

16-1 1) 转子转速和定子旋转磁场的转速相等的电机称为同步电机。

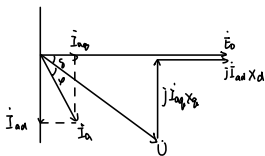
2) 转速 n_s 与极数关系为 $n_s = \frac{60f}{p}$

3) $n_s = 750 \text{ min}$, $f = 50 \text{ Hz}$. 则极数 $p = \frac{60f}{n_s} = 40$ 极数 $2p = 80$

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

17-18 额定运行时, $U^* = 1$, $I_a^* = 1$ 则内功率因数角 $\psi_0 = \arctan \frac{U^* \sin \varphi_N + I_a^* X_d^*}{U^* \cos \varphi_N} = 55.2^\circ$

功率角 $\delta = \psi_0 - \varphi_N = 55.2^\circ - 36.8^\circ = 18.4^\circ$



由相量图得

$$\begin{aligned} Z_0^* &= U^* \cos \delta + I_a^* \sin \psi_0 X_d^* \\ &= \cos 18.4^\circ + \sin 55.2^\circ \times 1.0 \\ &= 1.17 \end{aligned}$$

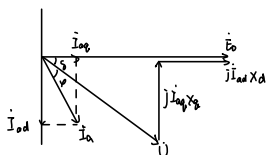
18-9 1) $U_{PN} = \frac{U_N}{\sqrt{3}} = \frac{11}{\sqrt{3}} \text{ kV} = 6.35 \text{ kV}$ $I_{PN} = I_N = \frac{S_N}{\sqrt{3} U_N} = \frac{8450}{\sqrt{3} \times 11} \text{ A} = 433.01 \text{ A}$

$$\text{则 } Z_0 = \frac{U_{PN}}{I_{PN}} = \frac{6.35}{433.01} \text{ k}\Omega = 14.6 \text{ V}$$

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

2) 额定运行时, $U^* = 1$, $I_a^* = 1$ 则内功率因数角 $\psi_0 = \arctan \frac{U^* \sin \varphi_N + I_a^* X_d^*}{U^* \cos \varphi_N} = 56.5^\circ$

功率角 $\delta = \psi_0 - \varphi_N = 56.5^\circ - 36.8^\circ = 19.66^\circ$



由相量图得

$$\begin{aligned} Z_0^* &= U^* \cos \delta + I_a^* \sin \psi_0 X_d^* \\ &= \cos 19.66^\circ + \sin 56.5^\circ \times 1.16 \\ &= 1.91 \end{aligned}$$

$$\text{则 } E_0 = Z_0^* U_{PN} = 12.13 \text{ kV}$$

$$\therefore P_e^* = \frac{E_0^* U^*}{X_d^*} \sin \delta + \frac{U^{*2} (X_d^* - X_q^*)}{2 X_d^* X_q^*} \sin 2\delta$$

$$\frac{dP_e^*}{d\delta} = \frac{E_0^* U^*}{X_d^*} \cos \delta + \frac{U^{*2} (X_d^* - X_q^*)}{X_d^* X_q^*} \cos 2\delta = 0 \quad \text{解得} \quad \delta_{\max} = 69.28^\circ$$

$$\begin{aligned} \text{对应最大功率} P_{\max}^* &= \frac{E_0^* U^*}{X_d^*} \sin \delta_{\max} + \frac{U^{*2} (X_d^* - X_q^*)}{2 X_d^* X_q^*} \sin 2\delta_{\max} \\ &= \frac{1.91 \times 1}{1.16} \sin 69.28^\circ + \frac{1 \times (1.16 - 0.61)}{2 \times 1.16 \times 0.61} \sin (2 \times 69.28^\circ) \\ &= 1.80 \end{aligned}$$

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

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,没有电功率和机械功率的交换

二. 选择题

2. C S. B

四. 计算题

2. 额定运行时, $U^* = 1, I^* = 1$

$$E_0^* = \sqrt{(U^* \cos \phi)^2 + (U^* \sin \phi + I^* X_s^*)^2} = \sqrt{0.8^2 + (0.6 + 2.15)^2} = 2.84$$

$$\text{例 } E_0 = E_0^* \cdot \frac{U_N}{\sqrt{3}} = 2.84 \times \frac{10.5}{\sqrt{3}} \text{ kV} = 17.22 \text{ kV}$$

$$E_0 \text{ 与 } I \text{ 夹角 } \psi_0 = \arctan \frac{I^* X_s^* + U^* \sin \phi}{U^* \cos \phi} = 73.67^\circ$$