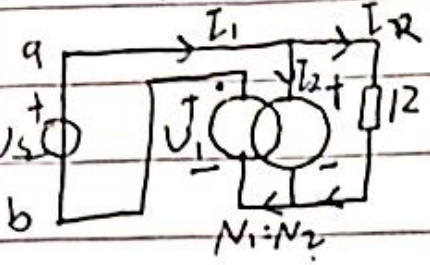
5.42. 用加压求流法，参考方向如图



由图知变压器异名端流入

$\frac{U_R}{U_1} = -\frac{N_2}{N_1}$　　$U_1 = -\frac{N_1}{N_2}U_R$

$U_1 + U_R = U_S$　　$U_R = \frac{U_S}{1-\frac{N_1}{N_2}}$

$I_2 = I_1 - I_R = I_1 - \frac{U_R}{R}$

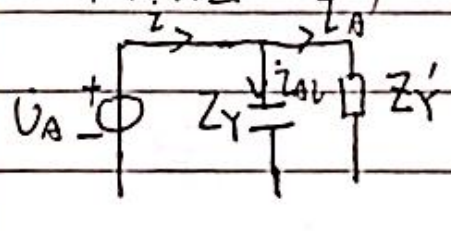
$\frac{I_2}{I_1} = \frac{N_1}{N_2}$　　$1 - \frac{U_R}{I_1 R} = \frac{N_1}{N_2}$

$I_1 = \frac{U_R}{R(1-\frac{N_1}{N_2})} = \frac{U_S}{R(1-\frac{N_1}{N_2})^2}$

$\frac{U_S}{I_1} = R(1-\frac{N_1}{N_2})^2$ 为入端阻抗

5.51. 将△变为Y，$Z_Y' = \frac{1}{3}Z_\Delta = 100\Omega$

单相图



$\sqrt{3}U_{ABL}I_{AL}\sin\varphi = 942\ var$　　$\varphi = -90°$

$U_{ABL} = \sqrt{3}U_A = 100\sqrt{3}V$　　为电压-电流相差

$I_{AL} = 3.14A$

由呈纯电容 $\dot{I}_{AL} = 3.14\angle -90°A$

$\dot{I}_A' = \frac{\dot{U}_A}{Z} = 1\angle 0°A$

$\dot{I}_{AB} = \frac{\sqrt{3}}{3}\dot{I}_A'\angle 30° = \frac{\sqrt{3}}{3}\angle 30°A$

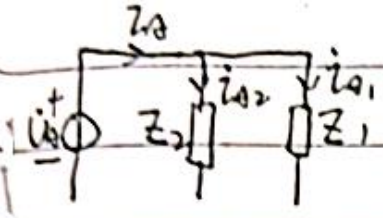
$\dot{I}_L = \dot{I}_A' + \dot{I}_{AL} = (1+3.14j)A$

$\tilde{S} = 3\times\dot{U}_A\times\bar{\dot{I}_L}$

$= (300-942j)VA$

5.13. 端口内部的为Y接负载

单相时：以相电压为参考相量



$\dot{U}_A = 220\angle 0°V$

$P_1 = 3U_A \times I_{A1} \cos\varphi_1$

$I_{A1} = \frac{20}{3}A$

$\dot{I}_{A1} = \frac{20}{3}\angle -60°A = (\frac{10}{3} - \frac{10}{3}\sqrt{3}j)A$

$\dot{I}_{A2} = \frac{\dot{U}_A}{Z_2} = (2.64 - 3.52j)A$

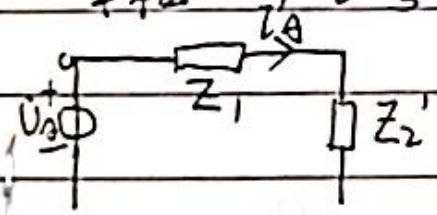
$\dot{I}_A = \dot{I}_{A1} + \dot{I}_{A2} = (5.97 - 9.29j)A$

