EE 330/330L Energy Systems (Spring 2012) Quiz #6

Name Key A

Instructions: Open book & notes. Place answers in indicated spaces & show all work for credit.

A six pole DC generator has a triplex lap-wound armature with 36 coils and 12 turns per coil. At 1200 RPM, it is rated for 12 kW at 60 V. At the rated load, determine the output current I_L, current per conductor I_{cond}, and induced torque τ_{ind}. Under no-load (i.e., open circuit) conditions, find the required magnetic flux ϕ needed to achieve the rated output voltage. Assume losses are negligible.

$P_{rated} = P_{out} = V_T I_L \Rightarrow I_L = \frac{12\times10^3}{60} = \underline{200\,A}$

per (7-26) # current paths $\equiv a = m\,p = \overset{\downarrow \text{Triplex}}{3}(6) = 18$

per (7-44) $I_{cond} = \frac{I_A}{a} = \frac{200}{18} = \underline{11.\overline{11}\,A}$

Neglecting losses $P_{conv} = P_{out} = T_{ind}\,\omega_m$

$T_{ind} = \frac{12\times10^3}{1200(\pi/30)} = \underline{95.493\,N\cdot m}$

per (7-37) $E_A = V_T = \frac{Z\,p}{2\pi a}\,\phi\,\omega_m$ (No-load)

where, per (7-22), $Z = 2C N_c = 2(36)12 = 864$ (# coils ↓, # turns ↑)

$\phi = \frac{V_T(2\pi a)}{Z\,p\,\omega_m} = \frac{60(2\pi\,18)}{864(6)1200(\pi/30)}$

$= 10.4\overline{16}\,mWb = 0.010416\overline{6}\,Wb$

$I_L =$ 200 A $\quad I_{cond} =$ 11.11 A $\quad \tau_{ind} =$ 95.493 N·m $\quad \phi =$ 10.416 mWb