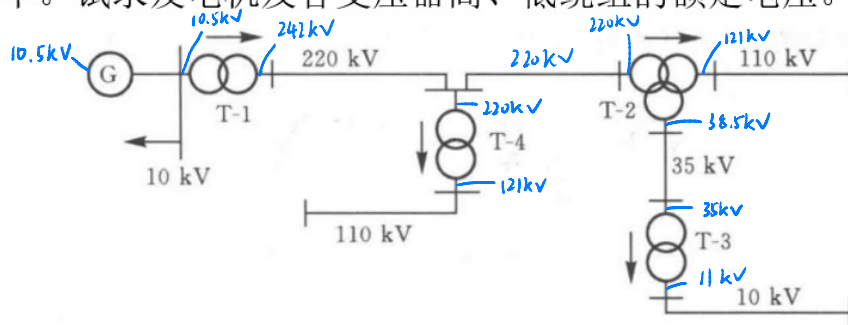
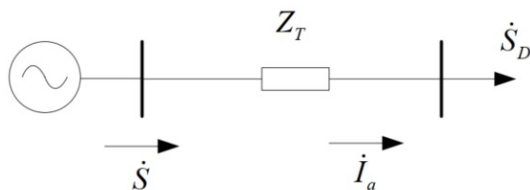


# 电力系统分析 - 作业1

1. 电力系统的部分接线如下图所示，各电压级的额定电压及功率传输方向已标明在图中。试求发电机及各变压器高、低绕组的额定电压。



2. 设如图所代表的三相对称交流电路，电源经由阻抗  $Z_T = 2 + j20 \Omega$  向某负载供电，输送电流  $\dot{I}_a = 20 \angle -15^\circ \text{ A}$ 。负载的复功率为  $\dot{S}_D = 10 - j6 \text{ kVA}$ （容性）。求：
- （1）电源送出的有功功率及无功功率？其无功功率是感性还是容性的？
  - （2）电源的线电压  $\dot{U}_{ab}$  向量。



$$\begin{aligned}
 (1) \quad \dot{S} &= \dot{S}_D + \dot{S}_2 \\
 &= \dot{S}_D + 3I_a^2 Z_T \\
 &= (10 - j6) + \{3 \times 20^2 \times (2 + j20)\} \times 10^{-3} \\
 &= 12.4 + j18 \text{ kVA}
 \end{aligned}$$

有功功率  $P = 12.4 \text{ kW}$

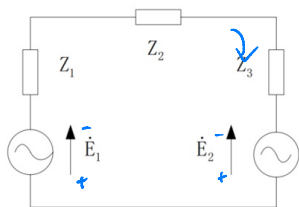
无功功率  $Q = 18 \text{ kvar}$ ，为感性负荷

$$\begin{aligned}
 (2) \quad \dot{S} &= \sqrt{3} \dot{U}_L \dot{I}_a^* e^{j30^\circ} \\
 \dot{U}_L &= \frac{\dot{S}}{\sqrt{3} \dot{I}_a^* e^{j30^\circ}} \\
 \dot{U}_L &= \frac{12.4 + j18}{\sqrt{3} \times 20 \angle 15^\circ} e^{j30^\circ} \\
 \dot{U}_L &= 0.6310 \angle 70.44^\circ \text{ kV}
 \end{aligned}$$

3. 如图单相电路,  $\dot{E}_1 = 220\angle 0^\circ \text{ V}$ ,  $\dot{E}_2 = 220\angle -60^\circ \text{ V}$ ,  $Z_1 = 1 - j3\Omega$ ,  $Z_2 = 2 + j4\Omega$ ,

$Z_3 = 3 + j7\Omega$ , 用复功率的概念求:

- (1) 各阻抗消耗的功率  $P$  及  $Q$ 。
- (2) 各个电源发出的功率  $P_1, Q_1, P_2, Q_2$ 。
- (3) 分别求出负荷消耗的总功率  $P_L, Q_L$  和电源发出的总功率  $P_S, Q_S$ , 并用  $\sum P = 0, \sum Q = 0$  检验结果。



$$(1) \quad \dot{I} = \frac{\dot{E}_1 - \dot{E}_2}{Z_1 + Z_2 + Z_3} = \frac{220\angle 0^\circ - 220\angle -60^\circ}{(1-j3) + (2+j4) + (3+j7)} = 22\angle 6.86^\circ$$

$$\dot{S}_1 = \dot{I}^2 Z_1 = 22^2 \times (1-j3) = 324 - j972 \text{ VA} \Rightarrow P_1 = 484 \text{ W}, Q_1 = -1452 \text{ Var}$$

$$\dot{S}_2 = \dot{I}^2 Z_2 = 22^2 \times (2+j4) = 648 + j1296 \text{ VA} \Rightarrow P_2 = 968 \text{ W}, Q_2 = 1936 \text{ Var}$$

$$\dot{S}_3 = \dot{I}^2 Z_3 = 22^2 \times (3+j7) = 972 + j2268 \text{ VA} \Rightarrow P_3 = 1452 \text{ W}, Q_3 = 3388 \text{ Var}$$

$$(2) \quad \dot{S}_{s1} = \dot{E}_1 \dot{I}^* = 220\angle 0^\circ \times 22\angle -6.86^\circ = 4805 - j578 \text{ VA} \Rightarrow P_{s1} = 4805 \text{ W}, Q_{s1} = -578 \text{ Var}$$

$$\dot{S}_{s2} = -\dot{E}_2 \dot{I}^* = -220\angle -60^\circ \times 22\angle -6.86^\circ = -1902 + j4450 \text{ VA} \Rightarrow P_{s2} = -1902 \text{ W}, Q_{s2} = 4450 \text{ Var}$$

$$(3) \quad \begin{array}{l|l} P_L = P_1 + P_2 + P_3 = 484 + 968 + 1452 = 2904 \text{ W} & P_S = 4805 - 1902 = 2903 \text{ W} \\ Q_L = Q_1 + Q_2 + Q_3 = -1452 + 1936 + 3388 = 3872 \text{ Var} & Q_S = -578 + 4450 = 3872 \text{ Var} \end{array}$$

可认为  $P_L = P_S, Q_L = Q_S$ , 即  $\sum P = 0, \sum Q = 0$