Human Adepoju
17/ENG05/1002
Mechatronics Engineering

1) $R = 100k\Omega$; $L = 20mH$, $C = 5nF$

$R = 100 \times 10^3 = 100000$ $L = 20 \times 10^{-3} H$ $C = 5 \times 10^{-9}$

2) $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{20 \times 10^{-3} \times 5 \times 10^{-9}}}$

$= \frac{1}{\sqrt{100 \times 10^{-12}}} = \frac{1}{10 \times 10^{-6}}$

$= 10^{-1} \times 10^6$

$= 10^5$

$= 100$ Krad/s.

) $Q = \frac{R}{\omega_0 L} = \frac{100,000}{100 \times 100 \times 20 \times 10^{-3}}$

$= \frac{1}{20} \times 10^3$

$= 50$

$$B = \frac{\omega_0}{Q} = \frac{100 \times 10^3}{50} = 2000 \text{ rad/s}$$

$$= 2 \text{ K/s}.$$

$$\omega_1 = \omega_0 - \frac{B}{2} = 100,000 - \frac{2000}{2}$$

$$= 100,00 - 1000$$

$$= 99,000$$

$$99 \text{ K rad/s}$$

$$\omega_2 = \omega_0 + \frac{B}{2} = 100,000 + \frac{2000}{2}$$

$$100,000 + 1000$$

$$= 101000 \text{ rad/s}$$

$$= 101 \text{ K rad/s}$$

2) Input admittance

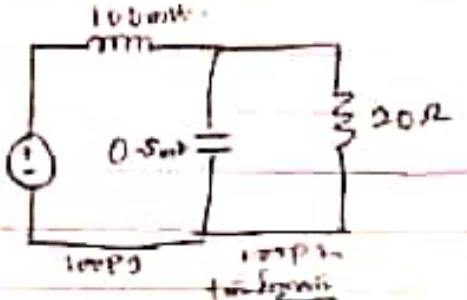
$$Y = j\omega 0.1 + \frac{1}{\omega} + \frac{1}{2 + j\omega 2} = 0.1 + j\omega 0.1 + \frac{2 - j\omega 2}{4 + 4\omega^2}$$

At resonance $Im(Y) = 0$ and

$$\omega_0 0.1 - \frac{2\omega_0}{4 + 4\omega_0^2} = 0 \Rightarrow$$

$$\therefore \omega_0 = 2 \text{ rad/s}$$

Question 3.



time domain

$100mH = (100 \times 10^{-3})\ H \rightarrow L$

$0.5mF = (0.5 \times 10^{-3})\ F \rightarrow C$

$20\Omega \rightarrow R$

frequency domain

$(100 \times 10^{-3})j\omega\ H$

$(0.5 \times 10^{-3}) = \frac{1}{2000} = 2000/j\omega$

20Ω

From loop 2

$R \| C$

$$\frac{20 \times \frac{2000}{j\omega}}{20 + \frac{2000}{j\omega}}$$ i.e Fraction form

$$\Rightarrow \frac{40000}{20j\omega + 2000} \Rightarrow \frac{40000}{20j\omega + 2000} \times \frac{(20j\omega - 2000)}{(20j\omega + 2000)}$$ (rationalization)

$$\Rightarrow \frac{80,0000j\omega - 80,000000}{-400j\omega - 4000000}$$

Back to loop 1.

$R = L + (R \| C)$ since the resistor is in series

$$\frac{800000j\omega - 80000000}{-400j\omega - 4000000} + (100 \times 10^{-3})j\omega$$

at resonance $Im(R)$

$$= \frac{800000j\omega}{-400j\omega - 4000000} + j\omega(100 \times 10^{-3})$$

$200000\omega_0 + (-40\omega_0^2) - 400000\omega_0$.

$400000 - 40\omega^2 = 0$.

$\omega^2 = 10000$

$\omega = 100 \text{ rad/s}$.