

34) a) $u_1(t) = 24\sqrt{2} \cos(377t - 45^\circ)$
 $\underline{U}_1 = 24 V \angle -45^\circ$

δ) $i_2(t) = 12 A \cos(377t + 120^\circ)$
 $\underline{I}_2 = 6\sqrt{2} A \angle 120^\circ$
 $\omega = 3518^\circ - 2513t$

1g) $u_3(t) = 12\sqrt{2} V \cos(377t - 425^\circ)$
 $\underline{U}_3 = 12 V \angle -65^\circ$

g) $i_4(t) = 18\sqrt{2} A \sin(2513t + 4,2^\circ)$
 $\underline{I}_4 = 18 A \angle -85,8^\circ$ $90^\circ - 2\pi ft + 135^\circ$

e) $u_5(t) = 2 V \sin(2\pi ft)$
 $\underline{U}_5 = \sqrt{2} V \angle -90^\circ$

φ) $i_6(t) = -8 A \sin(2\pi ft - 135^\circ)$
 $\underline{I}_6 = -4\sqrt{2} A \angle 225^\circ$

35) a) $\underline{U}_1 = 16 V \angle 20^\circ$

δ) $\underline{I}_2 = 10 A \angle -75^\circ$

$u_1(t) = 16\sqrt{2} V \cos(120\pi t + 20^\circ)$

$i_2(t) = 10\sqrt{2} A \cos(120\pi t - 75^\circ)$

36) a) $\underline{U}_1 = 10 V \angle 120^\circ$ $u_1(t) = 10\sqrt{2} V \cos(800\pi t + 120^\circ)$

δ) $\underline{I}_2 = 12 A \angle -60^\circ$ $i_2(t) = 12\sqrt{2} A \cos(800\pi t - 60^\circ)$

37) a) $u_1(t) = 6 V \cos(2\pi ft)$

$e^{i \cdot 0} = e^0$

$\underline{U}_1 = 3\sqrt{2} V \angle 0^\circ$

$\underline{U}_1 = 3\sqrt{2} V$

δ) $u_2(t) = 2 V \cos(2\pi ft + 45^\circ)$

$\underline{U}_2 = \sqrt{2} V \angle 45^\circ$

$\underline{U}_2 = \sqrt{2} \left(\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2} i \right) = (1 + j) V$

1g) $i_3(t) = \sqrt{2} A \sin(2\pi ft) = \sqrt{2} A \cos(2\pi ft - 90^\circ)$

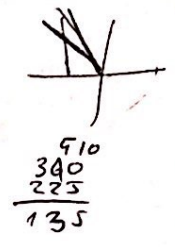
$\underline{I}_3 = 1 A \angle -90^\circ = -j A$

g) $i_4(t) = -3\sqrt{2} \cos(2\pi ft)$

$\underline{I}_4 = -3 A \angle 0 = -3 A$

38) a) $u_1(t) = -\sqrt{2} \sin(\omega t - 150^\circ) = -\sqrt{2} \cos(\omega t - 240^\circ)$

$\underline{U}_1 = -1V \angle -240^\circ = -1V \cdot (-\frac{1}{2} + \frac{\sqrt{3}}{2}j) = \frac{1}{2} - \frac{\sqrt{3}}{2}j$

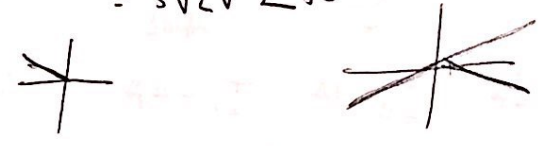


b) $i_2(t) = 2A \sin(\omega t - 135^\circ) = 2A \cos(\omega t - 225^\circ) = 2A \cos(\omega t + 135^\circ) = 2A \angle 135^\circ$
 $\underline{I}_2 = 2A (-\frac{\sqrt{2}}{2} + j\frac{\sqrt{2}}{2}) = (-1 + j)A$

39) $f = 2000 \text{ Hz}$

a) $\underline{U}_1 = (5 + j5)V = 5\sqrt{2} (\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}j)V = 5\sqrt{2} e^{j \cdot \arctan 1} = 5\sqrt{2}V \angle 45^\circ$

