

EE 205 Quiz #5

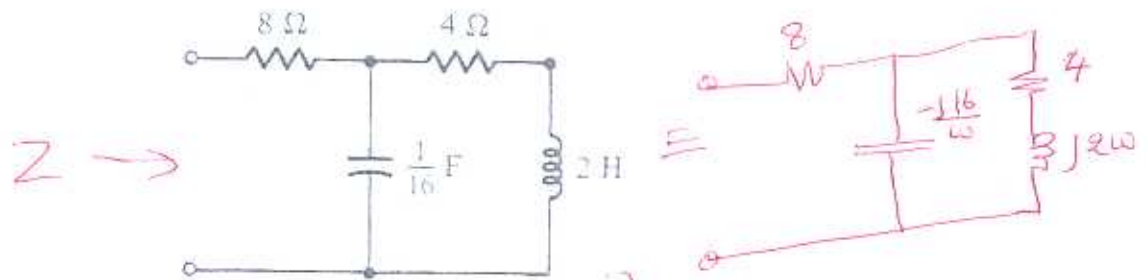
ID. #:

Key Name:

Sec:

Question:

Calculate the impedance Z of the circuit shown below. What is the condition for resonance? Find the resonant frequency. What is the value of Z at resonance?



$$\begin{aligned}
 Z &= 8 + \frac{(4 + j2\omega) \left(\frac{-j16}{\omega} \right)}{4 + j2\omega - \frac{j16}{\omega}} = \frac{-j16(4 + j2\omega)}{4\omega + j2\omega^2 - j16} + 8 \\
 &= 8 + \frac{32\omega - j64}{4\omega + j(2\omega^2 - 16)} = 8 + \frac{(32\omega - j64)(4\omega - j(2\omega^2 - 16))}{16\omega^2 + (2\omega^2 - 16)^2} \\
 &= 8 + \frac{32 \times 4\omega^2 - 64(2\omega^2 - 16)}{16\omega^2 + (2\omega^2 - 16)^2} + j \frac{-64 \times 4\omega - 32\omega(2\omega^2 - 16)}{16\omega^2 + (2\omega^2 - 16)^2}
 \end{aligned}$$

Condition:
Resonant when $64\omega(-4 - (2\omega^2 - 16)) = 0$ i.e.
 $\omega = 0$ or $\omega^2 = 4$ i.e. $\omega_r = 2$ rad/s

$$\begin{aligned}
 Z(2) &= 8 + \frac{32 \times 4 \times 4 - 64(8 - 16)}{16 \times 4 + (8 - 16)^2} \\
 &= 8 + \frac{64 \times 8 + 64 \times 8}{64 + 64}
 \end{aligned}$$

at resonance
 $Z = 8 + \frac{64(8+8)}{64(2)} = 8 + 8 = \underline{\underline{16 \Omega}}$