$I_A = 11.05A$

$\tilde{S}_Σ = 3 \times \dot{U}_A \times \overline{\dot{I}_A}$

取实部 $P = 3942W$

5.14 作Δ-Y变换



等相图 $Z_2' = \frac{1}{3}Z_2$

取A相电压为参考相量

$\dot{U}_A = 220\angle 0°V$

$\dot{I}'_A = \frac{\dot{U}_A}{Z_1 + Z_2} = (9.17 - 9.17j)A$

$= 12.97\angle -45°A$

$\dot{U}_{AB} = \sqrt{3}U_A\angle 30° = 380\angle 30°V$

$\dot{I}_3 = \frac{\dot{U}_{AB}}{Z_3} = 10A$

$\dot{I}_A = \dot{I}'_A + \dot{I}_3 = (19.17 - 9.17j)A$

$\dot{I}_B = \dot{I}'_A\angle -120° - \dot{I}_3 = (-22.52 - 3.36j)A$

$\dot{I}_C = \dot{I}'_A\angle 120° = 12.97\angle 75°A$

5-17. 令相电压为参考相量，Δ-Y变换 $Z' = \frac{Z}{3}$

(1)

$\dot{U}_A = 220\angle 0°\ V$

$\dot{I}_L = \frac{\dot{U}_A}{Z} = (52.8 - 39.6j)\ A$

W_1测 $\dot{I}_{AL} \times \dot{U}_{AB}$ 相之功率

$\dot{U}_{AB} = 380\angle 30°\ V$

$\tilde{S}_1 = \dot{U}_{AB}\ \bar{\dot{I}}_L = (9851.93 + 23063.95j)\ VA$

$P_{W_1} = 9851.93\ W$

W_2测 $\dot{I}_{CL} \times \dot{U}_{CB}$ 相之功率　$\dot{U}_{CB} = 380\angle 90°\ V$

$\tilde{S}_2 = \dot{U}_{CB}\ \bar{\dot{I}}_L\angle 120° = (24899.88 + 2999.95j)\ VA$

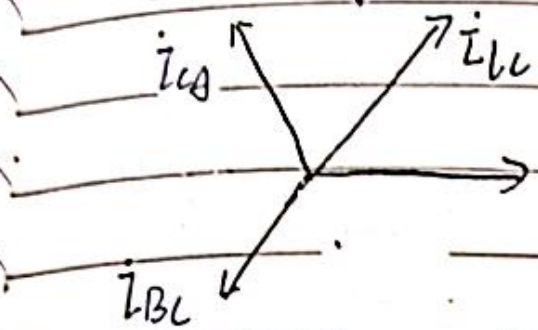
$P_{W_2} = 24899.88\ W$

$P_{总} = P_1 + P_2 = 34751.81\ W$

$Q_{总} = Q_1 + Q_2 = 26063.90\ var$

(2) 断开开关 CA上断路 $\dot{I}_{CA}=0$

画相量图



$\dot{I}_{LA}=\dot{I}_{AB}-\dot{I}_{CA}=\dot{I}_{AB}$

$\dot{I}_{LC}=\dot{I}_{CA}-\dot{I}_{BC}=-\dot{I}_{BC}$

仍取 $\dot{U}_{Aph}$ 为参考相量

$\dot{I}_{AB}=\frac{1}{\sqrt{3}}\dot{I}_l\angle 30°=(37.83-4.56j)$ A

$\dot{I}'_{LA}=\dot{I}_{AB}$

$\tilde{S}_1=\dot{U}_{AB}\cdot\overline{\dot{I}_{LA}}=(11583.06+868.35)$ VA

$P_{W_1}=11583.06$ W

$\dot{I}_{BC}=\frac{1}{\sqrt{3}}\dot{I}_{BC}\angle 30°$

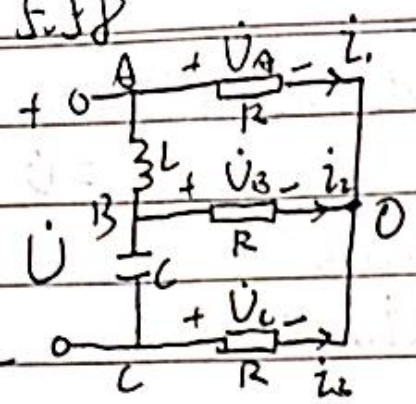
$=\frac{1}{\sqrt{3}}\dot{I}_l\angle -90°=(-22.86-30.484j)$ A

