1/3

تئوری مدار ۱۱/۲۵/

کوییز اول ۹۳/۱۲/۱۱

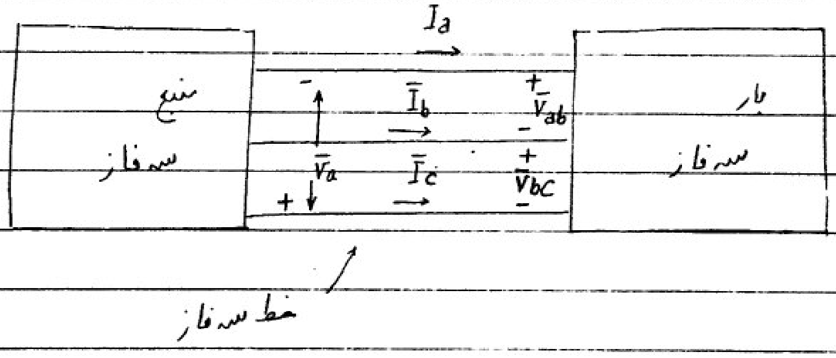
کوییز دوم ۹۴/۱/۲۴

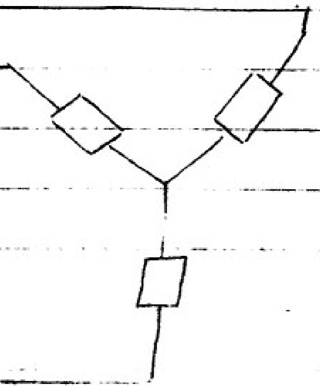
کوییز سوم ۹۴/۲/۷

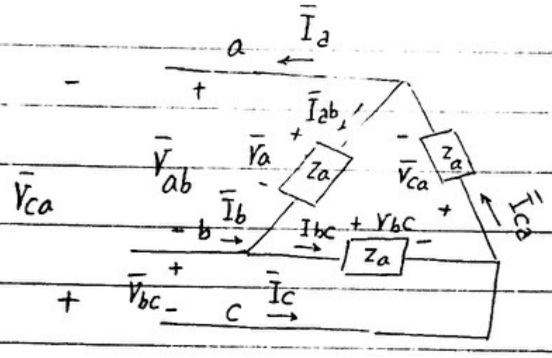
امتحان ۹۴/۲/۱۷ برق ۴ پنجشنبه صبح

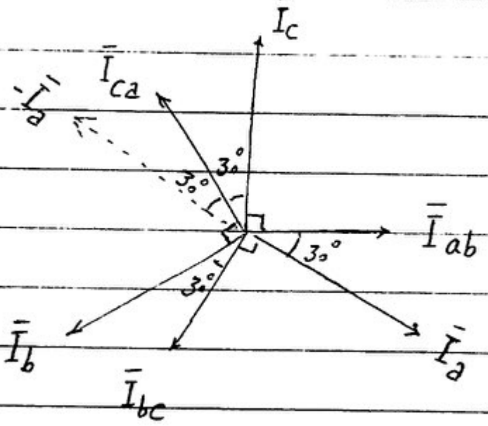
کوییز چهارم ۹۴/۳/۴

مکان کلاس تمرین برق 1









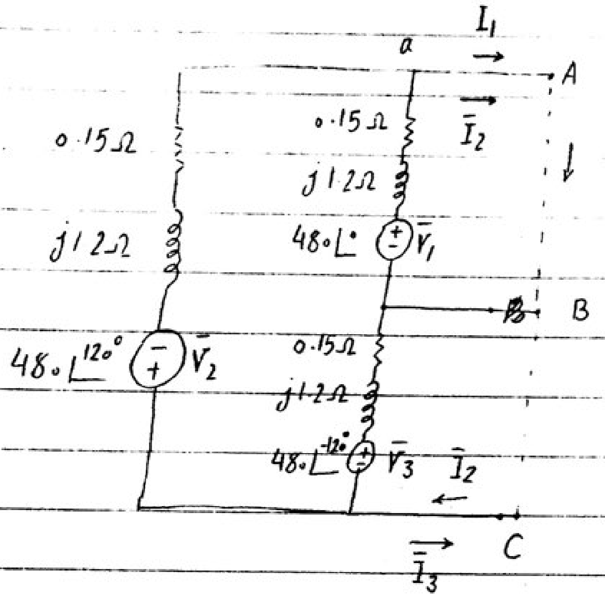
$$\bar{I}_a - \bar{I}_b = 3\,\bar{I}_{ab}$$

