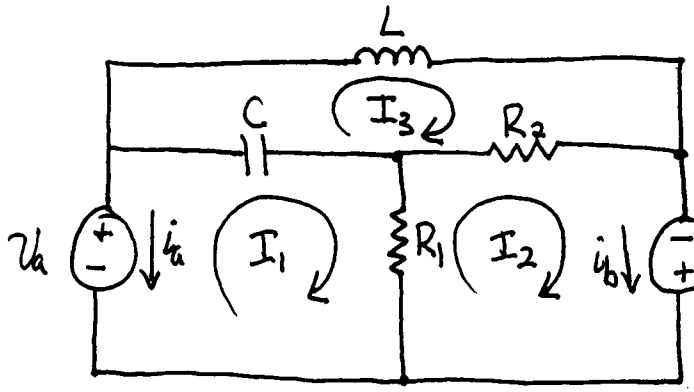
P9.65



$L = 10\mu H$

$C = 0.1\mu F$

$R_1 = R_2 = 10\Omega$

$v_a = 50\sin 10^6 t = 50\cos(10^6 t - 90°)$

$V_a = 50\angle -90° = -j50$

$v_b = 25\cos(10^6 t + 90°)$

$V_b = 25\angle 90° = j25$

$Z_L = j\omega L = j10^6(10\mu) = j10\Omega$

$Z_C = -j/\omega C = -j/10^6(0.1\mu) = -j10\Omega$

mesh1: $V_a - Z_C(I_1 - I_3) - R_1(I_1 - I_2) = 0$

$-j50 + j10(I_1 - I_3) - 10(I_1 - I_2) = 0$

$(-10 + j10)I_1 + 10I_2 - j10I_3 = j50$

mesh2: $V_b - R_1(I_2 - I_1) - R_2(I_2 - I_3) = 0$

$j25 - 10(I_2 - I_1) - 10(I_2 - I_3) = 0$

$10I_1 - 20I_2 + 10I_3 = -j25$

mesh3: $-Z_L I_3 - R_2(I_3 - I_2) - Z_C(I_3 - I_1) = 0$

$-j10I_3 - 10(I_3 - I_2) + j10(I_3 - I_1) = 0$

$-j10I_1 + 10I_2 - 10I_3 = 0$

$$\begin{bmatrix} -10+j10 & 10 & -j10 \\ 10 & -20 & 10 \\ -j10 & 10 & -10 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} j50 \\ -j25 \\ 0 \end{bmatrix}$$

$$I_1 = .5 - j1.5$$

$$I_2 = -1 + j.5$$

$$I_3 = -2.5$$

$$I_a = -I_1$$

$$= -.5 + j1.5$$

$$= 1.581138832\angle 108.4349488°$$

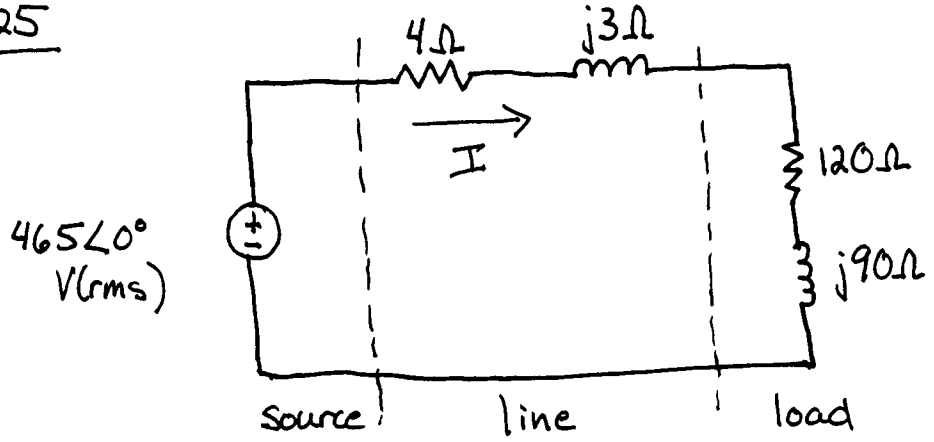
$$I_b = -I_2 = 1 - j.5$$

$$= 1.118033989\angle -26.56505118°$$

$$i_a = 1.58\cos(10^6 t + 108.4°)\,A$$

$$i_b = 1.12\cos(10^6 t - 26.6°)\,A$$

P 10.25



a) $Z = 4 + j3 + 120 + j90$

$= 124 + j93$

$= 155\angle 36.8698765^\circ$

$$I = \frac{465\angle 0^\circ}{155\angle 36.9^\circ} = 3\angle -36.9^\circ = 2.4 - j1.8$$

