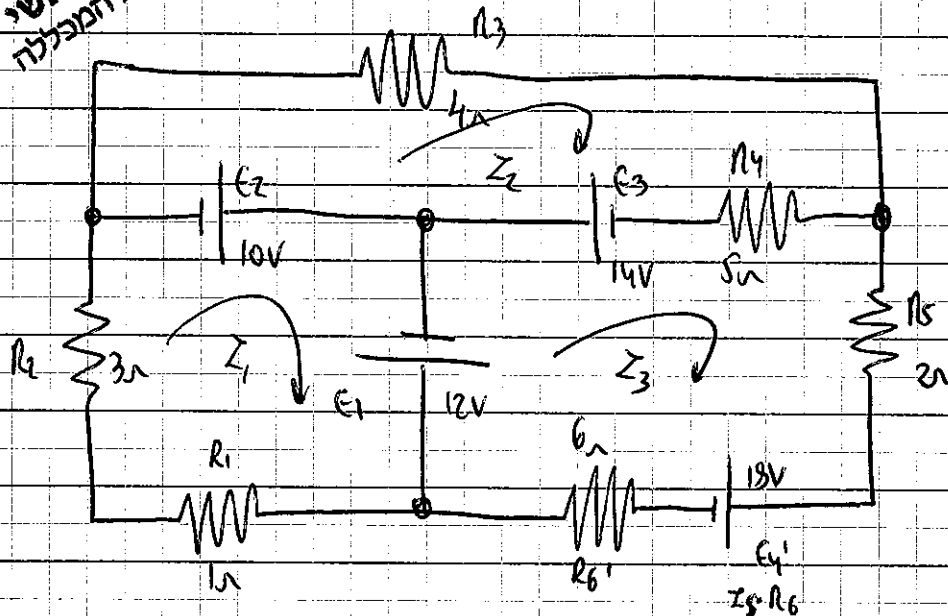


פתרון למבחן - מספר תלמיד 733003
 יום חמישי אדר תשע"ג, 2013

למבחן 2

נדרש למצוא את מקור הזרם (אם יש) ואת הזרם I_1 שזורם
 במעגל המכונה "מעגל הזרם"



$$I) + (R_1 + R_2) I_1 - 0 I_2 - 0 I_3 = E_1 + E_2 \quad (K)$$

$$II) - 0 I_1 + (R_3 + R_4) I_2 - R_4 I_3 = E_3 - E_2$$

$$III) - 0 I_1 - R_4 I_2 + (R_4 + R_5 + R_6) I_3 = -E_1 - E_3 - E_4$$

$$I) 4 I_1 - 0 I_2 - 0 I_3 = 22$$

$$II) - 0 I_1 + 9 I_2 - 5 I_3 = 4$$

$$III) - 0 I_1 - 5 I_2 + 13 I_3 = -44$$

$$\begin{bmatrix} 4 & 0 & 0 \\ 0 & 9 & -5 \\ 0 & -5 & 13 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 22 \\ 4 \\ -44 \end{bmatrix} \quad (L)$$

$$\Delta = \begin{vmatrix} 4 & 0 & 0 \\ 0 & 9 & -5 \\ 0 & -5 & 13 \end{vmatrix} = 368$$

$$\Delta_1 = \begin{vmatrix} 22 & 0 & 0 \\ 4 & 9 & -5 \\ -44 & -5 & 13 \end{vmatrix} = 2024$$

מסל המכונה

$$\Delta_2 = \begin{vmatrix} 4 & 22 & 0 \\ 0 & 4 & -5 \\ 0 & -44 & 13 \end{vmatrix} = -632$$

$$\Delta_3 = \begin{vmatrix} 4 & 0 & 22 \\ 0 & 9 & 4 \\ 0 & -5 & -44 \end{vmatrix} = -1504$$

$$I_1 = \frac{\Delta_1}{\Delta} = \frac{2024}{368} = 5.5(A)$$

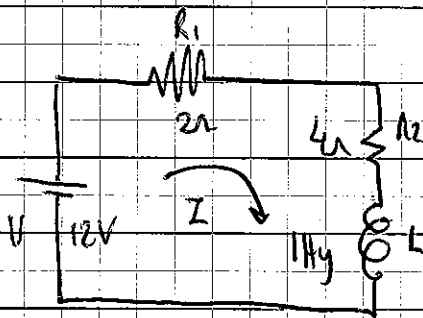
$$I_2 = \frac{\Delta_2}{\Delta} = \frac{-632}{368} = -1.72(A)$$

