

Exam II close & book, closed notes, 55 min, 19 APR 91

Problem #1
30 points

Given the following tests of a 3 ϕ , 60 Hz
6 pole synchronous machine running at
1200 RPM

$$I_f = 2 \text{ A} \quad |V_{as}| = 120 \text{ V} \quad |\bar{I}_{as}| = 0$$

$$I_f = 1 \text{ A} \quad |V_{as}| = 0 \text{ V} \quad |\bar{I}_{as}| = 5 \text{ A}$$

The machine has zero stator resistance and
zero leakage inductance.

Find: (a) The field current needed to make the
power factor at the terminals unity
when it is running as a generator
with $|V_{as}| = 120 \text{ V}$, $|\bar{I}_{as}| = 5 \text{ A}$

(b) The turns ratio N_f/N_s

Problem #2
35 points

A synchronous machine dynamic model is:

$$\left. \begin{aligned} \frac{d\delta}{dt} &= \omega_t & \delta(0) &= \pi/6 \\ \frac{d\omega_t}{dt} &= 5 - k_2 \sin \delta & \omega_t(0) &= 0 \end{aligned} \right\} \begin{aligned} k_2 &= 10 \text{ for} \\ t &\leq 0 \end{aligned}$$

Use this model to derive a test to see if k_2
can be suddenly reduced to 6. Use the test
to see if it can be done.

(OVER)

Problem #3

35 points

A 2 pole, 3 ϕ , 60 Hz machine has the following parameters:

$$R_s = 0 \Omega, X_s = 10 \Omega, K_f = 0.23 \text{ H}$$

It has an armature current rating of 20 A.

If the machine is connected to an infinite bus with voltage 120 ∠0 (l-n) and is supplying 2000 Watts (3 ϕ) to the bus, plot the "V" curve for constant 2000 watts power. Compute 3 points on the "V" curve exactly for the following three special conditions:

1. minimum field current
2. minimum armature current
3. Rated armature current