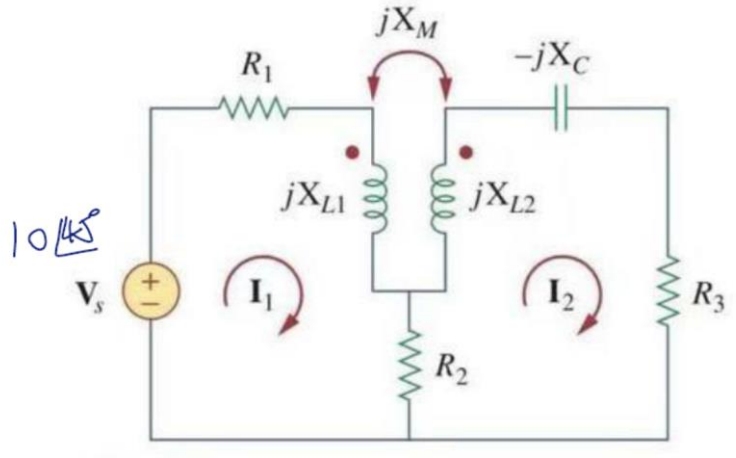
Q1 All RMS



$$\begin{cases} V_s = (R_1 + jX_{L1} + R_2)I_1 - R_2 I_2 - jX_M I_2 \\ (jX_{L2} - jX_C + R_3 + R_2)I_2 - R_2 I_1 - jX_M I_1 = 0 \end{cases}$$

$$\begin{cases} V_s = (10 + j15)I_1 - (5 + j2)I_2 \\ (j19.5 + 15)I_2 - (5 + j2)I_1 = 0 \end{cases}$$

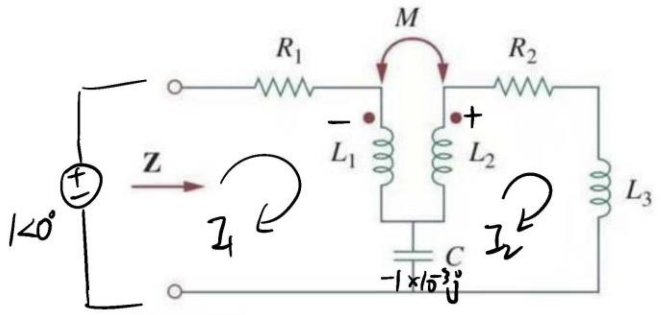
$$I_2 = \frac{5 + j2}{15 + j19.5} I_1$$

$$I_1 = (0.0286 - j0.0492)V_s = 0.569 \angle -14.83^\circ$$

$$I_2 = (-9.372 \times 10^{-5} - j0.0125)V_s = 0.125 \angle -45.43^\circ$$

Q2 All RMS

*correction
ω = 10k rad/s, not Hz.



Mesh:

$$\begin{cases} -1 + I_1(R_1 + j\omega L_1) + \frac{1}{j\omega C}(I_1 - I_2) - j\omega M I_2 = 0 \\ (I_2 - I_1)\cdot\frac{1}{j\omega C} + I_2(j\omega L_2 + R_2 + j\omega L_3) - j\omega M I_1 = 0 \end{cases}$$

$$\Rightarrow \begin{cases} -1 + (5k + 100kj) I_1 - 10^{-3} j (I_1 - I_2) - 200kj I_2 = 0 \\ -10^{-3} j (I_2 - I_1) + (5k + 150kj) I_2 - 200kj I_1 = 0 \end{cases}$$

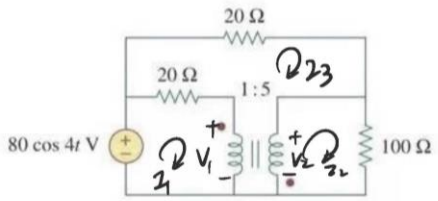
$$\Rightarrow I_2 = (1.33 + 0.044j) I_1$$

$$\Rightarrow (13879 - 16637.7j) I_1 = 1$$

$$\Rightarrow I_1 = 5.99 \times 10^{-6} \angle -85.23^\circ \text{ A}$$

$$\Rightarrow Z = \frac{1\angle 0^\circ}{I_1} = 1.67 \times 10^5 \angle -85.23^\circ \ \Omega$$

Q3



Mesh :

① $-80+20(I_1-I_3)+V_1=0$

② $V_2=100I_2$

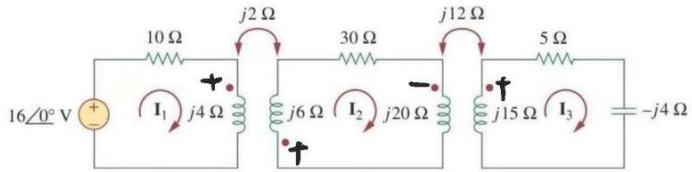
③ $40I_3-20I_1+V_2-V_1=0$

For transformers : $\begin{cases} V_2=-5V_1 \\ I_1-I_3=-5(I_2-I_3) \end{cases}$

$$\Rightarrow \begin{cases} I_1=5.94 \\ I_2=0.52 \\ I_3=1.42 \end{cases}$$

$$\Rightarrow \begin{cases} \text{top R}: P= 20.15\ \text{W} \\ \text{left R}: P= 203.95\ \text{W} \\ \text{right R}: P= 13.3\ \text{W} \end{cases}$$

Q4 All RMS



Mesh:

$$\begin{cases} 16 = (10+j4)I_1 + j2I_2 \\ 0 = j2I_1 + (30+j26)I_2 - j12I_3 \\ 0 = -j12I_2 + (5+j11)I_3 \end{cases}$$

$$\Rightarrow \begin{cases} I_1 = 1.475\angle -21.41^\circ \text{ A} \\ I_2 = 77.5\angle -134.85^\circ \text{ mA} \\ I_3 = 77\angle -110.49^\circ \text{ mA} \end{cases}$$