EE311 Name ____________________________

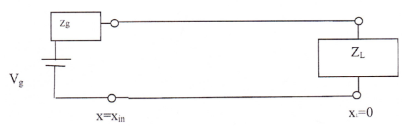
Spring 2020 Code _____________

Game 4/24/20 T-line voltage and current

For the following T-line system, you know Z_L=100 ohms Z_0=50 ohms Z_g =150 ohms and the length of the line is $\frac{300\lambda}{4}$

If you know that $V^-(x_{in} = -\frac{300\lambda}{4})$ is 10 volts

a) Find V^+ *and total* I at the input of the line
b) Find I^- at the load positions
c) Find the average power at the load (Note: In stead sate average power is $realpart\ of\ \frac{1}{2}VI^*$)
d) Can you find V_g? Explain and show if you can or cannot and find it if you think you can



a) To do this the easiest way is to find Zin

   a. $Z_{in} = Z(x_{in} = -\frac{300\lambda}{4}) = Z_0 \frac{1+\Gamma_L e^{j2\beta\left(-\frac{300\lambda}{4}\right)}}{1-\Gamma_L e^{j2\beta\left(-\frac{300\lambda}{4}\right)}} = 100\ \Omega\ \ NOTE\ \frac{300\lambda}{4} = \frac{150\lambda}{2}$ this is integer number of half wavelength so the exponential will be 1. also

   b. $\Gamma\left(x_{in} = -\frac{300\lambda}{4}\right) = \Gamma_{in} = \Gamma_L e^{j2\beta\left(-\frac{300\lambda}{4}\right)}\ \ \Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{1}{3}\qquad e^{j2\beta\left(-\frac{300\lambda}{4}\right)} = e^{-j2\frac{2\pi}{\lambda}\left(-\frac{300\lambda}{4}\right)} = 1 \rightarrow \Gamma_{in} = \frac{1}{3}$

   c. $\Gamma_{in} = \frac{V_{in}^-}{V_{in}^+}$ *so.* $V_{in}^+ = 10(\frac{1}{\frac{1}{3}})$= 30 V

   d. $I_{in} = \frac{V_{in}}{Z_{in}} = \frac{40}{100} = 0.4\ A = I_{in}$

b) $I_{in}^- = -\frac{V_{in}^-}{Z_0} = -\frac{10}{50} = -0.2\ A = I_{in}^-\qquad I_{in}^+ = \frac{V_{in}^+}{Z_0} = \frac{30}{50}$=0.6 A = I_{in}^+

c) *Since this is lossles should it be different thatn the one at the input?* Let us see. As you can see they are the same. However, for tests, games etc. we need to show what the question is asking for.

   a. $P_{in\ ave} = \frac{1}{2}V_{in}I_{in}^* = \frac{1}{2}(40)(0.4)$=8 W=$P_{in\ ave}$

   b. $P_{L\ ave} = \frac{1}{2}V_L I_L^* = \frac{V_L V_L^*}{2Z_L^*} = \frac{(40)(0.4)}{2}$= 8 W

d) We can find V_g *how?* $V_{in} = V_g \frac{Z_{in}}{Z_g + Z_{in}} \rightarrow\rightarrow V_g = V_{in}\frac{Z_g + Z_{in}}{Z_{in}} = 40\ \frac{150+100}{100} = 100V = V_g$