$u_1(t) = 10V \cos(4000\pi t + 45^\circ)$



b) $\underline{I}_2 = (-3 + j4)A = 5 (-\frac{3}{5} + \frac{4}{5}j) = 5e^{j \cdot (180 + \arctan \frac{4}{3})} = 5A \angle 126.87^\circ$

$i_2(t) = 5\sqrt{2}A \cos(4000\pi t + 126.87^\circ)$

40) a) $\underline{U}_1 = (-7 - j2)V = \sqrt{53} (-\frac{7}{\sqrt{53}} - \frac{2}{\sqrt{53}}j) = \sqrt{53} e^{j(180 + \arctan \frac{2}{7})} = \sqrt{53}V \angle 195.95^\circ$

$u_1(t) = \sqrt{106}V \cos(10000t + 195.95^\circ)$

b) $\underline{I}_2 = (2 - j5)A = \sqrt{29} (\frac{2}{\sqrt{29}} - \frac{5}{\sqrt{29}}j) = \sqrt{29}A \angle -68.2^\circ$

$i_2(t) = \sqrt{58}A \cos(10000t - 68.2^\circ)$



41) a) $u(t) = 50\sqrt{2} \cos(\omega t + 30^\circ)$ $\underline{U} = 50 \angle 30^\circ = 50 \cdot (\frac{\sqrt{3}}{2} + j\frac{1}{2})V$
 $R = 25\Omega$ $L = 20 \text{ mH}$ $C = 50 \mu\text{F}$ $f = 60 \text{ Hz}$

$\underline{Z}_e = \underline{Z}_R + \underline{Z}_C + \underline{Z}_L = R + \frac{1}{j\omega C} + j\omega L = R + j \cdot 2\pi f L - \frac{j}{2\pi f C}$

$\underline{Z}_e = (25 - 45.51j)\Omega$

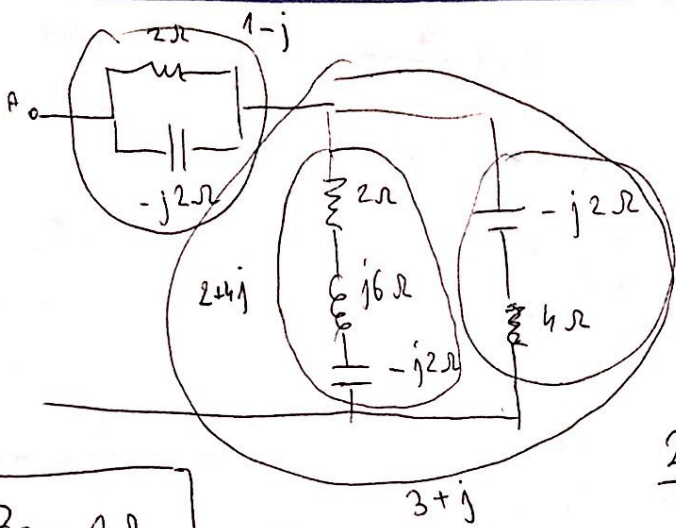
$\underline{I} = \frac{\underline{U}}{\underline{Z}_e} = \frac{25\sqrt{3} + 25j}{25 - 45.51j} = \frac{-55.22 + j \cdot 2595.64}{2696.16}$ (Note: $25\sqrt{3} + 25j$ and $25 + 45.51j$ are also shown in the original image)

$i(t) = 0.196A \cdot \cos(120\pi t + 91.22^\circ)$

b) $f = 400 \text{ Hz}$ $\underline{Z}_R = 25\Omega$ $\underline{Z}_L = j\omega L = j \cdot 2\pi f L = 50.265j\Omega$

$\underline{Z}_C = -\frac{j}{2\pi f C} = -7.196j\Omega$ $\underline{Z}_{ekv} = (25 + 42.131j)\Omega$