(כיוון זרם - זרם)

$$I_3 = \frac{\Delta_3}{\Delta} = \frac{-1504}{368} = -4.086(A)$$

(כיוון זרם - זרם)

2. $\frac{1}{2} \text{ dkl}$

 $0.5 \leq t \leq 0.1 \text{ sec (K)}$

$$\tau = L \cdot \frac{1}{(R_1 + R_2)} = \frac{1}{6} = 0.166 \text{ sec}$$

$$I_L(t) = I_L(\infty) - (I_L(\infty) - I_L(0+))$$

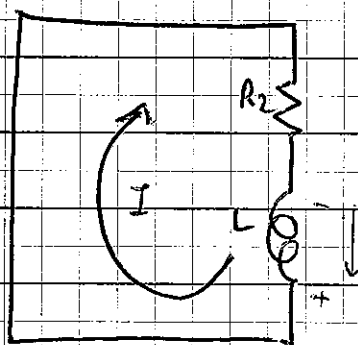
(3, 1, 0) $I_L(0) = \frac{U}{R_1 + R_2} = \frac{12}{6} = 2A$

$$(p_1) \quad (f_0) \quad I_L(0+) = 0$$

$$I_L(t) = 2 - (2-0)e^{-t/\tau_{L6}}$$

$$I_L(t) = 2 - 2e^{-6t} \text{ (A)}$$

$$I_L(t=0.4 \text{ sec}) = 2 - 2e^{-6 \cdot 0.1} = 0.902 \text{ (A)}$$



0.1 per 5 t (2)

$$T = L \cdot \frac{1}{f_2} = \frac{1}{4} = 0.25 \text{ sec}$$

$$I_L(0^+) = 0.902 \text{ A}$$

$$Z_1(y) = 0$$

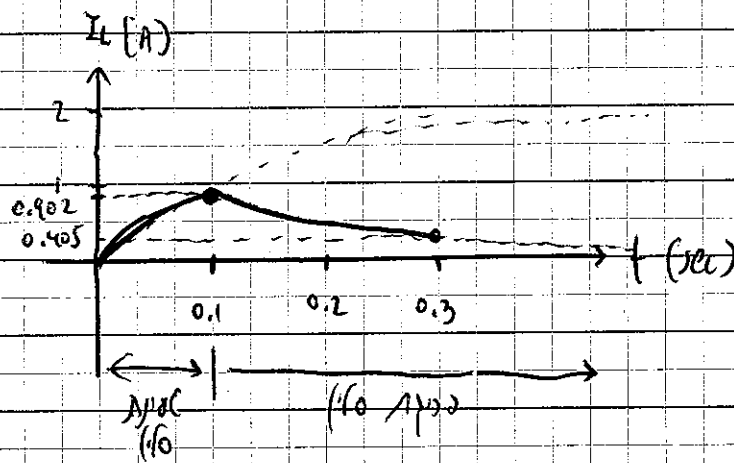
$$I_L(t) = 0 - (0 - 0.902)e^{-t/\tau_4}$$

$$Z_L(t) = 0.902 e^{-4t} \text{ (A)}$$

$$I_L(t = 0.2 \text{ sec}) = 0.902 e^{-4 \cdot 0.2} = 0.405 \text{ (A)}$$

0.2sec
המשך
החלפה
המשך

$t=0$ $-N$ 03 sec 2.10



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מנהל המכללה

3 שלב

$$|\bar{U}_{PH}| = 2400 V$$

(K) שלב (מתי) ה/יוס

$$|\bar{U}_L| = \sqrt{3} |\bar{U}_{PH}| = \sqrt{3} \cdot 2400 = 4156.921 V$$

$$P_T = \sqrt{3} |\bar{I}_L| |\bar{U}_L| \cos \phi$$

$$|\bar{I}_L| = \frac{P_T}{\sqrt{3} |\bar{U}_L| \cos \phi} = \frac{691.2 \cdot 10^3}{\sqrt{3} \cdot 4156.921 \cdot 0.8} = 120 A$$

$$\bar{U}_{PH1} = 2400 \angle 0^\circ V ; \bar{U}_{PH2} = 2400 \angle 120^\circ V ; \bar{U}_{PH3} = 2400 \angle -120^\circ$$

$$\bar{I}_{PH} = \frac{\bar{V}_{PH}}{\bar{Z}} \Rightarrow \phi_{Z_{PH}} = \phi_{U_{PH}} - \phi_Z$$

$$(I_L = I_{PH}) \quad \phi_{Z_{PH1}} = \phi_{Z_1} = 0 - 36.869 = -36.869^\circ$$

$$(I_L = I_{PH}) \quad \phi_{Z_{PH2}} = \phi_{Z_2} = 120 - 36.869 = 83.131^\circ$$

$$(I_L = I_{PH}) \quad \phi_{Z_{PH3}} = \phi_{Z_3} = -120 - 36.869 = -156.869^\circ$$