$$\bar{I}_b - \bar{I}_c = 3\,\bar{I}_{bc}$$

$$\bar{I}_c - \bar{I}_a = 3\,\bar{I}_{ca}$$

2/3

تئوری مدار ۲۵،۱۱،



$$\bar{I}_1 = \frac{480\angle 0}{0.15+j1.2}$$

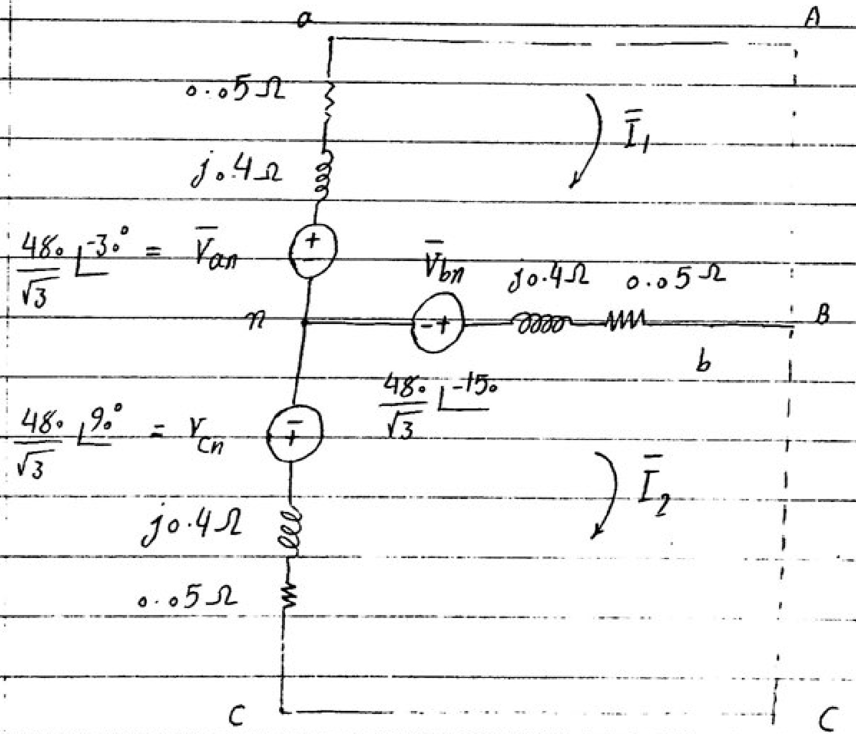
$$I_{aA} = I_1 + I_2$$

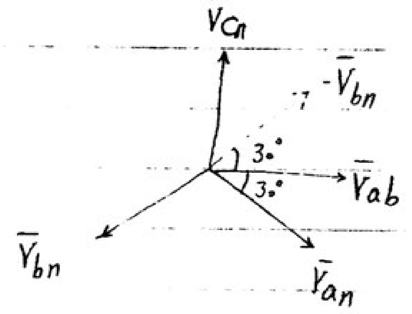
$$\bar{I}_2 = \frac{-480\angle 120}{0.15+j1.2}$$

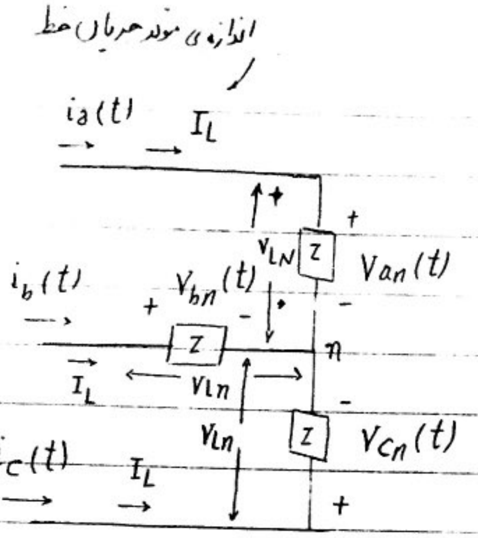
$$\bar{I}_3 = \frac{-480\angle -120}{0.15+j1.2}$$

$$\bar{I}_{\underset{bB}{ab}} = -\bar{I}_1 - \bar{I}_3$$

$$\bar{I}_{cC} = -\bar{I}_2 + \bar{I}_3$$







$$Z = \frac{\bar{V}_{an}}{\bar{I}_a} = \frac{V_{LN}\angle\delta}{I_L\angle\beta}$$

$$V_{an}(t) = \sqrt{2}\,V_{Ln}\cos(\omega t+\delta)$$

$$I_a(t) = \sqrt{2}\,I_L\cos(\omega t+\beta)$$

$$P_a(t) = V_{an}(t)\,i_a(t) = V_{LN}I_L\left[\cos(\delta-\beta)+\cos(\delta-\beta)\cos 2(\omega t+\delta)+\right.$$

$$\left.+\sin(\delta-\beta)\sin 2(\omega t+\delta)\right]$$

$$V_{bn}(t) = \sqrt{2}\,V_{LN}\cos(\omega t+\delta\mp 120^\circ)$$

$$i_b(t) = \sqrt{2}\,I_L\cos(\omega t+\overset{\beta}{\delta}\mp 120^\circ)$$

$$P_b(t) = V_{LN}I_L\left[\cos(\delta-\beta)+\cos(\delta-\beta)\cos 2(\omega t+\delta\mp 120)+\right.$$

$$\left.+\sin(\delta-\beta)\sin 2(\omega t\overset{+\delta}{\mp}120^\circ)\right]$$

$$V_{cn}(t) = \sqrt{2}\,V_{LN}\cos(\omega t+\delta\pm 120^\circ)$$

$$i_c(t) = \sqrt{2}\,I_L\cos(\omega t+\delta\beta\pm 120^\circ)$$

$$P_c(t) = V_{LN}I_L\left[\cos(\delta-\beta)+\cos(\delta-\beta)\cos(\omega t+\delta\pm 120^\circ)+\sin(\delta-\beta)\sin(\omega t+\delta\pm 120^\circ)\right]$$

