

16-1 (1) 转子转速和定子旋转磁场的转速相等，电机称为同步电机。

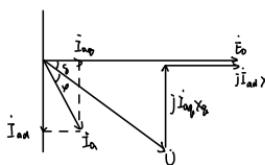
(2) 转速 n_s 与极数关系为 $n_s = \frac{60f}{p}$

$$\text{已知 } n_s = 750 \text{ r/min}, f = 50 \text{ Hz} \quad \text{求极对数 } p = \frac{60f}{n_s} = 40 \quad \text{相数 } 2p = 80$$

17-7 不可以，因为 X_{ad} 对应电机电流轴分量与交轴电流的关系，而 X_{ad} 对应电机电流直轴分量与直轴电动势的关系，分别对应电机电流在气隙最小和最大位置的电动势，作用效果可以叠加，但本身不可叠加。

$$17-18 \text{ 空载运行时, } U^* = 1, I_a^* = 1 \text{ 由内阻率因数角 } \psi_0 = \arctan \frac{U^* \sin \rho_N + I_a^* X_d^*}{U^* \cos \rho_N} = 55.27^\circ$$

$$\text{功率角 } \delta = \psi_0 - \rho_N = 55.27^\circ - 36.87^\circ = 18.40^\circ$$



由相量图得

$$\begin{aligned} I_0^* &= U^* \cos \delta + I_a^* \sin \psi_0 X_d^* \\ &= \cos 18.40^\circ + \sin 55.27^\circ \times 1.0 \\ &= 1.17 \end{aligned}$$

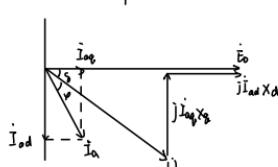
$$18-9 (1) U_{PN} = \frac{U_N}{\sqrt{3}} = \frac{11}{\sqrt{3}} \text{ kV} = 6.35 \text{ kV} \quad I_{PN} = I_N = \frac{S_N}{\sqrt{3} U_N} = \frac{8250}{\sqrt{3} \times 11} \text{ A} = 433.01 \text{ A}$$

$$\text{则 } Z_b = \frac{U_{PN}}{I_{PN}} = \frac{6.35}{433.01} \text{ kA} = 14.67 \text{ V}$$

$$\text{则 } X_d^* = \frac{x_d}{Z_b} = 1.16 \quad X_q^* = \frac{x_q}{Z_b} = 0.61$$

$$(2) \text{ 空载运行时, } U^* = 1, I_a^* = 1 \text{ 由内阻率因数角 } \psi_0 = \arctan \frac{U^* \sin \rho_N + I_a^* X_d^*}{U^* \cos \rho_N} = 56.57^\circ$$

$$\text{功率角 } \delta = \psi_0 - \rho_N = 56.57^\circ - 36.87^\circ = 19.66^\circ$$



由相量图得

$$\begin{aligned} I_0^* &= U^* \cos \delta + I_a^* \sin \psi_0 X_d^* \\ &= \cos 19.66^\circ + \sin 56.57^\circ \times 1.16 \\ &= 1.91 \end{aligned}$$

$$\text{则 } E_0 = I_0^* \cdot U_{PN} = 12.13 \text{ kV}$$

$$13) P_e^* = \frac{\bar{E}_d^* U^*}{X_d^*} \sin \delta + \frac{U^{*2} (X_d^* - X_q^*)}{2 X_d^* X_q^*} \sin 2\delta$$

$$\frac{dP_e^*}{d\delta} = \frac{\bar{E}_d^* U^*}{X_d^*} \cos \delta + \frac{U^{*2} (X_d^* - X_q^*)}{X_d^* X_q^*} \cos 2\delta = 0 \quad \text{解得} \quad \delta_{\max} = 69.28^\circ.$$

$$\begin{aligned} \text{对应最大功率 } P_{\max}^* &= \frac{\bar{E}_d^* U^*}{X_d^*} \sin \delta_{\max} + \frac{U^{*2} (X_d^* - X_q^*)}{2 X_d^* X_q^*} \sin 2\delta_{\max} \\ &= \frac{1.91 \times 1}{1.16} \sin 69.28^\circ + \frac{1 \times (1.16 - 0.61)}{2 \times 1.16 \times 0.61} \sin (2 \times 69.28^\circ) \\ &= 1.80 \end{aligned}$$

$$\text{则最大功率 } P_{\max}^* = S_N = 14850 \text{ kW}, \text{ 过载能力 } K = \frac{P_{\max}}{P_{eN}} = \frac{P_{\max}^*}{\cos \delta_{\max}} = 2.25$$

19-4 同步补偿机是通过发出或吸收电网的无功功率来调节电网电压的，可改善功率因数。

与同步电动机相比，在不考虑机械损耗情况下无电磁转矩，没有电动机机械功率的支援

二、选择题

2. C 5. B

四、计算题

2. 确定运行点。 $U^* = 1, I^* = 1$

$$E_d^* = \sqrt{(U^* \cos \varphi)^2 + (U^* \sin \varphi + I^* X_s^*)^2} = \sqrt{0.8^2 + (0.6 + 2.3)^2} = 2.84$$

$$14) \bar{E}_0 = E_d^* \cdot \frac{U_N}{\sqrt{3}} = 2.84 \times \frac{10.5}{\sqrt{3}} \text{ kV} = 17.22 \text{ kV}$$

$$15) \text{与 } \bar{E}_0 \text{ 的夹角 } \psi_0 = \arctan \frac{I^* X_s^* + U^* \sin \varphi}{U^* \cos \varphi} = 73.67^\circ$$