42



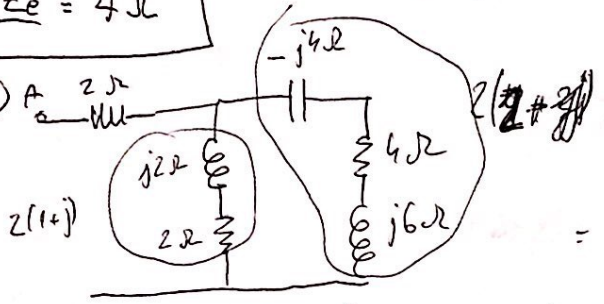
$$\frac{(4-2j)(2+4j)}{2+4j+4-2j} = \frac{16+12j}{6+2j} =$$

$$4-2j = \frac{4(4+3j)}{2(3+j)} \cdot \frac{3-j}{3-j} = \frac{2(4+3j)(3-j)}{5} = \frac{15+5j}{5} = 3+j$$

$Z_e = 4 \Omega$

$$\frac{2 \cdot (-2j)}{2-2j} = \frac{-4j}{2(1-j)} \cdot \frac{1+j}{1+j} = \frac{-2j+2}{2} = 1-j$$

43



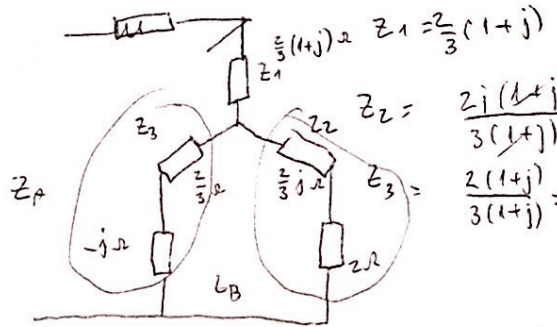
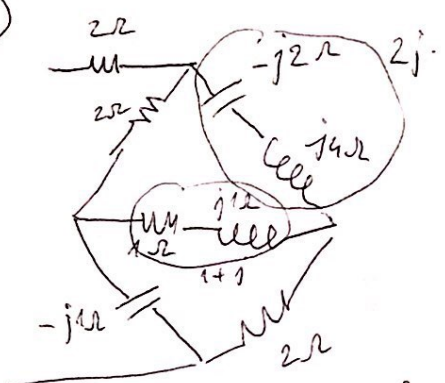
$$\frac{2(1+j)2(2+j)}{2(1+j+2+j)} = \frac{2(1+j)(2+j)}{3+2j} \cdot \frac{3-2j}{3-2j} = \frac{2(1+j)(2+j)(3-2j)}{13}$$

$$= \frac{2(1+3j)(3-2j)}{13} = \frac{2(3-2j+9j+6)}{13} = \frac{18+17j}{13} = 1,38 + j \cdot 1,08$$

$Z_e = (3,38 + j \cdot 1,08) \Omega$

$$Z_1 = \frac{4j}{3+3j} = \frac{4}{3} \cdot \frac{j}{1+j} \cdot \frac{1-j}{1-j} = \frac{1+j}{2} \cdot \frac{2}{3}$$

44



$$Z_1 = \frac{2(4j)}{3} = \frac{2}{3}(1+j)$$

$$Z_2 = \frac{2j(1+j)}{3(1+j)} = \frac{2}{3}j$$

$$Z_3 = \frac{2(1+j)}{3(1+j)} = \frac{2}{3}$$

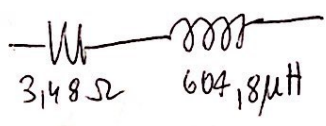
$$\frac{4-13}{9} = -\frac{14}{9}$$

$Z_A = \frac{2}{3} - j$ $Z_B = 2 + \frac{2}{3}j$

$$Z_e = \frac{(\frac{2}{3}-j)(2+\frac{2}{3}j)}{(\frac{2}{3}-j)+2+\frac{2}{3}j} = \frac{\frac{4}{3} + \frac{4}{9}j - 2j + \frac{2}{3}}{\frac{8}{3} - \frac{1}{3}j} =$$

