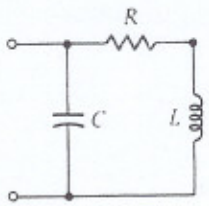
Serial #

King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE205: Electric Circuits II (031)
Quiz 5

Name: KEY II assume no formulas ID# Sec 01

For the practical tank circuit shown in the figure



R=0.002 Ω, L=2 H, and $C=\frac{1}{50}$ F

a) Find the resonance frequency of the circuit
b) Find the quality factor of the circuit

a) $Y_{in} = j\omega C + \frac{1}{R+j\omega L} = j\omega C + \frac{R-j\omega L}{R^2+\omega^2 L^2}$

$= \frac{R}{R^2+\omega^2 L^2} + j\left(\omega C - \frac{\omega L}{R^2+\omega^2 L^2}\right)$

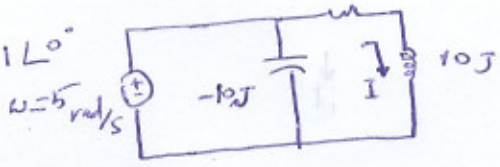
To find ω_r we let the imaginary part = zero.

$\omega_r C - \frac{\omega_r L}{R^2+\omega_r^2 L^2} = 0 \Rightarrow R^2 + \omega_r^2 L^2 = \frac{L}{C} \Rightarrow \omega_r^2 = \frac{1}{LC} - \frac{R^2}{L^2}$

$\omega_r = \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}} = \sqrt{\frac{1}{2(\frac{1}{50})} - \frac{4\times10^{-6}}{4}} = \sqrt{25 - 10^{-6}} \simeq 5$ rad/s

0.002

b) Quality factor



$I = \frac{1\angle 0^\circ}{0.002 + 10j} = 0.1\angle -90^\circ = -0.1j$

$W_C(t) = \frac{1}{2} C v^2(t) = \frac{1}{2}\left(\frac{1}{50}\right)\cos^2 5t = \frac{1}{100}\cos^2 5t$

$W_L(t) = \frac{1}{2} L i^2(t) = \frac{1}{2}(2)\left(\frac{1}{10}\right)^2 \sin^2 5t = \frac{1}{100}\sin^2 5t$

$W_C(t) + W_L(t) = \frac{1}{100}\left(\cos^2 5t + \sin^2 5t\right) = \frac{1}{100}$ $\quad W_{max} = \frac{1}{100}$

$P_R = \frac{1}{2}|I^2|R = \frac{1}{2}(0.1)^2(0.002) = 10^{-5}$ $\quad T = \frac{2\pi}{\omega} = \frac{2\pi}{5}$ s

$Q = 2\pi\left(\frac{W_{max}}{P_R T}\right) = 2\pi\left(\frac{\frac{1}{100}}{10^{-5}\frac{2\pi}{5}}\right) = 10^{-2} * 10^5 \times 5 = 5000$

Good Luck,
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