۹۳/۱۱/۲۵ تئوری مدار

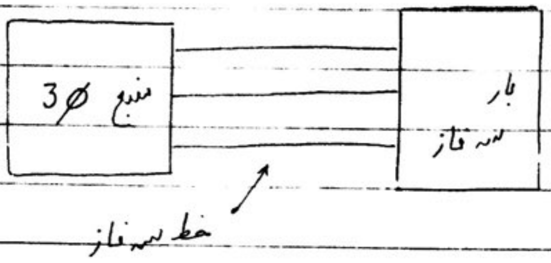
$$p_{3\phi}(t) = p_a(t) + p_b(t) + p_c(t) = \underbrace{3 V_{LN} I_L \cos(\delta-\beta)}_{3P_{1\phi}} = \sqrt{3}\, V_{LL} I_L \cos(\delta-\beta)$$

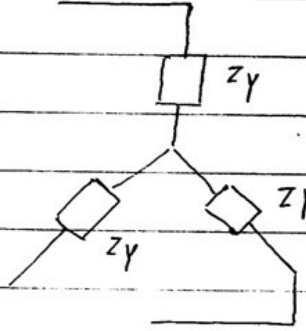
$$P_{3\phi} = 3P_{1\phi} = 3V_{LN} \overset{\cos(\delta-\beta)}{I_L} = \sqrt{3}\, V_{LL} I_L$$

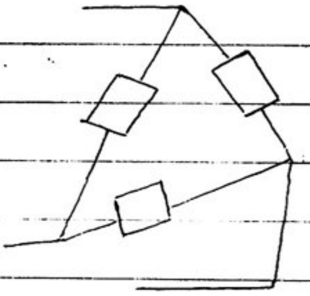
فاز امپدانس = $\delta - \beta$

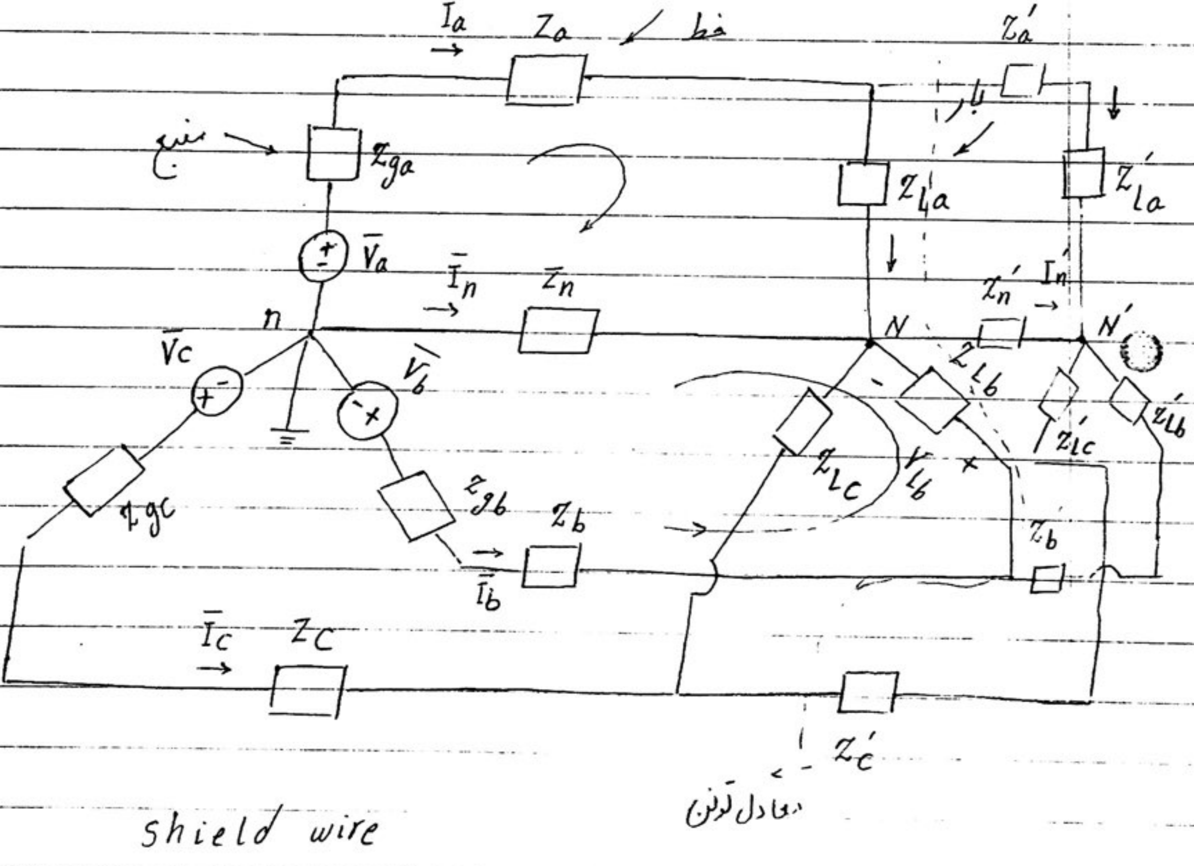
(زاویه ضریب توان)

1/2 تئوری مدار ۲۰/۱۱/۱۱









Shield wire

wire

Guard wire

$$KCL:\ \frac{\bar{V}_Y-\bar{V}_a}{Z_{ga}+Z_a+Z_{La}}+\frac{\bar{V}_Y-\bar{V}_b}{Z_{gb}+Z_b+Z_{Lb}}+\frac{\bar{V}_Y-\bar{V}_c}{Z_{gc}+Z_c+Z_{Lc}}+\frac{\bar{V}_Y}{Z_n}=0$$