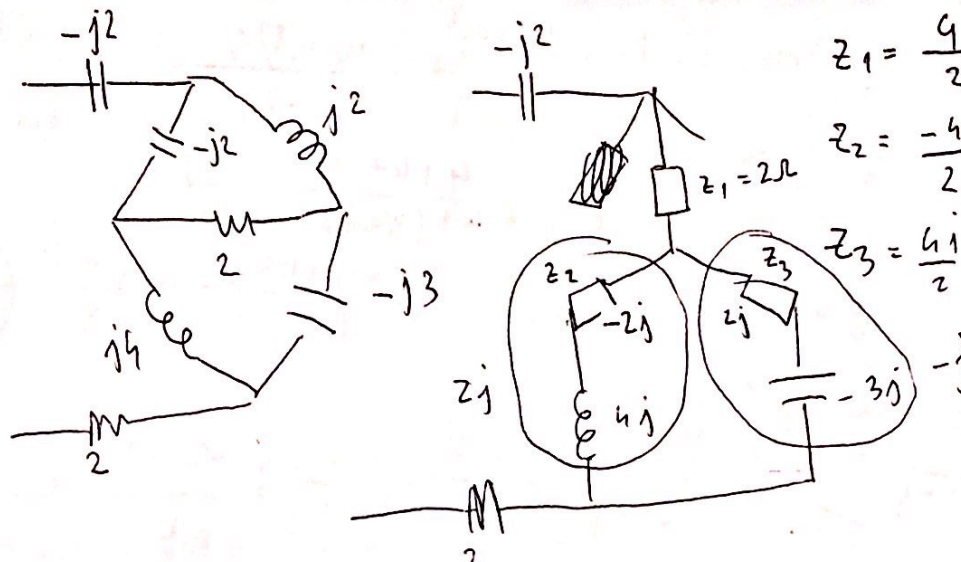
$$= \frac{2 - \frac{14}{9}j}{\frac{1}{3}(8-j)} \cdot \frac{8+j}{8+j} = \frac{(6 - \frac{14}{3}j)(8+j)}{65} = \frac{48 + \frac{14}{3} + 6j - \frac{8 \cdot 14}{3}j}{65} = 0,81 - 0,98j$$

$2 + \frac{2}{3} + \frac{2}{3}j + 0,81 - 0,98j = \underline{\underline{(3,48 + 0,19j) \Omega}}$



$\omega L = 0,19$
 $L = \frac{0,19}{2\pi f}$

(45)



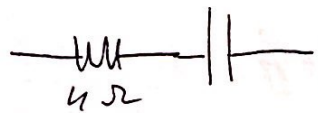
$$z_1 = \frac{4}{2} = 2\Omega$$

$$z_2 = \frac{-4j}{2} = -2j$$

$$z_3 = \frac{4j}{2} = 2j$$

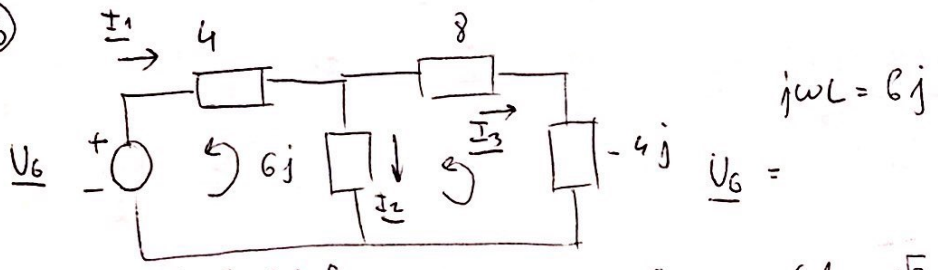
$$\frac{2j \cdot (-j)}{j} = \frac{2}{j} = -2j$$

$$Z_e = (4 - 4j)\Omega$$



$$+ \frac{j}{\omega C} = \times 4j \quad C = \frac{1}{4\omega} = \frac{1}{4 \cdot 2\pi f} = 398 \mu F$$

