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17/ENG04/076
ELECT./ELECT.
EEE 322

ASSIGNMENT

1.) $R = 100k\Omega$, $L = 20mA$, $C = 5mF$

$$\omega_o = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(2\times10^{-3})(5\times10^{-4})}} = \frac{1}{\sqrt{1\times10^{-10}}} = 100\,000 \text{ rad/s}$$

$\omega_o = 100k\text{rad/s}$

$$Q = \frac{R}{\omega_o L} = \frac{100\times10^3}{(100\times10^3)(20\times10^{-3})} = \frac{1}{20\times10^{-3}} = 50$$

$Q = 50$

$$B = \frac{\omega_o}{Q} = \frac{100\times10^2}{50} = 2000 \simeq 2k\text{rad/s}$$

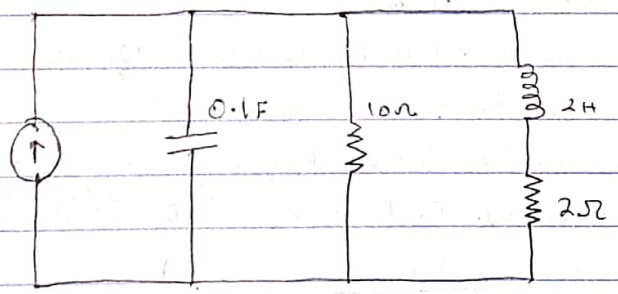
$$Q > 10, \omega_1 = \omega_o - \frac{B}{2} = 100\times10^{-3} - \frac{200}{2} = 100\times10^{-3} - 100$$

$\omega_1 = 99000 \simeq 99k\text{rad/s}$

$$\omega_2 = \omega_o + \frac{B}{2}, 100\times10^3 + \frac{2000}{2} = 100\times10^3 - 1000.$$

$\omega_2 = 101k\text{rad/s}$,

2.)



$$Y = \frac{1}{10} + j\omega 0.1\,\frac{1}{2+j\omega_2} = 0.1 + j\omega 0.1 + \frac{1}{2+j\omega_2}$$

$$\frac{1}{2+j\omega_2} = \frac{1}{2+j\omega_2} \times \frac{2-j\omega_2}{2-j\omega_2} = \frac{2-j\omega_2}{4+j\omega_2}$$

$$Y = 0.1 + j\omega 0.1 + \frac{2-j\omega_2}{4+j\omega_2} = 0.1 + j\omega 0.1 + \frac{2}{4+j\omega_2} - \frac{j\omega^2}{4+4\omega^2}$$

$$Y = 0.1 + \frac{2}{4+4\omega^2} + j\omega 0.1 - \frac{j\omega_2}{4+4\omega^2} = \frac{0.1+2}{4+4\omega^2} + j\left(\omega 0.1 - \frac{\omega^2}{4+4\omega^2}\right)$$

At Resonance, $\text{Im}(y) = 0$

Therefore, $\omega_o 0.1 - \frac{\omega_o 2}{4+4\omega^2} = 0$

Q1 - 1

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

$$0.1 = \frac{2}{4+4\omega^2}$$

$$0.4 + 0.4\omega^2 = 2$$

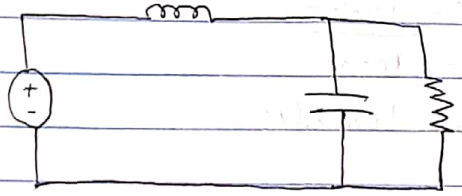
$$0.4\omega^2 = 1.6$$

$$\omega_o^2 = 0.4 \times 10$$

$$\omega_o^2 = 4$$

$$\omega_o = \sqrt{4} = 2 \text{ rad/s}$$

(c)



$$Z = j\omega 100\times10^{-3} + \left(\frac{20}{j\omega(0.5\times10^{-3})} \div \left(20 + \frac{1}{0.5\times10^{-3}j\omega}\right)\right)$$

$$= j\omega(100\times10^{-3}) + \left(\frac{20}{j\omega(0.5\times10^{-3})} \div \left(\frac{0.01j\omega+1}{0.5\times10^{-3}j\omega}\right)\right)$$

$$= j\omega(100\times10^{-3}) + \left(\frac{20}{j\omega(0.5\times10^{-3})} \times \left(\frac{j\omega(0.5\times10^{-3})}{0.01j\omega+1}\right)\right)$$

$$= j\omega(100\times10^{-3}) + \left(\frac{20}{0.01j\omega+1}\right)$$

$$\frac{20}{j\omega 0.1+1} = \frac{20}{0.01j\omega+1} \times \frac{0.01j\omega-1}{0.01j\omega-1}$$

$$= \frac{j\omega 0.2 - 20}{-1\times10^{-4}\omega^2-1} = \frac{-20+j\omega 0.2}{-1\times10^{-4}\omega^2-1}$$

$$Z = j\omega(100\times10^{-3}) = \frac{20}{1\times10^{-4}j\omega^2+1} - \frac{0.2j\omega}{1+1\times10^{-4}\omega^2} = \frac{20}{1\times10^{-4}\omega^2} + j\omega(100\times10^{-3})$$

$$= \frac{0.2j\omega}{1+1\times10^{-4}\omega^2}$$

$$Z = \frac{20}{1+10^{-4}j\omega^2} + j\left(\omega(100\times10^{-3}) - \frac{0.2\omega}{1+1\times10^{-4}\omega^2}\right)$$

At resonance, the imaginary part is 0

$$\therefore 100(10\times10^{-3}) = \frac{0.2\omega_0}{1+1\times10^{-4}\omega_0^2} = 0$$

$$\omega_0(100\times10^{-3}) = \frac{0.2\omega_0}{1+1\times10^{-4}\omega_0^2}$$

$$100\times10^{-2}(1+1\times10^{-4}\omega_0^2) = 0.2$$

$$100\times10^{-2} + 1\times10^{-5}\omega_0^2 = 0.2$$

$$1\times10^{-5}\omega_0^2 = 0.2 - 100\times10^{-3} = 0.1$$

$$1\times10^{-5}\omega_0^2 = 0.1$$

~~1×10^{-5}~~

$$\omega_0^2 = \frac{0.1}{10^{-5}}$$

$$\omega_0^2 = 10000$$

$$\omega_0 = \sqrt{10000}$$

$$\omega_0 = 100 \text{ rad/s}$$