EE311 Name ___________________________

Spring 2020 Code _____________

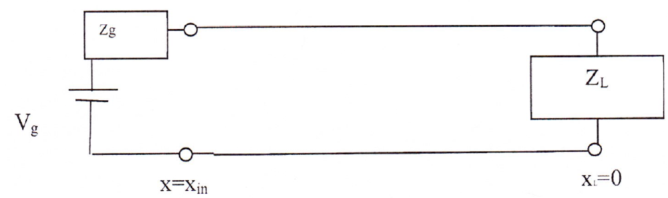
Game 4/22/20 T-line voltage and current

For this problem, you need to show your work in detail. Have clear presentation

For the following T-line system you know Z_L=150 ohms Z_0=50 ohms and the length of the line is $\frac{13\lambda}{2}$ *this means that* $x_{in} = -\frac{13\lambda}{2}$ since the load is at x=0.

If you know that $V^+(x=0)$ =5 volts

a) Find V^-
b) *Find* I at x=0
c) Find Zin which is the impedance at $x = x_{in}$
d) Find V^- *at* $x = x_{in}$
e) Find I^- *at* $x = x_{in}$



a) Reflection coefficient=$\Gamma(0) = \frac{150-50}{150+50} = \frac{1}{2} \rightarrow \frac{V^-(0)}{V^+(0)} = \Gamma(0) \rightarrow \frac{V^-(0)}{5} = \frac{1}{2}$ so. $V^-(0) = 2.5\ V$

b) We have two ways to do this let us try both

a. Knowing $V^+(0) = 5 \rightarrow \frac{V^+(0)}{z_0} = I^+(0) = \frac{1}{10}\ A.$ $I^-(0) = -\Gamma(0)I^+(0) = -\frac{1}{20}$

Knowing $I^+(0)$*we can find* $I(0) = I^+(0) + I^-(0) = I^+(0) - \Gamma(0)I^+(0) = \frac{1}{10} - \frac{1}{20} = \frac{1}{20} = I(0)$

Check answer, verify consistency. V(0)= $V^+(0) + V^-(0) = 7.5 \rightarrow I(0) = \frac{V(0)}{Z_L} = \frac{7.5}{150} \rightarrow I(0) = \frac{1}{20}$ *Checked*

c) $Z_{in} = Z(x_{in}) = z_0 \frac{1+\Gamma(0)e^{j2\beta x_{in}}}{1-\Gamma(0)e^{-j2\beta x_{in}}}$=50$\frac{1+\frac{1}{2}e^{j2\frac{2\pi}{\lambda}(-\frac{13\lambda}{2})}}{1-\frac{1}{2}e^{-j2\frac{2\pi}{\lambda}(-\frac{13\lambda}{2})}}$ = 150 Ohms =Z_{in}

as we know every half wavelength it repeats

d) $V^-(x_{in}) = V^-\left(-\frac{13\lambda}{2}\right)$=$V^-(0)e^{-j\frac{2\pi}{\lambda}(-\frac{13\lambda}{2})}$ = -2.5 V=$V^-(x_{in})$

e) *Technically at any point* $I^-(x_{in}) = -\frac{V^-(x_{in})}{z_0} = -\frac{-2.5}{50}$=$-\frac{1}{20}$ A=$I^-(x_{in})$

Another way $I^-(x_{in}) = I^-\left(-\frac{13\lambda}{2}\right)$=$I^-(0)e^{-j\frac{2\pi}{\lambda}(-\frac{13\lambda}{2})}$ = =$-\frac{1}{20}$ A=$I^-(x_{in})$

EE311 Name ___________________________

Spring 2020 Code _____________

Game 4/22/20 T-line voltage and current