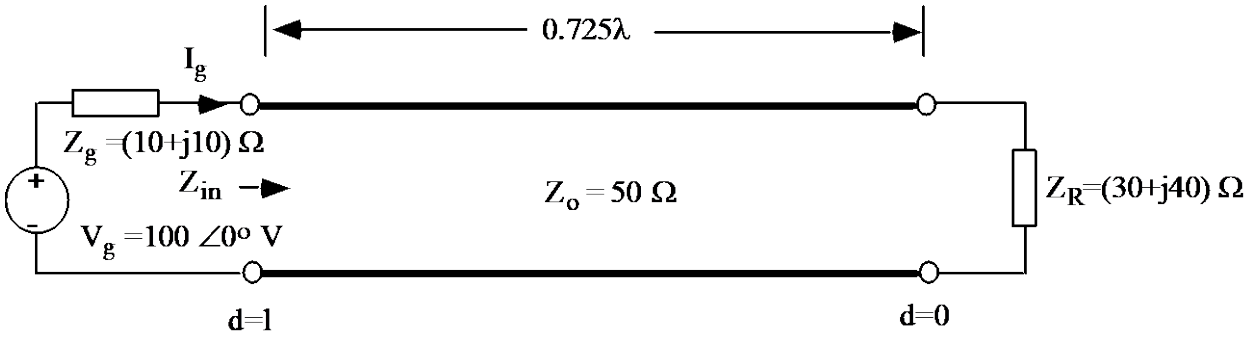
ECE 451 **Homework 1** **Due Wednesday, February 12, 2025**



1. Consider the transmission line system shown in the figure above.

   (a) Find the input impedance Z_{in}.

   (b) Find the current drawn from the generator

   (c) Find the time-average power delivered to the load

2. A lossless transmission line of characteristic impedance 75 Ω is terminated by some complex load, Z_L. If the distance from the load to the location of the first impedance minimum is measured to be .304λ and the impedance at that point is 22.5 Ω, using the Smith Chart find:

a) The SWR.

b) The load impedance, Z_L.

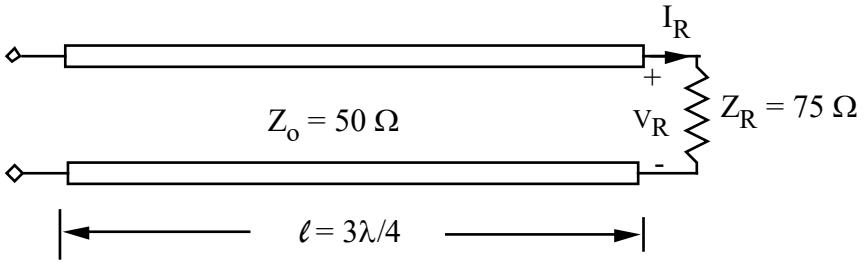
c) The reflection coefficient, $\overline{\Gamma}_L$.

d) Distance to the first voltage maximum.

e) Value of the line impedance at this point.

f) The distance to the closest point to the load where the real part of the line impedance is 75 Ω.

g) Is the impedance at the point located in part f inductive or capacitive?



3. Given the lossless transmission line shown above,

   (a) Find the reflection coefficient Γ_R and the standing wave ratio (SWR) for this loaded transmission line.

   (b) Sketch the standing wave patterns for the magnitude of the voltage along this transmission line in terms of V_R.

   (c) Determine the impedance at the input of this loaded transmission line.

   (d) If a sinusoidal generator $10 \angle 0^o$ V, which has a source impedance of 100 Ω is connected to this loaded transmission line, what is the time average power delivered to the 75-Ω load.

4. Answer the following questions using a Smith chart. Clearly identify significant features on the chart. A transmission line with characteristic impedance 50 Ω is terminated by a load of impedance $Z_r = 40 + j50\ \Omega$.

(a) What is the SWR?

(b) What is the phase of Γ_r?

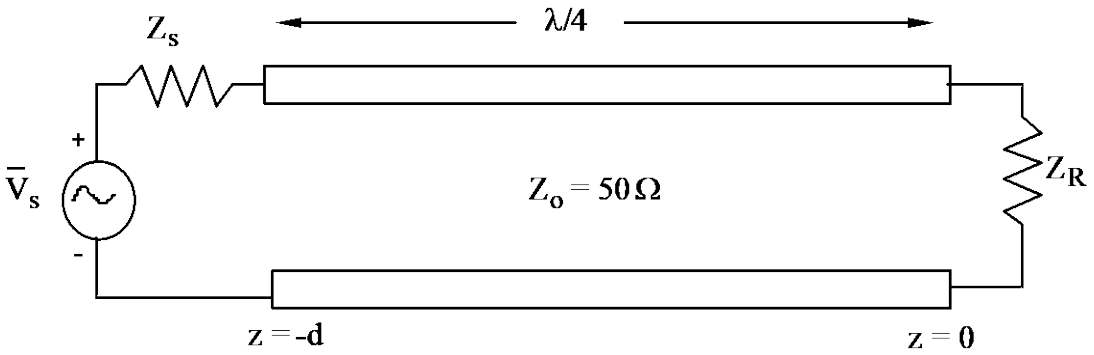
(c) What is the normalized admittance at the load?

(d) What is the normalized admittance at $d = 12.2\lambda$ toward the generator from the load?

(e) What is the phase of Γ at $d = 12.2\lambda$ toward the generator from the load?

(f) What is the shortest distance from the load at which a short-circuited stub could be attached to achieve an impedance match?

(g) What would the normalized input admittance of the stub be?



5. For the above figure, let $\overline{V}_s$ = 1 volt, Z_s = 30 Ω, and Z_R = 40 Ω.

   (a) What is the impedance at the input of the line (z = -d)?

   (b) What is the phasor current through Z_s?

   (c) What is the phasor current through Z_R ?

   (d) What is the time-average power delivered to the load ?