$\dot{I}_{LC}=-\dot{I}_{BC}=(22.86+30.48j)$ A

$\tilde{S}_2=\dot{U}_{CB}\cdot\overline{\dot{I}_{CL}}=(11582.4+868.8j)$ VA

$P_{W_2}=11582.4$ W

5.14



$$\dot{U}_{AO} = U_0 \angle 0°$$

$$\dot{U}_B = U_0 \angle -120°$$

$$\dot{U}_C = U_0 \angle 120°$$

$$U_{AB} = \sqrt{3} U_0 \angle 30°$$

$$U_{BC} = \sqrt{3} U_0 \angle -90°$$

$$\dot{I}_2 = \frac{\dot{U}_{BO}}{R} = \frac{U_0}{R} \angle -120° = -\frac{U_0}{2R} - \frac{\sqrt{3} U_0}{2R} j$$

$$\dot{I}_2 = \frac{\dot{U}_{AB}}{j\omega L} - \frac{\dot{U}_{BC}}{-j\frac{1}{\omega C}}$$

$$= \frac{\sqrt{3} U_0 \angle 30°}{j\omega L} + \frac{\sqrt{3} U_0 \angle -90°}{j\frac{1}{\omega C}}$$

$$= -\left(\frac{\sqrt{3} U_0}{\omega L} \times \frac{1}{2} - \frac{\sqrt{3}}{2} \times \frac{\sqrt{3} U_0}{\omega L} j\right) + \left(-\sqrt{3} U_0 \omega C\right)$$

$$\begin{cases} -\frac{U_0}{2R} = \frac{\sqrt{3} U_0}{2\omega L} - \sqrt{3} U_0 \omega C \\ -\frac{3U_0}{2\omega L} = -\frac{\sqrt{3} U_0}{2R} \end{cases} \Rightarrow \begin{cases} L = 55.1 \text{mH} \\ C = 183.78 \mu C \end{cases}$$

6.3. $f(t) = |V\sin(\frac{w_1}{2}t)|$ $\quad w_1 = \frac{2\pi}{T}$ $\quad w_2 = \frac{2\pi}{2T} = \frac{w_1}{2}$,

$$F_n = \frac{1}{T}\int_0^T f(t)e^{-jnw_1t}dt$$

$$= \frac{V}{T}\int_0^T \sin\frac{w_1}{2}t\, e^{-jnw_1t}dt$$

$$\int_0^T \sin\frac{w_1}{2}t\, e^{-jnw_1t}dt$$

$$= -\frac{2}{w_1}\left(\cos\frac{w_1}{2}t\, e^{-jnw_1t}\Big|_0^T + jnw_1\int_0^T \cos\frac{w_1}{2}e^{-jnw_1t}dt\right)$$

$$= -\frac{2}{w}\times(-2) - 2jn\cdot\frac{2}{w_1}\left(\sin\frac{w_1}{2}e^{-jnw_1t}\Big|_0^T + jnw_1\int_0^T \sin\frac{w_1}{2}e^{-jnw_1t}dt\right)$$

