EECS 215 Quiz 9 Solution Fall 2017

Problem #1

$$J5\left[7-J5+\frac{10}{5+J5}\right]=5\angle 90\left[7-J5+\frac{2(1-J)}{(1+J1)(1-J)}\right]$$

$$=5\angle 90^\circ\left[7-J5+(1-J)\right]=5\angle 90\left[8-J6\right]$$

$$=5\angle 90^\circ \times 10\angle -36.87 = 50\ \underline{\angle 53.13}$$

Problem #2

$$Z_{eq}=1/Y_{eq}$$

$$Y_{eq}=JC\omega+\frac{1}{100+J\omega}=JC\omega+\frac{100-J\omega}{10000+\omega^2}$$

$$Y_{eq}=\frac{JC\omega(10^4+\omega^2)-J\omega+100}{10^4+\omega^2}$$

For Z_{eq} or Y_{eq} to be real the imaginary Part must be zero.

$$\therefore\quad C\omega(10^4+\omega^2)-\omega=0$$

$$10^4+\omega^2=\frac{1}{C}=\frac{10^6}{50}=2\times 10^4$$

$$\omega^2=10^4$$

$$\omega=100\ ,\quad f=\frac{100}{2\pi}=15.9\ Hz$$

Problem #3

$v_s(t) = 10\sin(\omega t + 30^\circ) = 10\cos(\omega t - 60^\circ)$

$V_S = 10\angle -60^\circ$

With inductor removed, the open circuit Voltage is:

$$V_{OC} = V_{Th} = \frac{V_S \times 1\Omega}{2 - J2} = V_S \frac{2+J2}{8} = \frac{1}{4} V_S (1+J)$$

$$V_{Th} = \frac{10\angle -60^\circ}{4} \cdot \sqrt{2}\angle 45^\circ = 3.536\angle -15^\circ$$

To find Z_{Th}, apply V_t and find I_t when V_s is short circuit:

$i_x \rightarrow -I_t$, $V_t = 2i_x + I_t \times (1\Omega \| (1 - J2))$

$$V_t = -2I_t + I_t \frac{1-J2}{2-J2}$$

$$Z_{Th} = \frac{V_t}{I_t} = -2 + \frac{(1-J2)(2+J2)}{8}$$

$$= -2 + \frac{1 + J1 - J2 + 2}{4}$$

$$= -2 + 0.75 - 0.25J$$

$$= -1.25 - J0.25 = -0.25(5+J)$$

$$= 0.25\angle 180^\circ \times \sqrt{26}\angle 11.31^\circ$$

$$= 1.275\angle 191.31^\circ = 1.275\angle -168.69^\circ$$