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17/ENG05/033
MECHATRONICS

CIRCUIT THEORY 2

ASSIGNMENT 2

Solution for Assignment

1) A parallel resonant Circuit has $R = 100K\Omega$, $L = 20mH$ and $C = 5nf$ Calculate $\omega_0, \omega_1, \omega_2$, Q and B

Solution

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(20\times10^{-3})\times(5\times10^{-3})}}$$

$$= 100K\,rad/s$$

$$B = \frac{\omega_0}{Q} = \frac{1}{RC} = \frac{1}{100\times(5\times10^{-3})}$$

From the equations above we know that $\omega_0 = 100K\,rad/s$ and B is $2K\,rad$

So Q which is $\frac{\omega_0}{B}$

$$Q = \frac{\omega_0}{B} = \frac{100\times10^3}{2\times10^3} = 50$$

$$\omega_1 = \omega_0 - \frac{B}{2}$$

Since $Q \geq 10$

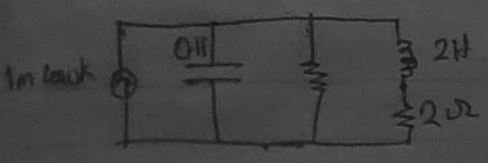
$$100\times10^3 - \frac{2\times10^3}{2} = 99\,rad/s$$

$$\omega_2 = \omega_0 + \frac{B}{2}$$

Since $Q \geq 10$

$$100\times10^3 + \frac{2\times10^3}{2} = 101K\,rad/s$$

2) Determine the resonant frequency of the circuit



Solution

Input admittance = Y

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

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

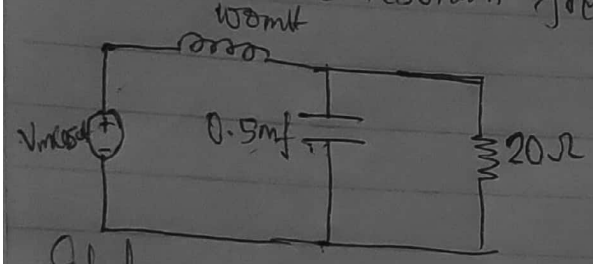
Resonance

$Im(Y) = 0$

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

$\omega_0 = 2 rad/s$

3) Calculate the resonant frequency of the circuit below



Solution

$$\frac{20 + \frac{2000}{j\omega}}{20 + \frac{2000}{j\omega}} = \frac{40000}{20j\omega + 2000} - \frac{4000}{20j\omega + 2000} + \frac{(20j\omega - 2000)}{(20j\omega - 2000)}$$

$$= \frac{80000j\omega - 8000000}{-400\omega - 4000000} + 100mH$$

At Resonance of the imaginary part at $\omega = 0$

$$= \frac{80000j\omega}{400\omega - 4000000} + j\omega C[100 \times \omega^{-3}]$$

$$= 800000\omega + [40\omega^2] - 4000000\omega$$

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

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

$$\omega^2 = 10000$$

$$\omega = \sqrt{10000}$$

$\omega = 100 rad s$