برای تعادل شبکه باید مساوی باشند

$$Z_{ga}=Z_{gb}=Z_{gc}$$

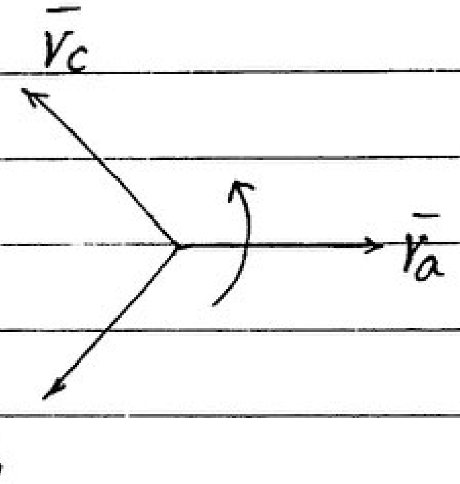
$$Z_a=Z_b=Z_c$$

$$Z_{La}=Z_{Lb}=Z_{Lc}$$

$$\frac{3\bar{V}_N}{Z_{ga}+Z_a+Z_{La}}+\frac{\bar{V}_N}{Z_n}=\frac{\overset{0}{\cancel{\bar{V}_a+\bar{V}_b+\bar{V}_c}}}{Z_{ga}+Z_a+Z_{La}}$$

