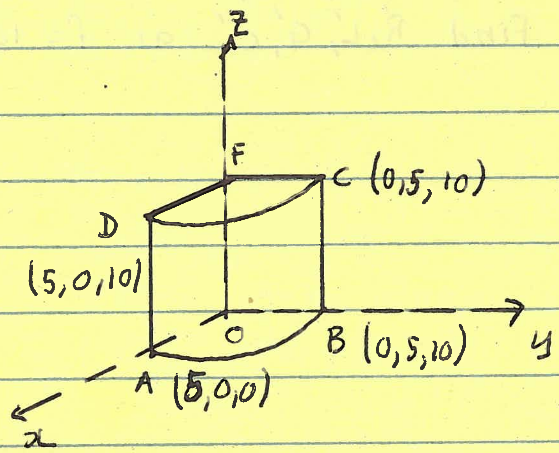
Points

EE 101 QUIZ L

Name:

Student ID.

1



Calculate

		Points
a)	Length BC	1
b)	length CD	1
c)	surface area ABCD	2
d)	surface area ABO	2
e)	volume ABCDFO	4

Points. 15

Q2. A transmission line is said to be distortionless if $R'/L' = G'/C'$. A distortionless line has $Z_0 = 60\,\Omega$, $\alpha = 20$ mNp/m, phase velocity $u_p = 0.6\,c$ where $c = 3\times10^8$ ms^{-1}. Find R', L', G', C' at $f = 100$ MHz.

Solution to Quiz 1.

10

First convert to cylindrical co-ordinate system

$(x, y, z) \qquad (\rho \;\; \phi \;\; z)$

1 $A(5,0,0) \rightarrow A(5, 0^0, 0)$

$B(0,5,0) \rightarrow B(5, \pi/2, 0)$

$C(0,5,10) \rightarrow C(5, \pi/2, 10)$

1 $D(5,0,10) \rightarrow D(5, 0^0, 10)$

(1) Along BC $dl = dz$

Hence $BC = \int dl = \int_0^{10} dz = 10$

(2) Along CD $dl = \rho\, d\phi$ and $\rho = 5$

$CD = \int_0^{\pi/2} \rho\, d\phi = 5\phi\Big|_0^{\pi/2} = 2.5\pi.$

$= 7.85$

2 (3) For ABCD $dS = \rho\, d\phi\, dz$, $\rho = 5$

Area of ABCD $= \int_{\phi=0}^{\pi/2} \int_{z=0}^{10} \rho\, d\phi\, dz = 25\pi = 78.5$

2 (4) For ABO $dS = \rho\, d\phi\, d\rho$ and $z = 0$.

Area of ABO $= \int_{\phi=0}^{\pi/2} \int_{\rho=0}^{5} \rho\, d\phi\, d\rho = 6.25\pi$. $\frac{25}{4}\pi$

$= 19.625$

4 (5) For volume ABCDFO. $dv = \rho\, d\phi\, dz\, d\rho$

$v = \int_{\rho=0}^{5} \int_{\phi=0}^{\pi/2} \int_{z=0}^{10} \rho\, d\phi\, dz\, d\rho = \int_0^{10} dz \int_0^{\pi/2} d\phi \int_0^{5} \rho\, d\rho$

$= 62.5\pi$. $\frac{125}{2}\pi$

$= 196.25$

Q2. $R'C' = G'L'$ or $G' = \frac{RC'}{L'}$

(5+10+4 = 27)

1 $\gamma = \sqrt{(R' + j\omega L')(G' + j\omega C')} = \alpha + j\beta$.

1 $Z_0 = \sqrt{\frac{(R' + j\omega L')}{(G' + j\omega C')}} = \sqrt{\frac{R'}{G'} \frac{\cancel{(1 + j\omega L'/R')}}{\cancel{(1 + j\omega C'/G')}}}$

but $L'/R' = C'/G'$

distortionless line is one where the signal propagates without either different attenuation or different phase velocity for different frequencies ie α and u_p are independent of ω

1 $Z_0 = \sqrt{\frac{R'}{G'}} = \sqrt{\frac{L'}{C'}}$ 4

Similarly $\gamma = \sqrt{R'\left(1 + j\omega \frac{L'}{R'}\right) G'\left(1 + j\omega \frac{C'}{G'}\right)}$

1 $= \sqrt{R'G'}\left(1 + j\omega \frac{C'}{G'}\right)$

Aside

$\sqrt{R'G'}\ \omega \frac{C'}{G'}$

$\sqrt{R'G'}\ \frac{L'}{R}$

$\sqrt{\frac{G'}{R'}}\ L'$

$\sqrt{\frac{C'}{L'}}\ L'$

$\sqrt{C'L'}$

1 $\alpha = \sqrt{R'G'}$, 1 $\beta = \omega\sqrt{L'C'}$

1 $= \frac{R'}{Z_0}$ or $R = \alpha Z_0$ 1

1 $u_p = \omega/\beta = \frac{1}{\sqrt{LC}}$

1 Using $R' = \alpha Z_0 = (20 \times 10^{-3})(60) = 1.2\ \Omega/m$

2 $L' = \frac{Z_0}{u_p} = \frac{60}{0.6(3 \times 10^8)} = 333\ nH/m$ 3.33×10^{-7}

2 $G' = \frac{\alpha^2}{R} = \frac{400 \times 10^{-6}}{1.2} = 333\ \mu S/m$ $3.3 \times 10^{-4}/m$ 9.2×10^{-11}

1 $u_p Z_0 = \frac{1}{C}$ $C = \frac{1}{u_p Z_0} = \frac{1}{0.6(3 \times 10^8) 60} = 92.59\ pF/m$