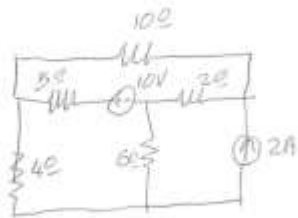


ΑΣΚΗΣΕΙΣ ΕΠΑΝΑΛΗΨΗΣ

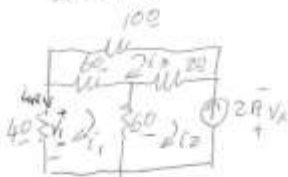
ΑΡΧΗ ΤΗΣ ΕΠΙΜΟΡΦΩΣΗΣ

Να επιλυθεί με χρήση της αρχής της επαλληλίας



Πρώτο είναι το πρόβλημα  
 Πρώτο είναι η τάση  $v_{4\Omega}$  στην αντιστάση  
 Πρώτο είναι η ισχύς  $S_{4\Omega}$

1ο. Μηδενίσω την πηγή 10V



$$\begin{bmatrix} 16 & -6 & -6 \\ -6 & 9 & -2 \\ -6 & -2 & 18 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} \Rightarrow$$

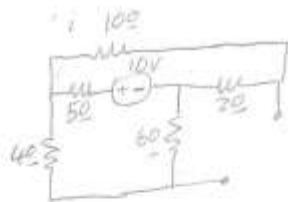
$$\Rightarrow \begin{bmatrix} 16 & -6 & -6 \\ 0 & -1 & 0 \\ -6 & -2 & 18 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix}$$

$$i_1' = -0,95 \text{ A} \Rightarrow i_{4\Omega} = 0,95$$

$$v_1' = i_{4\Omega} \cdot 4\Omega = 3,8 \text{ V}$$

$$2\text{A} = -i_2$$

2ο. Μηδενίσω την πηγή 2A



$$\begin{bmatrix} 15 & -5 \\ -5 & 17 \end{bmatrix} \begin{bmatrix} i_1'' \\ i_2'' \end{bmatrix} = \begin{bmatrix} -10 \\ 10 \end{bmatrix}$$

$$i_1'' = \frac{\begin{vmatrix} -10 & -5 \\ 10 & 17 \end{vmatrix}}{\begin{vmatrix} 15 & -5 \\ -5 & 17 \end{vmatrix}} = -0,52$$

$$i_{4\Omega}'' = 0,52 \text{ A}$$

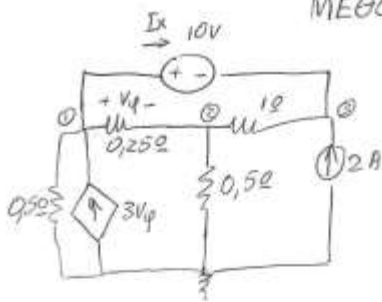
$$v_{4\Omega}'' = 2,09 \text{ V} = 0,52 \text{ A} \cdot 4\Omega$$

$$i_{4\Omega} = i_{4\Omega}' + i_{4\Omega}'' = -1,47 \text{ A}$$

$$v_{4\Omega} = v_{4\Omega}' + v_{4\Omega}'' = 3,8 \text{ V} + 2,09 \text{ V} = 5,89 \text{ V}$$

$$P_{4\Omega} = 5,89 \text{ V} \cdot 1,47 \text{ A} = 8,66 \text{ W}$$

# MEGOSOZ KOMBOW



$$\begin{bmatrix} \frac{1}{0,25} + \frac{1}{0,5} & -\frac{1}{0,25} & 0 \\ -\frac{1}{0,25} & \frac{1}{0,25} + 1 + \frac{1}{0,5} & -1 \\ 0 & -1 & \frac{1}{1} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 3V_\varphi - I_x \\ 0 \\ 2 + I_x \end{bmatrix} \Rightarrow$$

$$\Rightarrow \begin{bmatrix} 6 & -4 & 0 \\ -4 & 7 & -1 \\ 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 3V_\varphi - I_x \\ 0 \\ 2 + I_x \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 0 & -1 \\ -4 & 7 & -1 \\ 6 & -5 & 1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 3V_\varphi + 2 \end{bmatrix} \Rightarrow$$

$$10V = V_1 - V_3 = 1V_1 + 0V_2 - 1V_3 = \begin{bmatrix} 1 & 0 & -1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

$$V_\varphi = V_1 - V_2$$

$$\Rightarrow \begin{bmatrix} 1 & 0 & -1 \\ -4 & 7 & -1 \\ 6 & -5 & 1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 3(V_1 - V_2) + 2 \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 0 & -1 \\ -4 & 7 & -1 \\ 3 & -2 & 1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ +2 \end{bmatrix}$$

$$V_1 = 3,95V$$

$$V_\varphi = 3,44V$$

$$V_2 = 4,11V$$

$$I_x + 2 = -V_2 + V_3 \Rightarrow I_x = -2 - V_2 + V_3 = -9,55A$$

$$V_3 = -6,44V$$

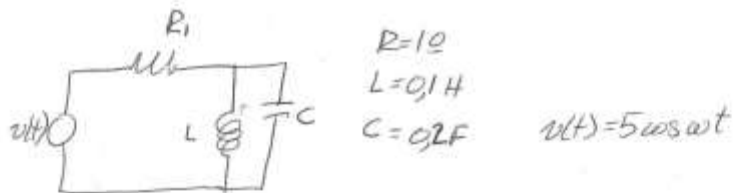
$$P_{2A} = 2 \cdot (0 - V_3) = 2(-6,44) = +12,89W \text{ kaceax.}$$

$$P_{10V} = I_x \cdot 10V = 10(-9,55)W = -95,5W \text{ napex.}$$

$$P_{3V_\varphi} = 3V_\varphi(V_1) = -3 \cdot 3,44(3,95) = -26,07W \text{ napex.}$$

$$P_{\text{napex}} = 26,07 + 95,5 = 121,57W$$

$$P_{\text{kacc}} = 12,89 + \frac{V_1^2}{0,5} + \frac{V_\varphi^2}{0,25} + \frac{V_2^2}{0,5} + \frac{(V_2 - V_3)^2}{1} = 108,99W$$