(46)



$$U_G = 24V \angle 60^\circ = 24 \left(\frac{1}{2} + \frac{\sqrt{3}}{2}j \right) V = (12 + 12\sqrt{3}j)V$$

$$I_2 \cdot 6j + I_1 \cdot 4 - U_G = 0$$

$$I_3 \cdot (-4j) + I_3 \cdot 8 - I_2 \cdot 6j = 0$$

$$I_1 = I_2 + I_3$$

$$I_2(4 + 6j) + 4I_3 = U_G$$

$$6jI_2 + 4I_2 + 4I_3 = U_G$$

$$I_2(-6j) + (8 - 4j)I_3 = 0$$

$$(8 - 4j)I_3 - 6jI_2 = 0$$

$$I_3 = \frac{6j}{8 - 4j} I_2 = \frac{3 \cdot 6j}{4(2 - j)} \cdot \frac{2 + j}{2 + j} I_2 = \frac{3(2j - 1)}{10} I_2 = \frac{-3 + 6j}{10} I_2$$

$$I_2(4 + 6j) + \frac{2(-3 + 6j)}{5} I_2 = U_G$$

$$I_2 \cdot \frac{1}{5} (20 + 30j - 6 + 12j) = U_G$$

$$I_2 \cdot \frac{14 + 42j}{5} = 12 + 12\sqrt{3}j$$

$$I_2 = \frac{60 + 60\sqrt{3}j}{14 + 42j} \cdot \frac{14 - 42j}{14 - 42j} = \frac{5204.8 - 1065j}{1960} = (2.65 - 0.54j) A$$

$$I_3 = \frac{-3(1 - 2j)(2.65 - 0.54j)}{10} = \frac{-3(2.65 - 5.184j)}{10} = (-0.795 + 1.555j) A$$

$$I_1 = 2.179 + 1.212j$$

U6 (Напряжения)

53

$$\underline{U}_1 = \underline{Z}_1 \underline{I}_2 \quad \underline{U}_2 = \underline{Z}_2 \cdot \underline{I}_3$$

$$i_1(t) = 3,53 \text{ A} \cos(10000t + 29,08^\circ)$$

$$i_2(t) = 3,02 \text{ A} \cos(10000t - 11,51^\circ)$$

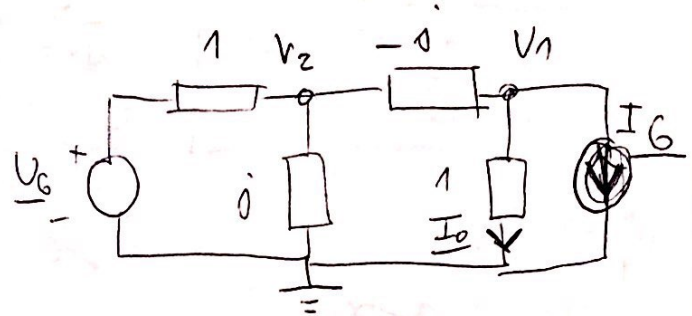
$$i_3(t) = 2,157 \text{ A} \cos(10000t + 105^\circ)$$

$$\underline{U}_1 = 6j \cdot (2,15 - 9,54j) = 3,24 + 15,9j$$

$$u_1(t) = 23 \text{ V} \cos(10000t + 78,48^\circ)$$

$$\underline{U}_2 = -j \cdot \underline{I}_3 = (7 + 1,884j) \text{ V}$$

$$u_2(t) = 10,25 \cos(10000t + 15,1^\circ)$$



57) $u_6(t) = 12\sqrt{2} \cos(2\pi f t)$ $U_G = 12 \text{ V}$

$$i_G(t) = 2\sqrt{2} \cos(2\pi f t) \quad I_G = 2 \text{ A}$$

$$f = 5 \text{ kHz} = 5000 \text{ Hz}$$

$$\underline{Z}_L = j \Omega \quad \underline{Z}_C = -j \Omega$$

$$\underline{V}_1 \left(\frac{1}{1} + \frac{1}{-j} \right) - \frac{1}{-j} \underline{V}_2 = -\underline{I}_G$$

$$\underline{V}_2 \left(\frac{1}{1} + \frac{1}{-j} + \frac{1}{j} \right) - \frac{1}{-j} \underline{V}_1 = \frac{U_G}{1}$$