$$\bar{V}_N\left(\frac{3}{Z_{ga}+Z_a+Z_{La}}+\frac{1}{Z_n}\right)=0$$

$$\bar{V}_N=0$$

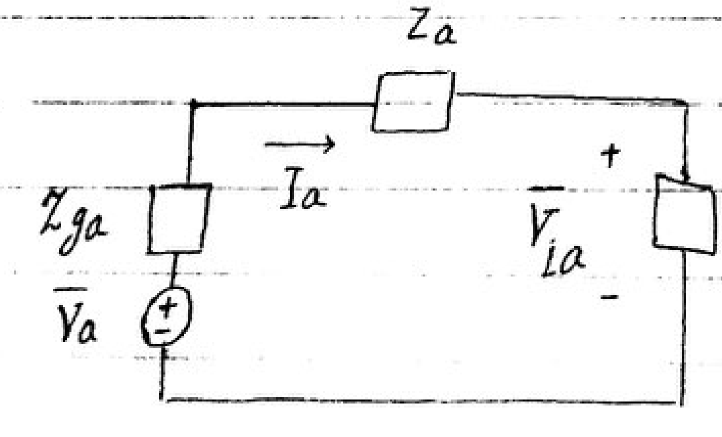


$$KVL:\ \bar{I}_a=\frac{\bar{V}_a}{Z_{ga}+Z_a+Z_{La}}$$

در حلقه‌ی فاز a

$$\bar{I}_b=\frac{\bar{V}_b}{Z_{gb}+Z_b+Z_{Lb}}$$

از نظر اندازه این ۳ شدت جریان باهم برابرند و ۱۲۰° اختلاف فاز دارند



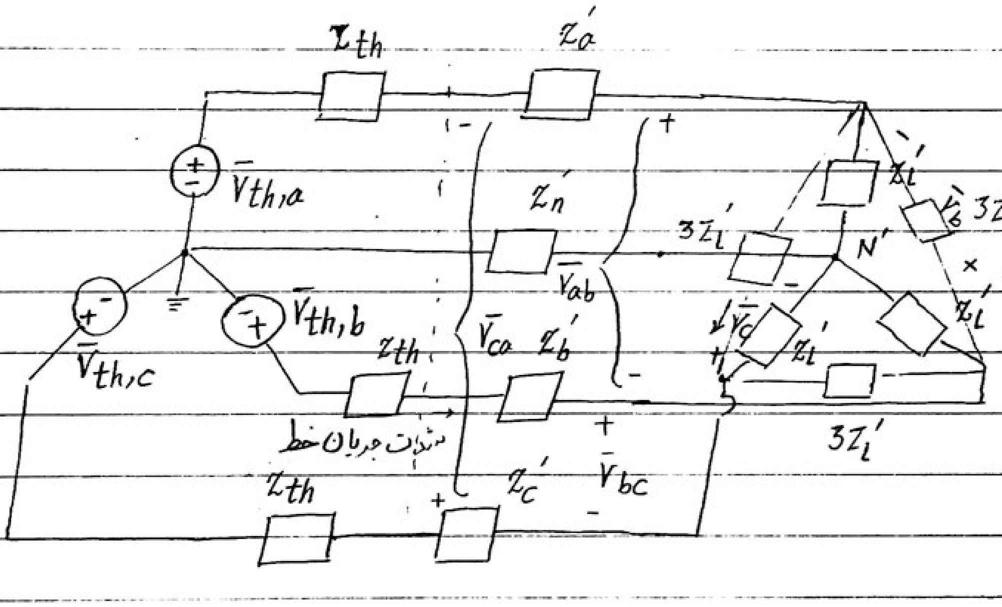
2/2 ۲۰،۱۱، تئوری مدار

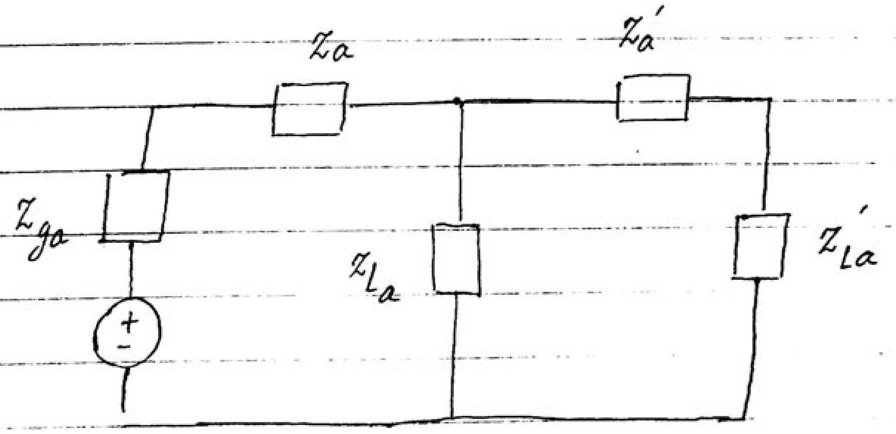
$$Z'_{ga} = Z'_b = Z'_c$$

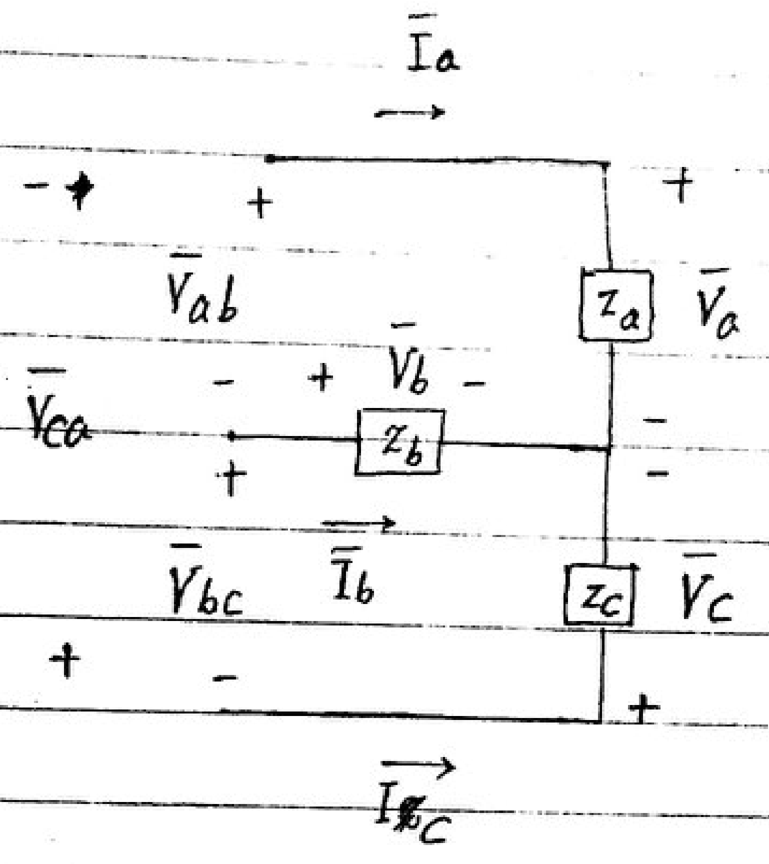
$$Z'_{La} = Z'_{Lb} = Z'_{Lc}$$

$$Z_{th} = Z_{La} \,\|\, (Z_{ga} + Z_a)$$

$$\bar{V}_{th_a} = \frac{Z_{La}}{Z_{ga} + Z_a + Z_{La}} \bar{V}_a$$



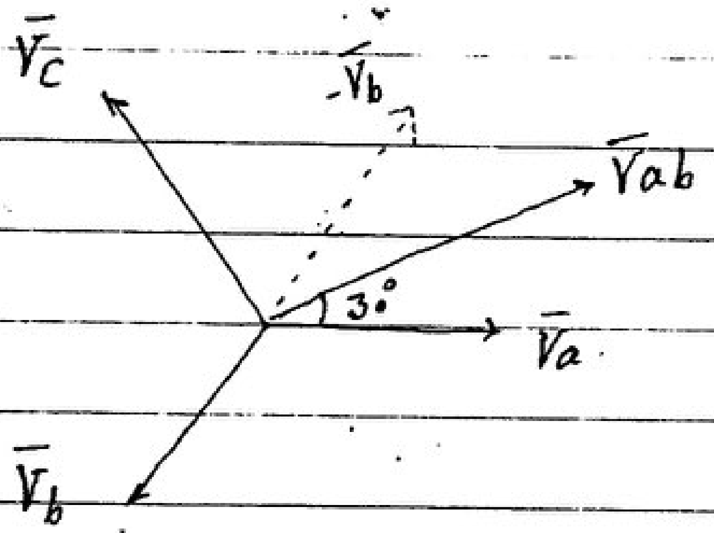




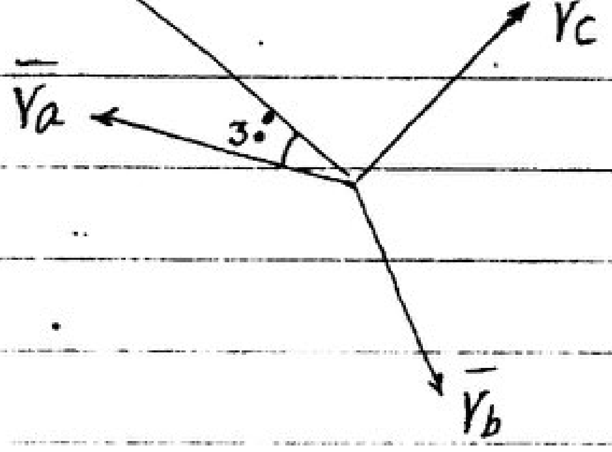
$$\bar{V}_{ab} = \bar{V}_a - \bar{V}_b$$

