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17/Eng04/075
ELECT/ELECT

i) Parameters

$R = 100K\Omega$, $L = 20mH$, $C = 5nf$

Conversion

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

a) $W_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{20 \times 10^{-3} \times 5 \times 10^{-9}}}$

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

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

$= 10^5$

$= 100\ Krad/s$

B) $Q = \frac{R}{W_0 L} = \frac{100,000}{100 \times 10^3 \times 20 \times 10^{-3}}$

$= 1/20 \times 10^{-3}$

$= 0.05 \times 10^3 = 50_{\Omega}$

c) $B = \frac{W_0}{Q} = \frac{100 \times 10^3}{50} = 2000\ rad/s = 2K/s$

D) $W_1 = W_0 - \frac{B}{2} = 100,000 - \frac{2000}{2}$

$= 100000 - 1000$

$= 99,000 = 99K\ rad/s$

d) $\omega_2 = \omega_0 + \frac{B}{2} = 100000 + \frac{2000}{2}$

$= 1000,000 + 1000$

$= 101,000 \text{ rad/s}$

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

Question 2 [Fig 14.28]

Solution

The input admittance is

$$Y = j\omega 0.1 + 1/10 + 1/2 + j\omega 2 = 0.1 + j\omega 0.1 + \frac{2 - \omega j 2}{4 + 4\omega^2}$$

At resonance, $Im[Y] = 0$ and

$$\omega_0 0.1 - \frac{2\omega_0}{4 + 4\omega_0^2} = 0 \Longrightarrow \omega_0 = 2 \text{ rad/s}$$

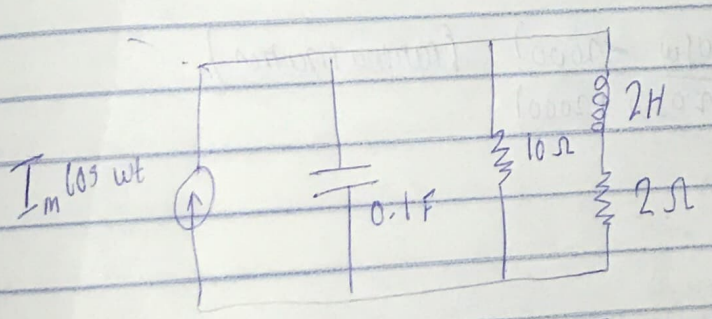
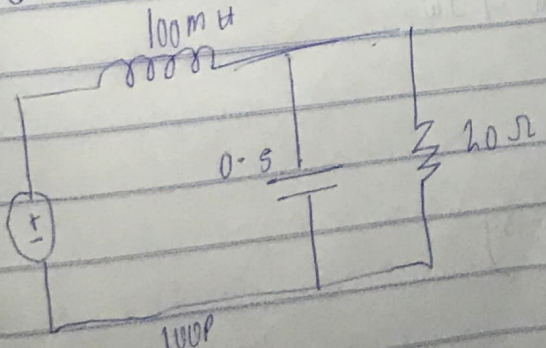


Fig 14.28

Question 3



Time domain

$100mH = (100 \times 10^{-5})\ H \longrightarrow L$

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

$20\Omega \longrightarrow R$

Frequency domain

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

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

20Ω

From loop 2

$R \| C$

$$\frac{20 \times \frac{2000}{J\omega}}{20 + \frac{2000}{J\omega}}$$ i.e Product / Sum

$$\Rightarrow \frac{40000}{20J\omega + 2000} \Rightarrow \frac{40000}{20J\omega + 2000} \times \frac{(20J\omega - 2000)}{(20J\omega + 2000)}$$ (Rationalization)

B)

$\Rightarrow 80,0000\ J\omega - 80,000\ 000$

$-400J\omega - 4000000$

Back to loop A

$R = L + (R \| C)$ Since the inductor is in series

C)

$$\frac{800\ 000\ J\omega - 800\ 00000}{-400\ J\omega - 400\ 0000} + (100 \times 10^{-3})\ J\omega$$

at resonance $Im(R)$

D)

$$= \frac{800000\ J\omega}{-400\ J\omega - 400000} + J\omega(100 \times 10^{-3})$$

$8000\,00\,\omega_0 + (-40\omega_0^2) - 4000000\,\omega_0$

$400000 - 40\omega^2 = 0$

$\omega^2 = 10000$

$\omega = 100\ rad/s.$