~~$$\underline{V}_1(1-j) + j \underline{V}_2 = -\underline{I}_G / (1+j)$$~~

~~$$\underline{V}_2(1-j) + \underline{V}_1 = U_G$$~~

~~$$2\underline{V}_1 + (-1+j)\underline{V}_2 = -I_G(1+j)$$~~

~~$$-2\underline{V}_1 + 2(1-j)\underline{V}_2 = -2U_G$$~~

~~$$\underline{V}_2(-1+j-2+2j) = -I_G(1+j) \Omega - 2U_G$$~~

~~$$3 \underline{V}_2(-1+j) = -I_G(1+j) - 2U_G$$~~

$$\underline{V}_2 \left(\frac{1}{1} + \frac{1}{j} + \frac{1}{-j} \right) - \frac{1}{-j} \underline{V}_1 = \underline{U}_G$$

$$\underline{V}_2 - j \underline{V}_1 = \underline{U}_G$$

$$\underline{V}_1 \left(1 + \frac{1}{-j} \right) - \frac{1}{-j} \underline{V}_2 = -I_G$$

$$\underline{V}_1(1+j) - j \underline{V}_2 = -I_G$$

$$-j \underline{V}_1 + \underline{V}_2 = \underline{U}_G / j$$

$$\underline{V}_1(2+j) = j \underline{U}_G - I_G \cdot 1 \Omega$$

$$\underline{V}_1 = \frac{12j - 2}{2+j} \cdot \frac{2-j}{2-j} = \frac{24j - 4 + 12 + 2j}{5} = \frac{8 + 26j}{5} = 1,6 + 5,2j$$

$$i_0(t) = 7,69 \text{ A} \cos(10000\pi t + 72,9^\circ)$$

$$\underline{I}_0 = (1,6 + 5,2j) \text{ A}$$

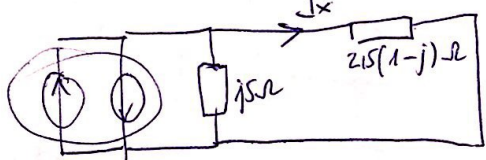
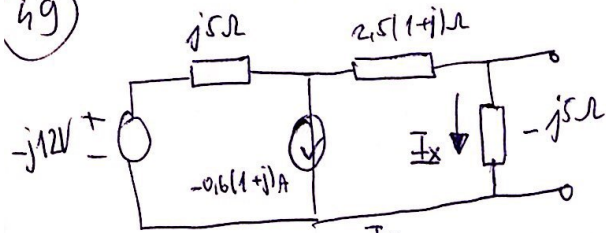
~~$$i_0(t) = 9,88 \text{ A} \cos(10000\pi t)$$~~

$$\underline{V}_2 = U_G + j \underline{V}_1 = 12 + 16j - 5,2 = 6,8 + 16j$$

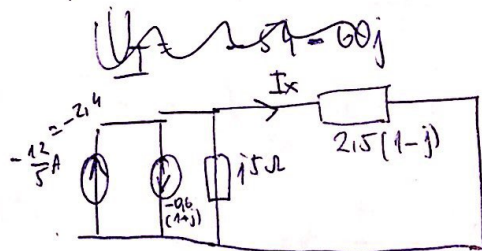
11

(48) $S = R \cdot |I|^2 = 29,6$

(49) $P = 29,6W$ $Q = 0VAR$ $S = 29,6VA$ $\cos\varphi = 1$



$0,6(1+j)$



$V_I = 12 \cdot (-5j) \cdot (1+2j) = 6(2-1)$

~~$V_I = 12 - 6j$~~

~~$I_x = \frac{j5\Omega}{j5\Omega + 2,5 - 2,5j} \cdot (0,6 - 1,14j)$~~

~~$I_x = \frac{j \cdot 8^2}{2,5(1+j)} \cdot \frac{1-j}{1-j} \cdot (0,6 - 1,14j) =$~~

