



# SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore - 641 107

AN AUTONOMOUS INSTITUTION



Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POWER SYSTEM ANALYSIS

UNIT - II

Permanent Magnet Synchronous Motor

② 3  $\phi$ , 400 V, 50 Hz, 4 pole star connected synchronous reluctance motor has  $X_d = 8 \Omega$  and  $X_q = 2 \Omega$  and load torque  $T_L = 80 \text{ Nm}$ . Calculate i) load angle which is torque angle ii) armature current iii) Input power factor

Soln

$$V_L = 400 \text{ V}$$

$$V_p = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}}$$

$$= 230.94 \text{ V}$$

$$X_d = 8 \Omega$$

$$X_q = 2 \Omega$$

$$w_s = \frac{2w}{p} = \frac{491.6}{p} = \frac{400 \times 80}{p}$$

angular velocity  $w_s = 157.07 \text{ rad/sec}$

$$T_L = \frac{3}{2} \times \frac{V_A^2}{w_s} \times \left( \frac{x_d - x_q}{x_d x_q} \sin 2\delta \right)$$

$$80 = \frac{-3}{2} \times \frac{(200.94)^2}{157.07} \times \left( \frac{8-2}{16} \sin 2\delta \right)$$

$$80 = -572.99 \sin 2\delta \Rightarrow \sin 2\delta = -0.1398$$

$$\sin 2\delta = -0.1398$$

$$2\delta = \sin^{-1}(-0.1398)$$

$$2\delta = -7.46^\circ$$

$$\delta = -3.73^\circ$$

$$ii) I_a = \sqrt{I_d^2 + I_q^2}$$

$$I_d = \frac{V \cos \delta}{X_d}$$

$$I_q = \frac{V \sin \delta}{X_q}$$

$$I_d = \frac{400 \cos(-3.73)}{8}$$

$$I_d = 49.89 \text{ A}$$

$$I_q = \frac{400 \sin(-3.73)}{2}$$

$$I_q = -13.01 \text{ A}$$

$$I_a = \sqrt{(49.89)^2 + (-13.01)^2}$$

$$I_a = 51.55 \text{ A.}$$

$$\text{iii) } P = \sqrt{3} VI \cos \phi.$$

$$P_L \times W_S = \sqrt{3} VI \cos \phi.$$

$$\cos \phi = \frac{P_L \times W_S}{\sqrt{3} VI}$$

$$= \frac{80 \times 157.07}{\sqrt{3} \times 400 \times 51.55}$$

$$\cos \phi = 0.35.$$



Activate  
Go to Sett