$$\bar{V}_{bc} = \bar{V}_b - \bar{V}_c$$

$$\bar{V}_{ca} = \bar{V}_c - \bar{V}_a$$



$$\bar{V}_{ab} = (\sqrt{3} \angle 30^\circ)\,\bar{V}_a$$



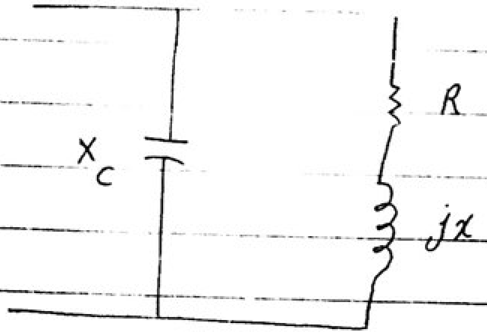
$$\bar{V}_{ab} = (\sqrt{3} \angle -30^\circ)\,\bar{V}_a$$

1/3

۹۳,۱۱,۱۸

تئوری مدار

$pf_{new} \dashrightarrow$

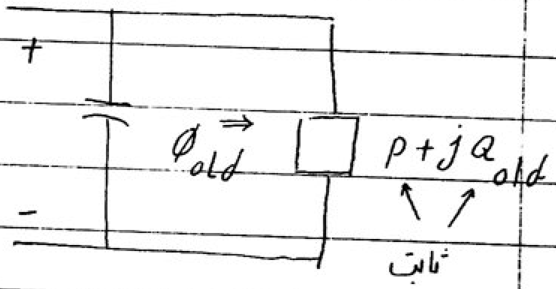


$$x_C = \frac{R^2 + x^2}{R(\tan(\cos^{-1} pf_{new}) - x}$$

دارم دارم

$$Q_{new} = (\overset{\text{دارم}}{\tan\phi_{new}})\overset{\text{دارم}}{P}$$

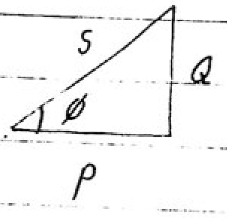
$\phi_{new} \Rightarrow$



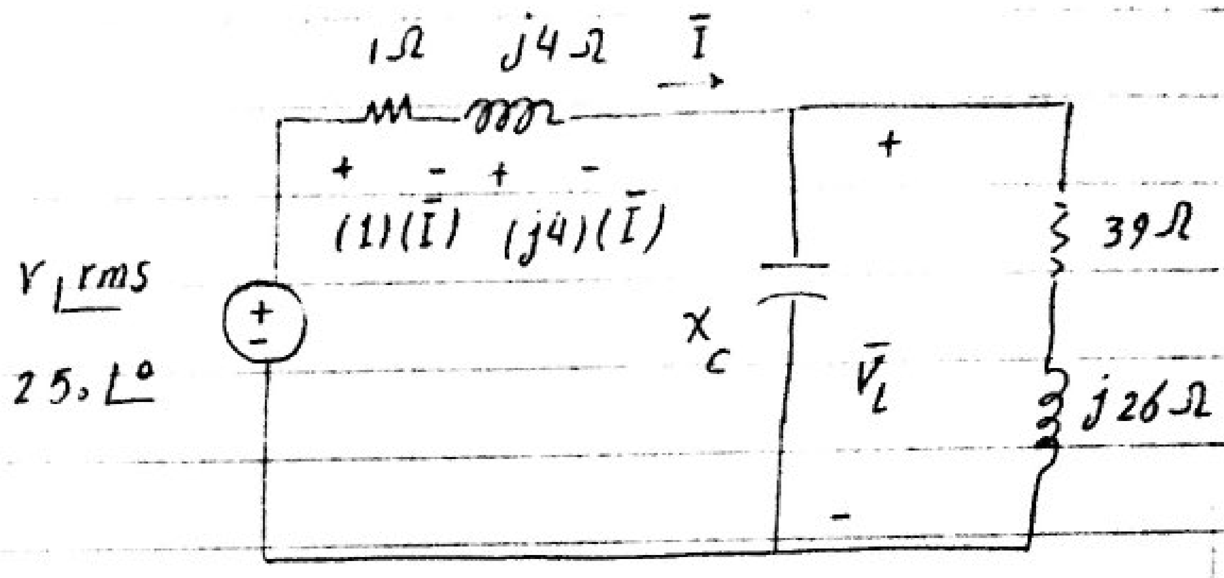
$$Q_{new} = \underset{\text{دارم}}{Q_{old}} + Q_C$$