$V_{line} = Z_{line} I$

$= (4+j3)(2.4-j1.8)$

$S_{line} = V_{line} I^*$

$= (4+j3)(2.4-j1.8)(2.4+j1.8)$

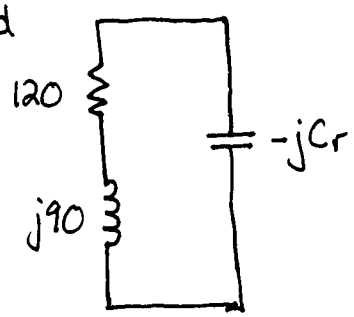
$= (4+j3)(5.76+3.24)$

$= (4+j3)9$

$= 36 + j27$

$\Rightarrow P_{avg} = 36W$

b) load



$$Z = \left(\frac{1}{120+j90} - \frac{1}{jC_r}\right)^{-1}$$

$S_{load} = P + jQ \leftarrow$ want $Q = 0$

-without the added capacitor

$$V_{load} = I Z_{load}$$
$$= (2.4 - j1.8)(120 + j90)$$
$$= 450V$$

$$S_{load} = V_{load} I^*$$
$$= 450(2.4 + j1.8)$$
$$= 1080 + j810$$

$$X_C = \frac{|V_{eff}|^2}{-Q} = \frac{450^2}{-810} = -250 \Rightarrow C_r = 250\Omega$$

c) $Z_{load} = \left(\frac{1}{120+j90} - \frac{1}{j250}\right)^{-1} = 187.5\Omega$

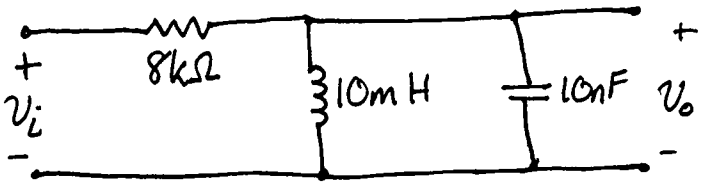
d) $Z = 187.5 + 4 + j3$
$= 191.5 + j3$
$= 191.523497\angle 0.897510597^\circ$

$$I = \frac{465\angle 0^\circ}{191.52\angle 0.898^\circ} = 2.427900527\angle -0.898^\circ$$

$$P_{avg} = (2.427900527)^2(4)$$
$$= 23.57880388W$$

e) % power $= \frac{23.58}{36} = 65.4966775\%$

P14.15



following example 14.6

a) $\omega_o = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10m(10n)}} = 1\times10^5 \text{ rad/s} = 100\text{k rad/s}$

b) $f_o = \frac{\omega_o}{2\pi} = \frac{1\times10^5}{2\pi} = 1.591549431\times10^4 \text{ Hz} = 15.92\text{kHz}$

c) $Q = \sqrt{\frac{R^2C}{L}} = \sqrt{\frac{(8k)^2(10n)}{10m}} = 8$

d) $\omega_{c_1} = -\frac{1}{2RC} + \sqrt{\left(\frac{1}{2RC}\right)^2 + \frac{1}{LC}}$

$= -\frac{1}{2(8k)(10n)} + \sqrt{\left(\frac{1}{2(8k)(10n)}\right)^2 + \frac{1}{10m(10n)}}$

$= -6.25\times10^3 + 100\times10^3$

$= 9.375\times10^4 \text{ rad/s} = 93.75\text{k rad/s}$

e) $f_{c_1} = \frac{\omega_{c1}}{2\pi} = \frac{9.375\times10^4}{2\pi} = 1.492077591\times10^4\text{Hz} = 14.92\text{kHz}$

f) $\omega_{c2} = \frac{1}{2RC} + \sqrt{\left(\frac{1}{2RC}\right)^2 + \frac{1}{LC}}$

$= 6.25\times10^3 + 100\times10^3$

$= 1.0625\times10^5 \text{ rad/s} = 106.25\text{k rad/s}$

g) $f_{c2} = \frac{\omega_{c2}}{2\pi} = \frac{1.0625\times10^5}{2\pi} = 1.69102127\times10^4\text{Hz} = 16.91\text{KHz}$

h) $\beta = \frac{1}{RC} = \frac{1}{8k(10n)} = 1.25\times10^4 \text{ rad/s} = 12.5\text{ krad/s}$

$= 1.99\text{kHz}$