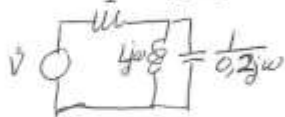
Power series in frequency domain

)) )) average ))

)) )) reactance ))

Power series in time domain

$v(t) = 5 \cos \omega t$   
 $\omega = 10$   
 $\dot{V} = 5 \angle 0^\circ$



$$\dot{V} = \left[ R + \left( 0,1j\omega \parallel \frac{1}{0,2j\omega} \right) \right] \dot{I} = \left[ 1 + \frac{0,1j\omega \cdot \frac{1}{0,2j\omega}}{0,1j\omega + \frac{1}{0,2j\omega}} \right] \dot{I} = \left[ 1 + \frac{0,5}{-0,02\omega^2 + 1} \right] \dot{I} =$$

$$= \left[ 1 + \frac{0,25\omega}{1 - 0,02\omega^2} \right] \dot{I} = \left[ 1 + \frac{j}{1-2} \right] \dot{I} = [1 - j] \dot{I} \Rightarrow$$

$$\dot{I} = \frac{\dot{V}}{1-j} = \frac{5 \angle 0^\circ}{\sqrt{1^2+1^2} \angle (-45^\circ)} = \frac{5 \angle 0^\circ}{\sqrt{2} \angle -45^\circ} = 3,53 \angle 0 - (-45^\circ) = 3,53 \angle 45^\circ$$

$$S = \dot{V} \dot{I} = 5 \cdot 3,53 \angle (0 + 45^\circ) = 17,68 \angle 45^\circ$$

$$|S| = 17,68 \text{ VA}$$

$$S = P + jQ = |S| \cos(45^\circ) + j|S| \sin(45^\circ) = 9,286 + j15,05$$

$$P = 9,286 \text{ W}$$

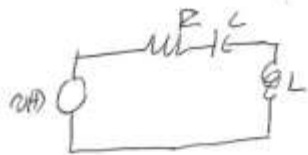
$$Q = 15,05 \text{ VAR}$$

$$V_C = v(t) - R i(t) \Rightarrow \dot{V}_C = \dot{V} - R \dot{I} \text{ or } V_C = i(t) Z_L \parallel Z_C \Rightarrow$$

$$\Rightarrow \dot{V}_C = \dot{I} \left( \frac{0,1j\omega \cdot \frac{1}{0,2j\omega}}{0,1j\omega + \frac{1}{0,2j\omega}} \right) = \dot{I} \frac{0,5}{-0,02\omega^2 + 1} = \dot{I} \frac{0,5 \cdot 0,2 \cdot 10j}{1-2} =$$

$$= \dot{I} \frac{j}{-1} = |\dot{I}| \angle (-1) = 3,53 \angle -45^\circ$$

$$v_C(t) = 3,53 \cos(10t - 45^\circ)$$



$$\begin{aligned}
 R &= 10 \\
 C &= 0,1 \text{ F} \\
 L &= 0,5 \text{ H} \\
 u(t) &= 10 \cos(20t)
 \end{aligned}$$

Naći struju  $i$  kroz oboje R  
i L

$$\dot{V} = \left( R + \frac{1}{Cj\omega} + j\omega L \right) \dot{I} = \left( 10 + \frac{1}{0,1j20} + j20 \cdot 0,5 \right) \dot{I} = \left( 1 + 10j + \frac{1}{2j} \right) \dot{I} =$$

$$= \left[ \frac{2j - 20 + 1}{2j} \right] \dot{I} = \left[ \frac{-19 + 2j}{2j} \cdot \frac{-2j}{-2j} \right] \dot{I} = \left[ \frac{-38j + 4}{4} \right] \dot{I} \Rightarrow \dot{I} = \frac{\dot{V} \cdot 4}{4 - 38j}$$

$$\Rightarrow \dot{I} = \frac{10 \cdot 4}{4^2 - 38^2} \cdot \frac{10 \angle -83,99^\circ}{38,2} = \frac{40}{38,2} \frac{10 \angle -83,99^\circ}{4 - 38j} = 1,05 \angle 83,99^\circ$$

$$\dot{V}_R = \dot{I} \cdot R = 1,05 \angle 83,99^\circ \Rightarrow v_R(t) = 1,05 \cos(20t + 83,99^\circ)$$

$$\begin{aligned}
 \dot{V}_L &= \dot{I} \cdot j\omega L = 1,05 \angle 83,99^\circ \cdot 0,5 \cdot 20j = 1,05 \angle 83,99^\circ \cdot 10 \angle 90^\circ = \\
 &= 10,5 \angle 173,99^\circ \Rightarrow
 \end{aligned}$$

$$\Rightarrow v_L(t) = 10,5 \cos(20t + 173,99^\circ)$$

