19-11-2020

EWE - Tutorial 4

Vedant Milind Athavale
181090071
TY BTech EXTC

Q1.] a.) $\frac{R}{L} = \frac{G}{C} \Rightarrow G = \frac{R}{L} C = \frac{20 \times 63 \times 10^{-12}}{0.3 \times 10^{-6}}$

$G = 4.2 \times 10^{-3}$ S/m

$\alpha = \sqrt{RG} = \sqrt{20 \times 4.2 \times 10^{-3}} = 0.2898$

$\beta = \omega\sqrt{LC} = 2\pi \times 120 \times 10^{6} \sqrt{0.3 \times 10^{-6} \times 63 \times 10^{-12}} = 3.278$

$\gamma = 0.2898 + j3.278$ /m

b.) Let V_0 be its original magnitude

$V_0 e^{-\alpha z} = 0.2 V_0$

$\Rightarrow e^{\alpha z} = 5$

$\therefore z = \frac{1}{\alpha} \ln 5 = 5.554$ m

c.) $\beta l = 45° = \pi/4 \Rightarrow l = \frac{\pi}{4\beta} = \frac{4}{4 \times 3.278}$

$\Rightarrow \boxed{l = 0.2396 \text{ m}}$

Q2.] We are given that there's a 60Ω lossless line connected to a source with

$V_g = 10 \angle 0° \; V_{rms}$ & $Z_g = 50 - j40\ \Omega$

Load is of $j40\ \Omega$.

length, $l = 100$m , $\beta = 0.25$ rad/m

a.) $\beta l = \frac{1}{4} \times 100 = 25 \text{ rad} = 1432.4° = 352.4°$

$Z_{in} = 60 \left[\frac{j40 + j60 \tan 352.4°}{60 - 40 \tan 352.4°} \right] = j29.375\ \Omega$

$$V(z=0) = V_0 = \frac{Z_{in}}{Z_{in}+Z_g} V_g = \frac{j29.375\,(10\angle 0^\circ)}{j29.375+50-j40}$$

$$= \frac{29.375\angle 90^\circ}{51.116\angle -12^\circ} = \underline{\underline{0.575\angle 102^\circ}}$$

b.) $Z_{in} = Z_L = j40\ \Omega$

$V_L = V_s(z=l)$, $V_0 = V_L \cdot e^{j\beta l}$

$$V_L = V_0 \cdot e^{-j\beta l} = (0.575 \cdot e^{j102^\circ})(e^{-j352.4^\circ})$$

$$= \underline{\underline{0.575\angle -250.4^\circ}}$$

c.) $\beta l = \frac{1}{4} \times 4 = 1\ \text{rad} = 57.3^\circ$

$$Z_{in} = 60\left[\frac{j40 + j60\tan 57.3^\circ}{60 - 40\tan 57.3^\circ}\right] = \underline{\underline{-j3487.11\ \Omega}}$$

$$V = V_L e^{j\beta l} = (0.575\angle -250.4^\circ)\, e^{j57.3^\circ}$$

$$= \underline{\underline{0.575\angle -193.1^\circ}}$$

d.) 3 m from the source is the same as 97 m from the load, i.e.,

$l = 100 - 3 = 97\ m$, $\beta l = \frac{1}{4} \times 97 = 24.25\ \text{rad} = 309.42^\circ$

$$Z_{in} = 60\left[\frac{j40 + j60\tan 309.42^\circ}{60 - 40\tan 309.42^\circ}\right] = -j18.2\ \Omega$$

$$V = V_L e^{j\beta l} = (0.575\angle -250.4^\circ)\, e^{j309.42^\circ}$$

$$\Rightarrow \boxed{V = 0.575\angle 59.02^\circ}$$