$$\tan\phi_{new} = \frac{Q_{new}}{P}$$

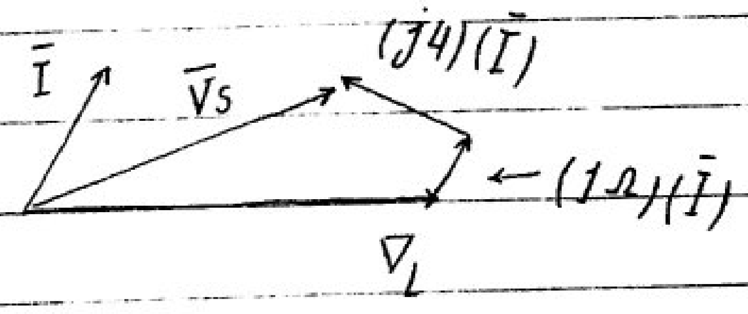
$$Q_C = Q_{new} - Q_{old} = p(\tan\phi_{new} - \tan\phi_{old})$$



$$\tan\phi_{old} = \frac{Q_{old}}{P}$$



$X_C = -\frac{1}{\omega C}$	Z_{eq}	$\bar I$	$\bar V_L$	
~~بدون خازن~~ بدون خازن	$39+j26$	$5\angle -36.87^\circ$	$234.36\angle -3.18^\circ$	0
-86	$56.33+j0.66$	$4.35\angle -4.65^\circ$	$244.85\angle -3.97$	697.11
-84.5	$56.33\angle 0$	$4.34\angle -3.99^\circ$	$245.04\angle -3.99$	710.59
-36	$31.18-j28.00$	$6.23\angle 36.72$	$261.00\angle -5.21^\circ$	1892.25

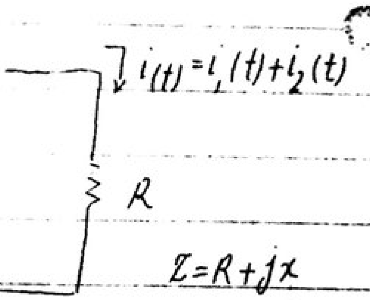


$$S_C = \cancel{P_C} + jQ_C = \frac{|\bar V|^2}{Z_C^*} = \frac{|V_L|^2}{(jX_C)^*} = -j\omega C|\bar V_L|^2$$

2/3 ۱۸/۱۱/ تئوری مدار

$i_1(t) = I_{1,max}\cos(m\omega t+\phi) \qquad I_1\angle\phi$

$i_2(t) = I_{2,max}\cos(n\omega t+\theta) \qquad I_2\angle\theta$



$Z=R+jx$

$p(t)=Ri_{(t)}^2 = R(i_1^2+i_2^2+2i_1i_2)$

$m\omega$

$n\omega$

دو منبع ولتاژ سینوسی

$$P=\frac{1}{T}\int_0^T p(t) = \underbrace{\frac{R}{T}\int_0^T i_1^2\,dt}_{P_1} + \underbrace{\frac{R}{T}\int_0^T i_2^2\,dt}_{P_2} + \underbrace{\frac{2R}{T}\int_0^T i_1 i_2\,dt}_{P_{12}}$$

$$P_{12} = \frac{R I_{1,max} I_{2,max}}{T}\int_0^T \{\cos[(m-n)\omega t+(\phi-\theta)] +$$

$m\neq n$

$$+\cos[(m+n)\omega t+(\phi+\theta)]\}\,dt$$

$m=n \rightarrow P_{12} = R I_{1,max} I_{2,max}\cos(\phi-\theta)$

rms

$R(I_1\angle\phi + I_2\angle\theta)(I_1\angle\phi + I_2\angle\theta)^* \qquad S=\bar{V}\bar{I}^* = R\bar{I}\bar{I}^*$

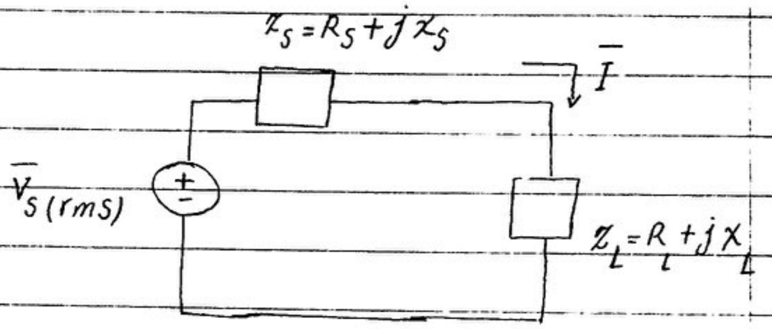
$R[I_1^2+I_2^2+I_1I_2\angle\phi-\theta + I_1I_2\angle\theta-\phi]$

$I_1I_2[\cos(\phi-\theta)+j\sin(\phi-\theta)] \qquad I_1I_2[\cos(\theta-\phi)+j\sin(\theta-\phi)]$

$+\ 2I_1I_2\cos(\phi-\theta)$

$$(\sqrt{2}\,I_1)(\sqrt{2}\,I_2)\cos(\phi-\theta) = I_{1,max}\,I_{2,max}\cos(\phi-\theta) = P_{12}$$

