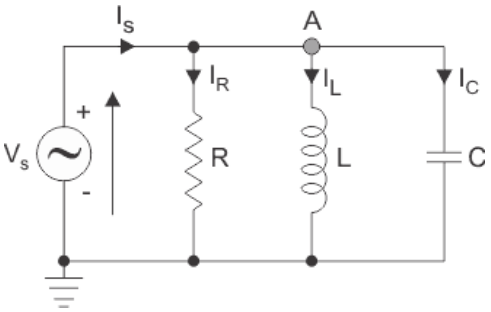
Microwave Engineering

HW01b Solutions (10 points each)

2.1



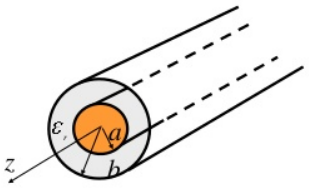
$f = 1\text{MHz},\ V_s = 5e^{j40^\circ}, R = 5\ \Omega, L = 1\mu\text{H},\ C = 30\ \text{nF}$

$\omega L = 6.3\ \Omega,\ \dfrac{1}{\omega C} = 5.3\ \Omega$

$$I_s = I_R + I_L + I_C = \frac{V_g}{R} + \frac{V_g}{j\omega L} + \frac{V_g}{1/\ j\omega C} = 5e^{j40^\circ}\left(\frac{1}{5} + \frac{1}{j6.3} + \frac{1}{-j5.3}\right) = 0.67 + j0.76 = 1.0\ e^{j48.5^\circ}\ \text{(A)}$$

2.2

characteristic impedance of a coax.



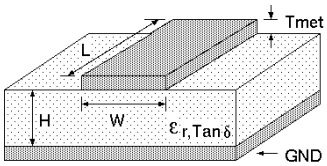
$$C = \frac{2\pi\varepsilon_0\varepsilon_r}{\ln\left(\frac{b}{a}\right)}\ \text{F/m} \qquad L = \frac{\mu_0}{2\pi}\ln\left(\frac{b}{a}\right)\ \text{H/m}$$

$$Z_0 = \frac{1}{2\pi}\sqrt{\frac{\mu_0}{\varepsilon_0}}\frac{1}{\sqrt{\varepsilon_r}}\ln\left(\frac{b}{a}\right)$$

$$Z_0 = \sqrt{\frac{L}{C}} = \sqrt{\frac{\frac{\mu_0}{2\pi}\ln\left(\frac{b}{a}\right)}{\frac{2\pi\varepsilon_0\varepsilon_r}{\ln\left(\frac{b}{a}\right)}}} \qquad Z_o = \frac{60}{\sqrt{\varepsilon_r}}\ln\frac{b}{a}$$

$$a = 1.5, b = 4.5, \varepsilon_r = 2.1 \rightarrow Z_0 = \frac{60}{\sqrt{2.1}}\ln\frac{4.5}{1.5} = 45.5\ \Omega$$

2,3



Use an online program: http://www.emtalk.com/mscalc.php

$H = 1\ \text{mm}, W = 2\ \text{mm}, \varepsilon_r = 4.3$

$Z_0 = 49.4\ \Omega$