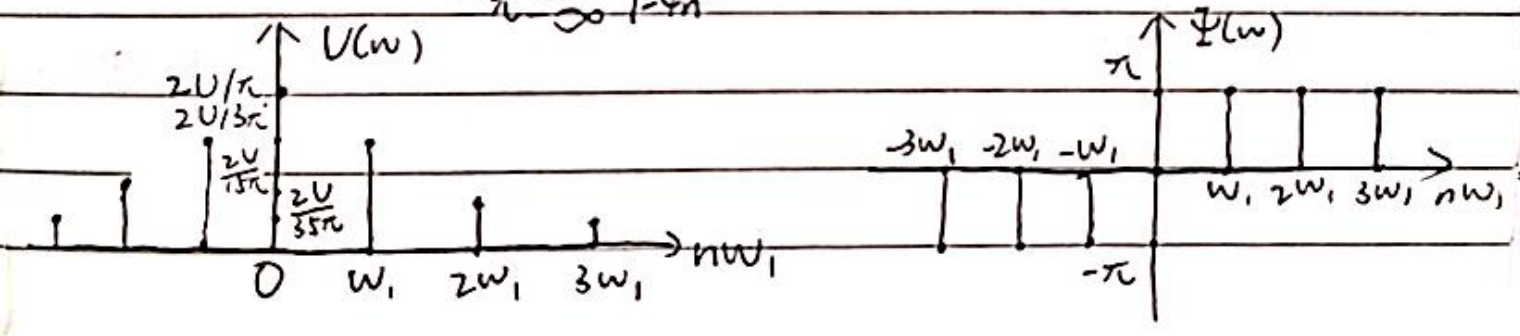
$$= \frac{4}{w} + 4n^2\int_0^T \sin\frac{w_1}{2}e^{-jnw_1t}dt$$

