

EMEROLE CHINAEME IKENNA
MECHATRONICS ENGINEERING
171EN0051012

Question 1

Given Parameters

$$R = 100\text{K}\Omega, \quad L = 20\text{mH}, \quad C = 5.0\text{nF}$$

$$R = 100 \times 10^3 \quad L = 20 \times 10^{-3}\text{H} \quad C = 5 \times 10^{-9}$$
$$= 100000\Omega \quad = 0.02\text{H} \quad = 5\text{nF}$$

$$a \quad \omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{0.0002 \times 5 \times 10^{-9}} = \frac{1}{10 \times 10^{-6}} = 10^{-1} \times 10^6 = 10^5 = 100\text{krad/s}$$

$$b \quad Q = \frac{R}{\omega_0 L} = \frac{100,000}{100,000 \times 20 \times 10^{-3}} = \frac{1 \times 10^5}{20} = 0.05 \times 10^5 = 50$$

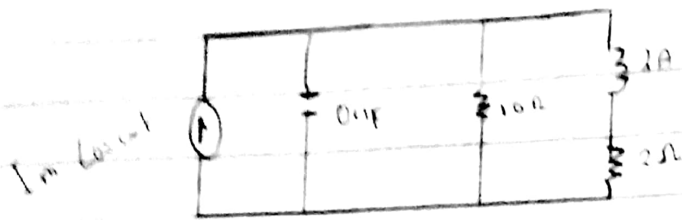
$$c \quad B = \frac{\omega_0}{Q} = \frac{100 \times 10^3}{50} = 2000\text{rad/s}$$

2krad/s

$$W_1 = \omega_0 - \frac{B}{2} = 100,000 - \frac{2000}{2} = 100,000 - 1000 = 99,000 = 99\text{krad/s}$$

$$W_2 = \omega_0 + \frac{B}{2} = 100,000 + \frac{2000}{2} = 100,000 + 1000 = 101,000\text{rad/s}$$

= 101krad/s



The input

$$Y = j\omega C + \frac{1}{10} + \frac{1}{2 + j\omega L} = 0.1 + j\omega \cdot 10^{-6} + \frac{2 - j\omega L}{4 + 4\omega^2 L^2}$$

At resonance $\text{Im}(Y) = 0$

$$\omega \cdot 0.1 - \frac{2\omega L}{4 + 4\omega^2 L^2} = 0$$

$$0.4 - 0.4\omega^2 L^2 - 2\omega L = 0$$

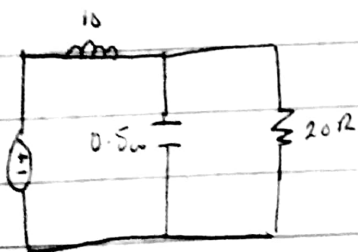
Divide through by ωL

$$0.4 + 0.4\omega^2 L^2 - 2 = 0$$

$$0.4\omega^2 L^2 = 1.6$$

$$\omega^2 L^2 = \frac{1.6}{0.4} \Rightarrow \omega L = \sqrt{4} = 2 \text{ rad/s}$$

Question 3



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

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

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

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

$$20 \Omega$$

From loop 2

R // L

$$20 \times \frac{2000/j\omega}{2 + 2000/j\omega} \quad \text{r.c.}$$

$$2 + 2000/j\omega$$

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

$$\Rightarrow \frac{80,000j\omega - 80,000,000}{-400j\omega - 400,000}$$

$R = L + (R // L)$ since the inductor is in series

$$\frac{80,000j\omega - 80,000,000}{-400j\omega - 400,000} + (100 \times 10^{-3})$$

at resonance $\text{Im}(R)$

$$= \frac{80,000j\omega}{-400j\omega - 400,000} + j\omega (100 \times 10^{-3})$$

$$80000\omega + (-400\omega^2) = 40000\omega$$

$$40000 - 400\omega^2 = 0$$

$$\omega^2 = 10000$$

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