ה/יוס
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$$\bar{I}_1 = 120 \angle -36.869^\circ (A) ; \bar{I}_2 = 120 \angle 83.131^\circ (A) ; \bar{I}_3 = 120 \angle -156.869^\circ (A)$$

$$|\bar{I}_L| = \frac{|\bar{U}_{PH}|}{|\bar{I}_{PH}|} = \frac{2400}{120} = 20 (\sqrt{3})$$

(2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100)

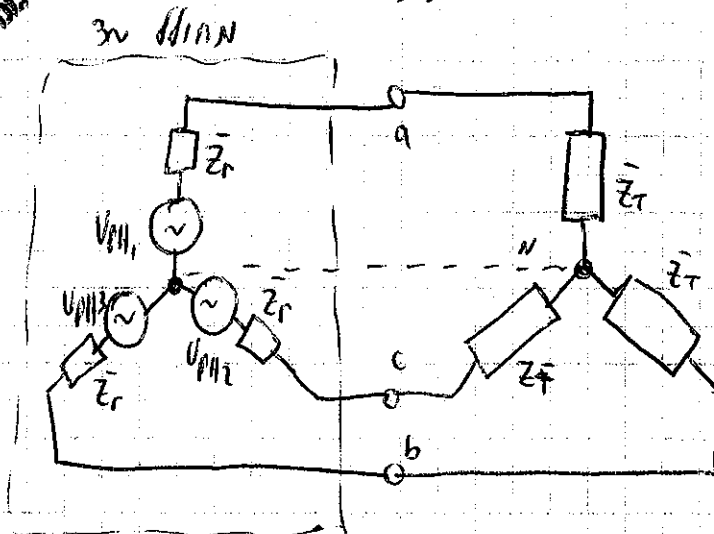
$$\bar{Z}_T = \bar{Z}_L + \bar{Z}_C = 0.2 + j0.8 + 20 \angle 36.864^\circ (\text{Vph})$$

$$\bar{Z}_T = (16.2 + j12.8) \text{ Vph} = 20.646 \angle 38.312^\circ (\text{Vph})$$

$$|\bar{U}_{PH}| = |\bar{Z}_{PH}| \cdot |\bar{I}_T| = 120 \cdot 20.646 = 2477.52 \text{ V}$$

$$|\bar{U}_L| = \sqrt{3} \cdot |\bar{U}_{PH}| = \sqrt{3} \cdot 2477.52 = 4291.19 (\text{V})$$

הערה: המערכת היא מערכת חשמלית



הערה: המערכת היא מערכת חשמלית

$$\bar{U}_{PH1} = \bar{Z}_L (\bar{I}_T + \bar{I}_T) = 120 \angle -36.869^\circ (0.02 + j0.16 + 20.646 \angle 38.312^\circ)$$

$$\bar{U}_{PH1} = 2491.343 \angle 1.755^\circ (\text{V})$$

$$\bar{U}_{PH2} = 2491.343 \angle 121.755^\circ (\text{V})$$

$$\bar{U}_{PH3} = 2491.343 \angle -118.245^\circ (\text{V})$$

הערה: המערכת היא מערכת חשמלית

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$$P_T = \sqrt{3} \cdot |\bar{Z}_L| \cdot |\bar{U}_L| \cdot \cos \phi = \sqrt{3} \cdot 120 \cdot 4291.19 \cdot \cos(38.312^\circ) = 649.831 (\text{kW})$$

4 אפריל

נמצא את הוולטג'ים בעזרת:

$$\bar{Z}_A = \frac{1}{Y_1} = \frac{1}{0.2} = 5 \Omega ; \bar{Z}_B = \frac{1}{Y_2} = \frac{1}{0.02 \angle -90^\circ} = 50 \angle 90^\circ \Omega$$

$$\bar{Z}_C = \frac{1}{Y_3} = \frac{1}{0.25 \angle 90^\circ} = 4 \angle -90^\circ \Omega$$

