

Required Homework 8

Saliency Pole Synchronous Machines

A synchronous machine has

$$r_s = \text{negligible} \quad X_{ds} = 0.75 \quad X_{qs} = 0.5 \quad \text{at } \omega_e = 1.0$$

a) Find E and δ at the rated power point ($P_{\text{out}} = 1.0$, $V = 1.0$ and $\omega_e = 1.0$) if it is known that the input power factor is 0.85 lagging at this point. Also, find E assuming no saliency ($X_{qs}=0.75$).

$$I = \text{_____ pu}$$

$$E_{\text{sal}} = \text{_____ pu} \quad \delta = \text{_____}^\circ$$

$$E_{\text{non}} = \text{_____ pu} \quad \delta = \text{_____}^\circ$$

b) Find the maximum torque for constant V and E for the two cases above (salient and non-salient).

$$T_{\text{msal}} = \text{_____ pu}$$

$$T_{\text{mnon}} = \text{_____ pu}$$

c) For the salient pole case, find the maximum torque available operating as a reluctance motor ($E = 0$) with V and $\omega_e = 1.0$ and the current and power factor at this operating point. Repeat if $X_{qs} = 0.1$ pu.

$$X_{qs} = 0.5$$

$$X_{qs} = 0.1$$

$$T_{\text{max}} = \text{_____ pu} \quad T_{\text{max}} = \text{_____ pu}$$

$$I = \text{_____ pu} \quad I = \text{_____ pu}$$

$$\text{Cos } \theta = \text{_____} \quad \text{Cos } \theta = \text{_____}$$

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d) With V and I limited to 1.0, find the maximum torque available (this is one point on the capability curve) and the corresponding power factor at $\omega_e = 1.5$ operating as a reluctance motor (with $X_{qs} = 0.5$). The problem can be solved without iteration.

$$T_{\max} = \underline{\hspace{2cm}} \text{ pu}$$

$$\cos \theta = \underline{\hspace{2cm}}$$