✓ صفحات 461 , 462 کتاب جبه دار جلد اول

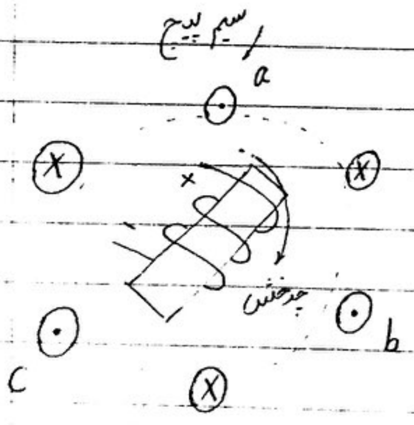


$$\bar{I} = \frac{\bar{V}_S}{Z_L + Z_C}$$

$$P = R_L|\bar{I}|^2 = \frac{|\bar{V}_S|\,R_L}{(R_S+R_L)^2 + (X_S+X_L)^2}$$

$$X_L = -X_S$$

$$\frac{dP}{dR_L} = 0 \longrightarrow R_L = R_S \qquad Z_L = Z_S^{*} = R_S - jX_S$$



این ولتاژها اندازه‌های یکسانی دارند و 120° با هم اختلاف فاز دارند.

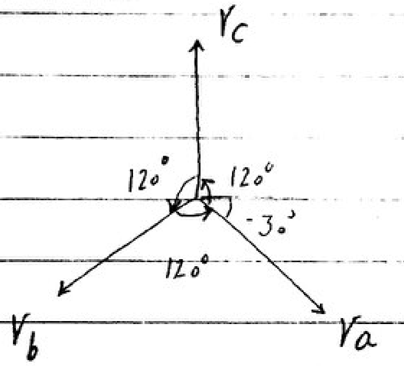
V_a

V_b

V_c

3/3 ۱/۱۱/۱۸ تئوری مدار

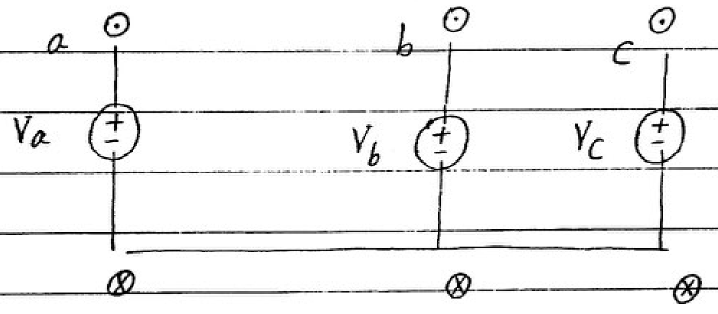
c ، ۱۲۰° از a جلوتر است

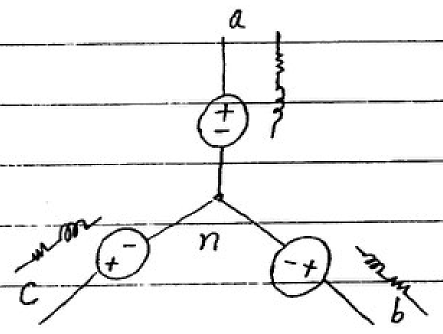


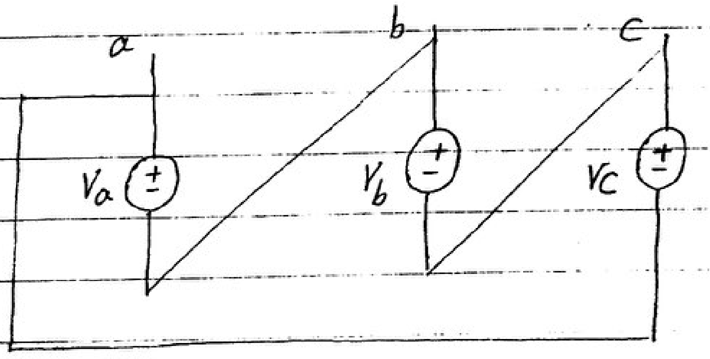
$$V_a = V_{max} \cos(\omega t - 30^\circ)$$

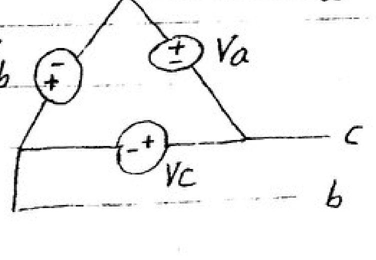
$$V_b = V_{max} \cos(\omega t - 150^\circ)$$

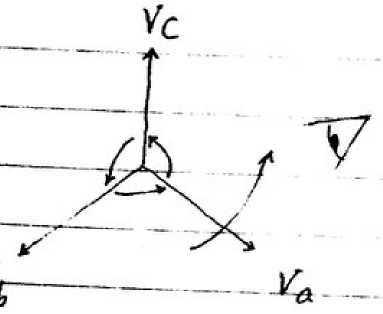
$$V_c = V_{max} \cos(\omega t + 90^\circ)$$







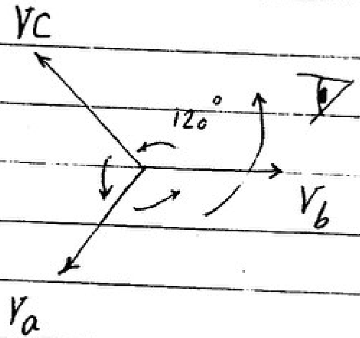




توالی فاز abc

مثبت

راستگرد



توالی فاز acb

منفی

چپگرد