$$\therefore 2\int_0^T \sin\frac{w_1}{2}e^{-jnw_1t}dt = \frac{4}{w(1-4n^2)}$$

$$F_n = \frac{2V}{\pi(1-4n^2)}$$

$$f(t) = \sum_{-\infty}^{\infty} F_n e^{jnw_1t}$$

$$= \frac{-2V}{\pi}\sum_{-\infty}^{\infty}\frac{1}{1-4n^2}e^{jnw_1t}$$



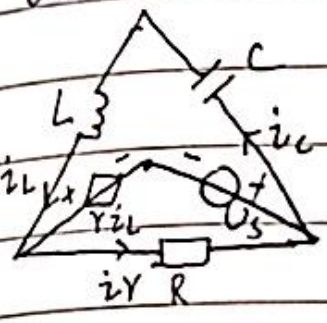
6.5 $U=\sqrt{5^2+40^2+30^2}=50.25V$

$I=\sqrt{1^2+5^2+3^2}=5.92A$

$P=5\times1+40\times5\times\cos(30°-(-30°))+30\times3\times\cos(-20°-10°)$

$=183W$

6.8 当n=1时



$i_C(1)=i_L(1)=i(1)$

$\omega L=\frac{1}{\omega C}$ L与C串联处谐振，

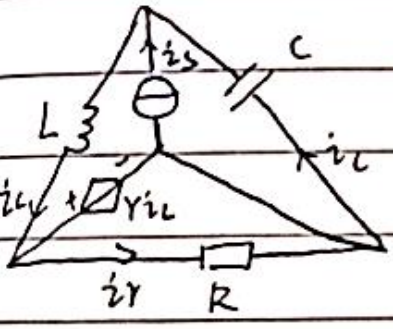
R视为短路

$\dot{I}(1)(j\omega L-j\frac{1}{\omega C})+r\dot{I}(1)=\dot{U}_S$

$\dot{I}_{US}(1)=\dot{I}(1)=1\angle0°A$

$\dot{I}_r(1)=0$

当n=2日寸



作KVL

$\dot{I}_L(2)\cdot j\omega L+r\dot{I}_L(2)+\dot{U}_{IS}(2)=0$

$\dot{I}_C(2)(-j\frac{1}{\omega C})=\dot{U}_{IS}(2)$

$\dot{I}_R=r\dot{I}_L(2)$

$\dot{I}_L(2)-\dot{I}_C(2)=\dot{I}_S(2)=3\angle45°$

$\dot{I}_L(2)=-\frac{\sqrt{2}}{2}j\ A$

$I_C(2)=-\frac{3\sqrt{2}}{2}-\sqrt{2}j=\frac{5}{\sqrt{2}}\angle-129.6°A$

$\dot{I}_R(2)=-\frac{3}{\sqrt{2}}j\ A$

$\dot{U}_{IS}(2)=-20\sqrt{2}+15\sqrt{2}j\ V$

$i_L = i_{L(1)} + i_{L(2)}$

$= \sqrt{2}\sin\omega t + 1\sin(2\omega t - 90°)$ A

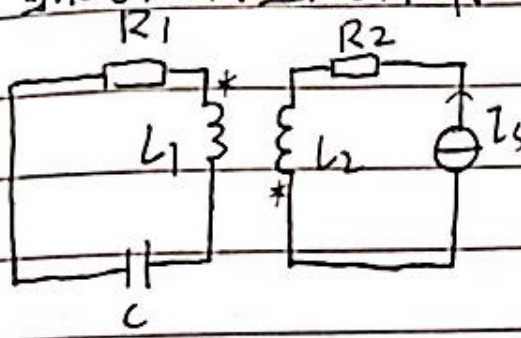
$i_R = i_{R(2)} = 3\sin(2\omega t - 90°)$ A

$i_L = i_{L(1)} + i_{L(2)} = \sqrt{2}\sin\omega t + 5\sin(2\omega t - 129.6°)$ A

$P_{US} =$ ~~[illegible]~~ $U_S I_{US(1)} \cos\varphi = 30W$ 消耗

$P_{IS} = U_{IS(2)} I_S \cos\varphi' =$ ~~[illegible]~~ $-15W$ 产生

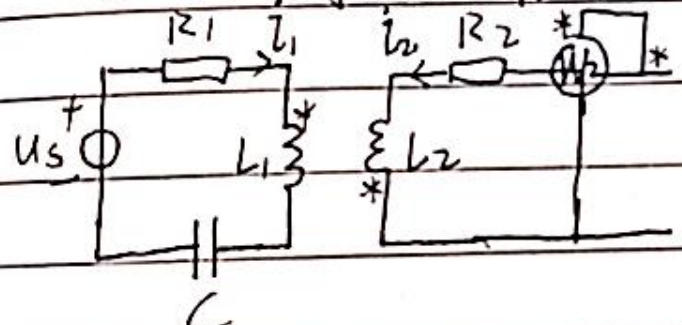
6.10, 当n=0, 只有直流作用



左端无感无电流 $P_1(0) = 0$

$P_2(0) = I_S^2 R_2 = 10W$

当n=1, 只有U_S作用, 电流源相当于断路



$P_2(1) = 0$

L_1与C串联谐振相当于短路

$\dot{I}_1 = \frac{\dot{U}_S}{R_1} = 10\angle 0°$ A

$P_1(1) =$ ~~[illegible]~~ $U_S I_1 \cos\varphi = 1000W$

$P_{W1} = 1000W$ $P_{W2} = 10W$

6.11 $w=2rad/s$时 $U_{cD}=U_R=0.5U_S$ 此时

C与L_2并联谐振断路

$\frac{1}{wC}=wL_2 \quad L_2=1H$

$w=4rad/s$时 $U_{cD}=0$ 此时C

C//L_2与L_1串联谐振，短路

$(-j\frac{1}{wC}//jwL_2)+jwL_1=0$

$-\frac{4}{3}j+4jL_1=0 \quad L_1=\frac{1}{3}H$

当$n=0$时，只有直流，cd上R被短路

$P(0)=\frac{U_S^2(0)}{R}=\frac{100}{R}$

当$n=1$时 $P(1)=\frac{U_S^2(1)}{2R}=\frac{400}{2R}$

当$n=2$时 $P(2)=\frac{U_S^2(2)}{R}=\frac{100}{R}$

$P=P(1)+P(2)+P(3)=\frac{400}{R}=40W$

有 $R=10\Omega$