

King Fahd University of Petroleum & Minerals

Electrical Engineering Department

EE205: Electric Circuits II (092)

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Quiz 4: Resonance Frequency

Serial #

0

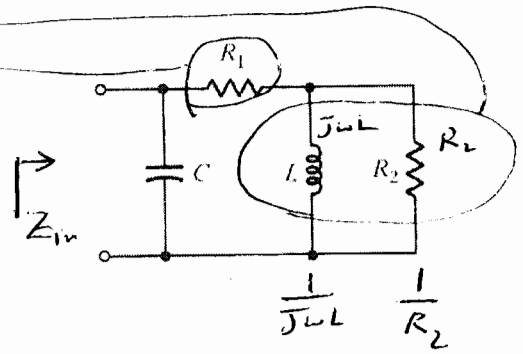
-1 points for not writing your serial number

Name: KEY

For the shown circuit, find the resonance frequency in Hz.

Let $R_1=3$ Ohms, $L=1$ H, $R_2=2$ Ohms, and $C=4.5$ pF.

(Be clear and organized. Show your solution step by step. No credit will be given for messy work)



$$Z_{in} = \frac{1}{j\omega C} \parallel \left(R_1 + \frac{j\omega L R_2}{j\omega L + R_2} \right)$$

$$Z_{in} = \frac{1}{j\omega C} \parallel \frac{R_1 R_2 + j\omega L R_1 + j\omega L R_2}{j\omega L + R_2}$$

$$Z_{in} = \frac{1}{j\omega C} \parallel \frac{6 + j\omega 3 + j\omega 2}{j\omega + 2}$$

← substitute R_1, R_2, L

$$Z_{in} = \frac{1}{j\omega C} \parallel \frac{6 + j\omega 5}{2 + j\omega}$$

simplify

② use Y for ||

$$Y_{in} = j\omega C + \frac{2 + j\omega}{6 + j\omega 5} \cdot \frac{6 - j\omega 5}{6 - j\omega 5}$$

multiply by conjugate

$$= j\omega C + \frac{12 - 4j\omega + 5\omega^2}{36 + 25\omega^2}$$

imag(Y) = 0

①

$\omega_r = 0$ (is the trivial solution)

$$\Rightarrow \left(\cancel{j\omega C} - \frac{4\cancel{j\omega}}{36 + 25\omega^2} \right) = 0$$

$$\Rightarrow \omega_r^2 = \frac{1}{25} \left(\frac{4}{C} - 36 \right)$$

$$C = \frac{4}{36 + 25\omega_r^2}$$

$$\Rightarrow \omega_r = \frac{1}{5} \sqrt{\frac{4}{C} - 36} \Rightarrow$$

$$36 + 25\omega_r^2 = \frac{4}{C}$$

$$\omega_r = 30 \text{ kHz}$$

Good Luck, Dr. Ali Muqaibel

do not substitute for C until the end.