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מנהל המכללה

אז נמצא את π :

$$\bar{Y}_{11} = \frac{\bar{Z}_A + \bar{Z}_B}{\bar{Z}_A \bar{Z}_B} = \frac{5 + j50}{5 \cdot j50} = \left(\frac{1}{5} - j \frac{1}{50} \right)$$

$$\bar{Y}_{12} = \bar{Y}_{21} = - \frac{1}{\bar{Z}_B} = - \frac{1}{50 \angle 90^\circ} = j \frac{1}{50}$$

$$\bar{Y}_{22} = \frac{\bar{Z}_B + \bar{Z}_C}{\bar{Z}_B \bar{Z}_C} = \frac{j50 + (-j4)}{50 \angle 90^\circ \cdot 4 \angle -90^\circ} = j \frac{23}{100}$$

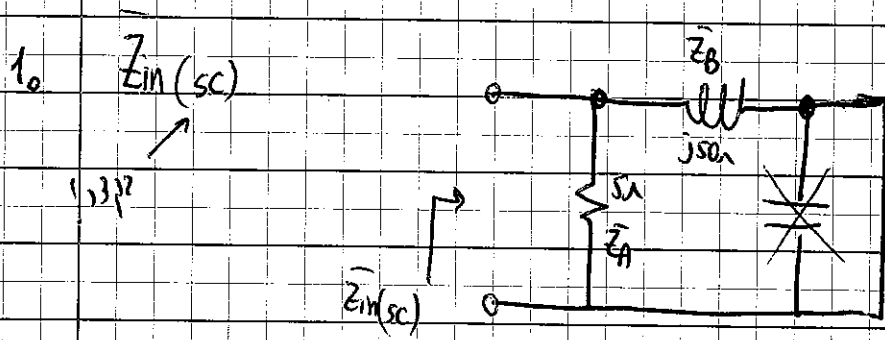
$$\bar{Y} = \begin{bmatrix} \left(\frac{1}{5} - j \frac{1}{50} \right) & j \frac{1}{50} \\ j \frac{1}{50} & j \frac{23}{100} \end{bmatrix}$$

$$\bar{Z}_{11} = \frac{\bar{Z}_A (\bar{Z}_B + \bar{Z}_C)}{\bar{Z}_A + \bar{Z}_B + \bar{Z}_C} = \frac{5(j50 - j4)}{(5 + j46)} = (4.941 + j0.533) \quad (?)$$

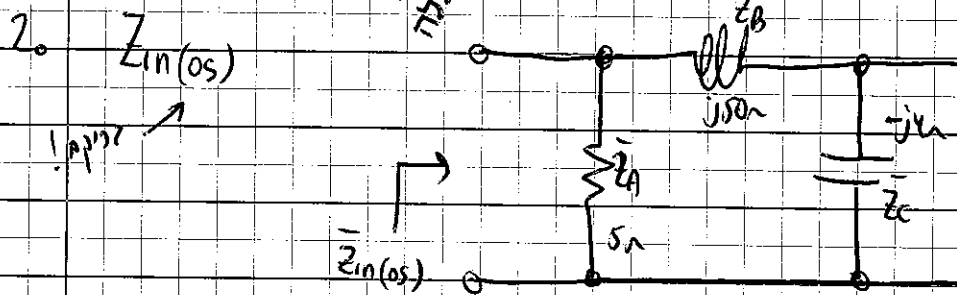
$$\bar{Z}_{12} = \bar{Z}_{21} = \frac{\bar{Z}_A \bar{Z}_C}{\bar{Z}_A + \bar{Z}_B + \bar{Z}_C} = \frac{5 \cdot 4 \angle -90^\circ}{(5 + j46)} = (-0.429 - j0.0467)$$

$$\bar{Z}_{22} = \frac{\bar{Z}_C (\bar{Z}_A + \bar{Z}_B)}{\bar{Z}_A + \bar{Z}_B + \bar{Z}_C} = \frac{4 \angle -90^\circ (5 + j50)}{(5 + j46)} = (0.0333 - j4.343)$$

$$\bar{Z} = \begin{bmatrix} (4.941 + j0.533) & (-0.429 - j0.0467) \\ (-0.429 - j0.0467) & (0.0333 - j4.343) \end{bmatrix}$$



$$\bar{Z}_{in(sc)} = \bar{Z}_A \parallel \bar{Z}_B = \frac{5 \cdot j50}{5 + j50} = (4.95 + j0.495) \Omega$$



$$\bar{Z}_{in(os)} = (\bar{Z}_B + \bar{Z}_C) \parallel \bar{Z}_A = \frac{j46 \cdot 5}{j46 + 5} = (4.94 + j0.53) \Omega$$

