4-5

(3) X_m大小，$X_{1\sigma}$小。略 (4) X_m变小，$X_{1\sigma}$基本不变。(7) X_m和$X_{1\sigma}$各增加5%

(8) X_m增大5%，$X_{1\sigma}$基本不变 (9) X_m减小，$X_{1\sigma}$基本不变 (10) X_m减小，$X_{1\sigma}$基本不变

4-6 低压侧接 220V后，U电流增一倍，励磁电流大大增加（饱和时增加大于一倍）

= 欢测 440V左右，钢耗大大增加，过热，电源可能被击穿。

4-13 变比 $k = \dfrac{U_{1N}}{U_{2N}} = \dfrac{380}{220} = 1.727$

(1) 归算到高压侧：

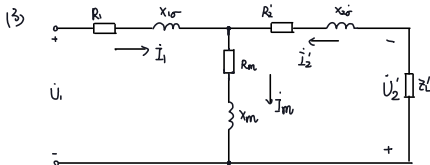$Z_{1\sigma} = R_1 + jX_{1\sigma} = (0.14 + j0.22)\Omega$ $Z_m = R_m + jX_m = (80 + j570)\Omega$

$R_2' = k^2 R_2 = 3 \times 0.035 \Omega = 0.105\Omega$ $X_{2\sigma}' = k^2 X_{2\sigma} = 3 \times 0.055 \Omega = 0.165\Omega$

$Z_{2\sigma}' = R_2' + jX_{2\sigma}' = (0.105 + j0.165)\Omega$ $Z_L' = k^2 Z_L = 3 \times (3 + j4)\Omega = (9 + j12)\Omega$

(2) 归算到低压侧：

$Z_{1\sigma}'' = \dfrac{Z_{1\sigma}}{k^2} = \dfrac{0.14 + j0.22}{3}\Omega = (0.04) + j0.073)\Omega$ $Z_m'' = \dfrac{Z_m}{k^2} = \dfrac{80 + j570}{3}\Omega = (26.667 + j123.333)\Omega$

$Z_{2\sigma} = R_2 + jX_{2\sigma} = (0.035 + j0.055)\Omega$ $Z_L = (3 + j4)\Omega$.

(3)

T形等效电路如上图所示． $Z_T = Z_{1\sigma} + ((Z_{2\sigma}' + Z_L') \| Z_m) = (8.733 + j12.095)\Omega$

$\dot{I}_1 = \dfrac{\dot{U}_1}{Z_T} = \dfrac{380}{8.733 + j12.095} A = 25.472\angle -54.169° A$.

$\dot{I}_2' = -\dfrac{Z_m}{Z_m + Z_{2\sigma}' + Z_L'} \dot{I}_1 = -\dfrac{80 + j570}{80 + j570 + 0.105 + j0.165 + 9 + j12} \times 25.972\angle -54.169° A = -24.572\angle -53.245° A$
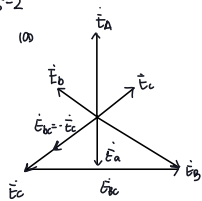
(四) $I_2 = k I_2' = 1.727 \times 24.572 A = 42.436 A$ $U_2 = I_2 |Z_L| = 42.436 \times 5 V = 212.18 V$
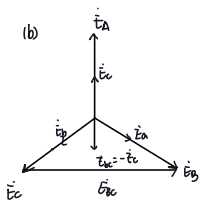
(4)

简化等效电路如左图所示

$\dot{I}_2' = -\dot{I}_1 = -\dfrac{\dot{U}_1}{Z_{1\sigma} + Z_{2\sigma}' + Z_L'} = \dfrac{380}{0.14 + j0.22 + 0.105 + j0.165 + 9 + j12} A = 24.58\angle -53.26° A$

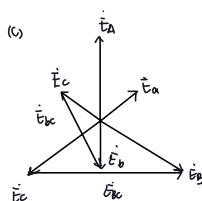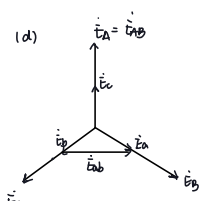则 $I_2 = k I_2' = 1.727 \times 24.587 A = 42.462 A$. $U_2 = I_2 |Z_L| = 42.462 \times 5 V = 212.31 V$
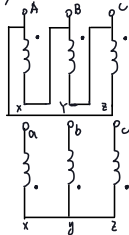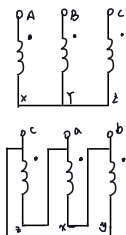
5-2