~~$= (j+1)(0,6 - 1,14j) = 0,6j - 1,14j + 0,6 + 1,14 = 1,2 - 0,54j$~~

$I_G = -1,8 - 0,6j = -0,6(3+j)$

$I_x = \frac{j5^2}{2,5(1+j)} \cdot (-0,6)(3+j) \cdot \frac{j-1}{j+1} = -0,6(3j-1)(j-1) = -0,6(1-3-4j) = -0,6(-2-4j) = 1,2(1+2j)$

$Z_I = 5 - 10j \Omega$

$$U_T = 12 - 6j \quad U_T = -6 + 12j$$

$$Z_T = 5 - 10j$$

$$I_P = \frac{U_P}{Z_P + Z_T} = \frac{-6 - 3j}{5 - 10j} = -6 - 3j$$

$$I_P = \frac{U_P}{Z_P} = \frac{-6}{5} + \frac{3}{5}j = -1,2 + 0,6j$$

$$S = (3 + 4j) \cdot \sqrt{\frac{36 + 9}{25}} = (3 + 4j) \cdot \frac{3}{5} = 5,4 + 7,2j$$

$$P = 5,4W \quad Q = 7,2VAR \quad S = 9VA$$

$$\cos \varphi = 0,6$$

50) $f = 50000 \text{ Hz}$

$$u_{g1}(t) = 2V \cos(2\pi ft + 45^\circ) \quad U_{g1} = \sqrt{2} \cdot \left(\frac{\sqrt{2}}{2} + j\frac{\sqrt{2}}{2}\right) = 1 + j$$

$$u_{g2}(t) = -2\sqrt{2} \sin(2\pi ft) = -2 \angle -180^\circ = -2 \angle 0^\circ = 2j$$

$$i_{g1}(t) = 2A \cos(2\pi ft - 45^\circ)$$

$$I_{g1} = \sqrt{2} \left(\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}j\right) = (1 - j)A$$

$$Z_{L1} = j\omega L = j \cdot 2\pi f L$$

$$i_{g2}(t) = -\sqrt{2} \cos(2\pi ft - 90^\circ) = 1jA$$

$$Z_{L2} = j\omega L$$

$$U_{AB} = -I_{g2} (Z_R + Z_L) + U_{g2}$$

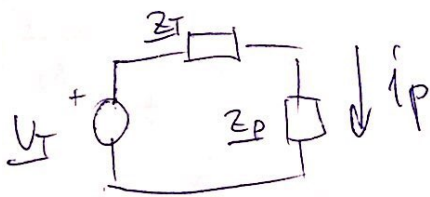
$$Z_{L2} = 3j\Omega$$

$$Z_{C1} = -2j\Omega$$

$$= -j(3 + j) + 1 + j = -3j + 1 + 2j = 1 - j$$

$$U_T = 1(1 - j) \quad Z_T = (3 + j) = \frac{3 - 2j}{3 + 2j} = \frac{9j - 3 + 6 + 2j}{11} = \frac{11j + 3}{11} = \frac{3}{11} + j$$

d) $Z_P = 3 - j$



$$U_P = \frac{Z_P}{Z_P + Z_T} \cdot U_T = 4 \cdot \frac{3 - j}{3 + j + 3 - j} = \frac{4(3 - j)}{6} = \frac{12 - 4j}{6} = 2 - \frac{2j}{3}$$

$$I_P = \frac{U_P}{Z_P} = \frac{2 - \frac{2j}{3}}{3 - j} = \frac{2(3 - j) + 2j}{3(3 - j)} = \frac{6 - 2j + 2j}{3(3 - j)} = \frac{6}{3(3 - j)} = \frac{2}{3 - j} = \frac{2(3 + j)}{3(9 + 1)} = \frac{2(3 + j)}{30} = \frac{2 - 2j}{3}$$

$$\underline{I_P} = \frac{\underline{U_T}}{\underline{Z_P} + \underline{Z_T}} = \frac{1-j}{6} = \frac{\sqrt{2}}{6} \left(\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2} j \right)$$

$$\boxed{i_P(t) = \frac{1}{3} \cos(100000\pi t - 45^\circ)} \cdot V_{cc}$$