SOLUTION 10 FOR 6.013

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Solution 10.1

a) velocity $c=\sqrt{\frac{1}{LC}}$,$L=\frac{1}{c^2C}=\frac{1}{(3\times10^8)^2\times10^{-10}/3}=3.33\times10^{-7}$[m/s]

b) $Z_0=\sqrt{\frac{L}{C}}=\sqrt{\frac{\frac{1}{c^2C}}{C}}=1/Cc=\frac{1}{3\times10^8\times10^{-10}/3}=100$[ohms]

c) $\underline{\Gamma}_L=\frac{Z_L-Z_0}{Z_L+Z_0}=\frac{3Z_0-Z_0}{3Z_0+Z_0}=1/2$

d) $\underline{\Gamma}(z=-\lambda/4)=\underline{\Gamma}_Le^{2jkz}=\underline{\Gamma}_Le^{-2jk\lambda/4}=\underline{\Gamma}_Le^{-j\pi}=-1/2$

e) $\underline{Z}_n=\frac{1+\underline{\Gamma}}{1-\underline{\Gamma}}=\frac{1-1/2}{1-1/2}=\frac{2-1}{2+1}=1/3$

f) $\underline{Z}=\underline{Z}_nZ_0=100/3=33.3$[ohm]

g) $\underline{\Gamma}_L=\frac{Z_L-Z_0}{Z_L+Z_0}=\frac{jZ_0-Z_0}{jZ_0+Z_0}=\frac{j-1}{j+1}=j$

$\underline{\Gamma}(z=-\lambda/4)=\underline{\Gamma}_Le^{2jkz}=\underline{\Gamma}_Le^{-2jk\lambda/4}=\underline{\Gamma}_Le^{-j\pi}=-j$

$\underline{Z}_n=\frac{1+\underline{\Gamma}}{1-\underline{\Gamma}}=\frac{1-j}{1+j}=-j$

$\underline{Z}=\underline{Z}_nZ_0=-j\cdot100=-100j$

Solution 10.2

(a) $VSWR=\frac{V_{max}}{V_{min}}=3$
b) $\lambda=2$meter
c) $\Gamma(z)=\frac{VSWR-1}{VSWR+1}=0.5$
d) $\underline{Z}_n=\underline{Z}_L/Z_0=\frac{1+\Gamma_L}{1-\Gamma_L}=\frac{1+1/2}{1-1/2}=3$
e) $1\rightarrow B$, $2\rightarrow A$, $3\rightarrow E$(at the image axis).
f) F point.
g) $jwL/Z_0=jX=j1.1$, $L=XZ_0/(2\pi c/\lambda)=XZ_0\lambda/(2\pi c)=\frac{1.1\times100\times2}{2\times\pi\times3\times10^8}=1.16\times10^{-7}$[H]

h) Yes. The VSWR plot can provide Γ, $Z_n(z)$, $Z(z)$.