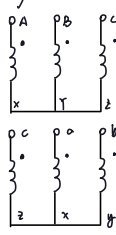(a) 联结组号为 Yd5　(b) 联结组号为 Yd3　(c) 联结组号为 Yy2　(d) 联结组号为 Dy3

5-3

(1) Dy5　(2) Yd5　(3) Yy4　(4) Dd4
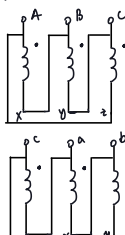
5-5　接成三角形的三次谐波可流通，在正弦电源作用下，励磁电流为尖顶波，

主磁通和感应电动势为正弦波。

一次侧和二次侧接成三角形无影响。

6-6　不能。

组号不同的变压器之间因电压的相位差而相位差，若电动势相等，则二次侧的 $\Delta E_2 = 2E_1 \sin \dfrac{30}{2} = 0.52E_1$

会产生很大的环流，烧毁变压器，因此不允许并联运行。

6-7　变比 $K = \dfrac{U_{1N}}{U_{2N}} = \dfrac{66000}{6600} = 10$

短路实验中等各量归算到一次侧为

$|Z_k| = \dfrac{U_k}{I_k} = \dfrac{3260}{15.15}\,\Omega = 213.86\,\Omega$　　$R_k = \dfrac{P_k}{I_k^2} = \dfrac{9300}{15.15^2}\,\Omega = 40.52\,\Omega$　　$X_k = \sqrt{Z_k^2 - R_k^2} = 209.99\,\Omega$

换算到 75℃ 下各量为

$R_{k75℃} = 40.52 \times \dfrac{235+75}{235+18}\,\Omega = 48.31\,\Omega$　$|Z_{k75℃}| = \sqrt{R_{k75℃}^2 + X_k^2} = 215.48\,\Omega$

由 $Z_{1b} = \dfrac{U_{1N}^2}{S_N} = \dfrac{66000^2}{1600 \times 10^3} = 4356\,\Omega$　得标幺值为

$|Z_k^*| = \dfrac{|Z_k|}{Z_{1b}} = 0.049$　　$R_k^* = \dfrac{R_k}{Z_{1b}} = 0.011$　　$X_k^* = \dfrac{X_k}{Z_{1b}} = 0.048$

(1) $\cos\varphi_2 = 0.8$ (感性) 时 $I_2^* = 1$. $\Delta U_N^* = I_2^*(R_k^* \cos\varphi_2 + X_k^* \sin\varphi_2) = 0.011 \times 0.8 + 0.048 \times 0.6 = 0.038$

(2) $\cos\varphi_2 = 0.8$ (容性) 时 $I_2^* = 1$. $\Delta U_N^* = I_2^*(R_k^* \cos\varphi_2 - X_k^* \sin\varphi_2) = 0.011 \times 0.8 - 0.048 \times 0.6 = -0.020$

(3) 当电压变化为 ΔU^* 为最大 $\varphi_2 = \arctan \frac{R_k^*}{X_k^*} = \arctan \frac{0.011}{0.048} = 12.91°$ 对应的 $\cos\varphi_2 = 0.97$

(4) $I_{1N} = \frac{S_N}{U_{1N}} = \frac{1000 \times 10^3}{66000} = 15.15A$. $I_k = I_{1N}$. $P_k = P_{kN}$

$I_2^* = \sqrt{\frac{P_0}{P_{kN}}} = \sqrt{\frac{5400}{9300}} = 0.762$. $P_0^* = \frac{P_0}{S_N} = \frac{5400}{10^6} = 0.0054$ $P_{kN}^* = \frac{P_{kN}}{S_N} = \frac{9300}{10^6} = 0.0093$.

最大效率 $\eta_{max} = \frac{I_2^* \cos\varphi_2}{I_2^* \cos\varphi_2 + 2P_0^*} \times 100\% = \frac{0.762 \times 0.8}{0.762 \times 0.8 + 2 \times 0.0054} \times 100\% = 98.26\%$

额定效率 $I_2^* = 1$ $\eta_N = \frac{I_2^* \cos\varphi_2}{I_2^* \cos\varphi_2 + P_0^* + I_2^{*2} P_{kN}^*} \times 100\% = \frac{1 \times 0.8}{1 \times 0.8 + 0.0054 + 1^2 \times 0.0093} \times 100\% = 98.20\%$

选择题

1. A   2. A   4. B   5. C F

判断题

2. ✗   4. ✗   5. ✓