**Microwave Engineering**

**HW-01a Solutions (10 points each)**

1. Express $\dfrac{2+j6}{3-j4}$ in the polar coordinates.

(Answer) Use the Android program 'PowerCalc'.

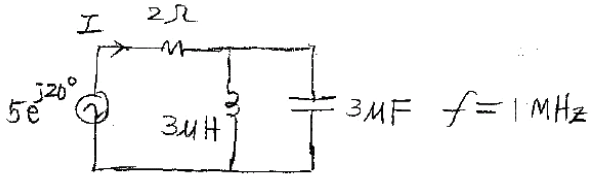
$$\frac{2+j6}{3-j4}=1.26e^{j124.7^\circ}$$

2. For express $\sqrt{\dfrac{2+j6}{3-j4}}$ in the polar coordinates.

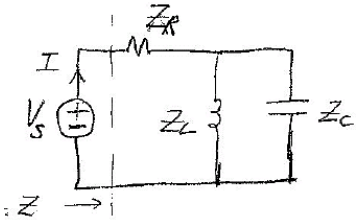
(Answer) Use the Android program 'PowerCalc'.

$$\sqrt{\frac{2+j6}{3-j4}}=1.12e^{j62.3^\circ}$$

3. Find the current $I$ in the following circuit.




(Answer)

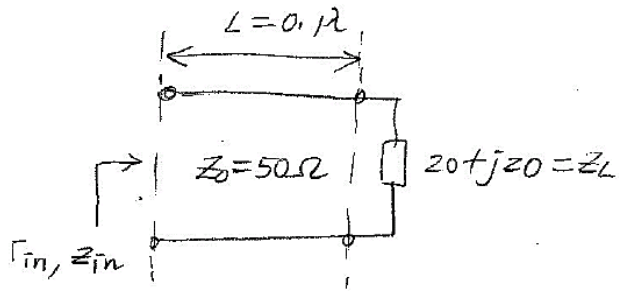



$$Z=Z_R+\frac{Z_LZ_C}{Z_L+Z_C},Z_R=2,Z_L=j\omega L=j18.8,Z_C=-j0.053$$

$$Z=2+\frac{18.8\times0.053}{j18.8-j0.053}=2-j0.053=2e^{-j1.5^\circ}$$

$$I=\frac{V}{Z}=\frac{5e^{j20^\circ}}{2e^{-j1.5^\circ}}=2.5e^{j21.5^\circ}$$

4. Finc the input impedance $Z_{in}$ in the following circuit.



(Answer)

Method 1:

$$Z_{\text{in}} = Z_0 \frac{Z_L + jZ_0 \tan \beta L}{Z_0 + jZ_L \tan \beta L} = 50 \frac{20 + j20 + j50 \tan((2\pi / \lambda)0.1\lambda)}{50 + (20 + j20) j50 \tan((2\pi / \lambda)0.1\lambda)} = 52.0 + j58.1 \ (\Omega)$$

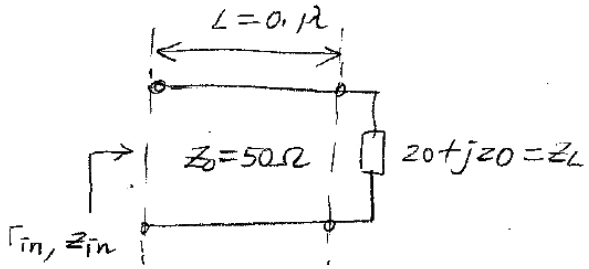
Method 2:

$$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{20 + j20 - 50}{20 + j20 + 50} = 0.495 e^{j130.4^\circ}$$

$$\Gamma_{\text{in}} = \Gamma_L e^{-j2\beta L} = 0.495 e^{j130.4^\circ} e^{-j2(2\pi/\lambda)(0.1\lambda)} = 0.495 e^{j58.4^\circ}$$

$$Z_{\text{in}} = Z_0 \frac{1 + \Gamma_{\text{in}}}{1 - \Gamma_{\text{in}}} = 50 \frac{1 + 0.495 e^{j58.4^\circ}}{1 - 0.495 e^{j58.4^\circ}} = 52.0 + j58.0 \ (\Omega)$$

5. Finc the input reflection coefficient $\Gamma_{\text{in}}$ in the following circuit.




(Answer)

$$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{20 + j20 - 50}{20 + j20 + 50} = 0.495 e^{j130.4^\circ}$$

$$\Gamma_{\text{in}} = \Gamma_L e^{-j2\beta L} = 0.495 e^{j130.4^\circ} e^{-j2(2\pi/\lambda)(0.1\lambda)} = 0.495 e^{j58.4^\circ}$$