

Exam IIFriday, May 1, 1998

Closed book, no sheet, 55 minutes (2 "formulas" given)
P & Q

Problem #1
25 Points

A 3 ϕ , 6 pole, 60 Hz Synchronous generator has an open-circuit voltage of 120V (l-n) with 3.0 Amps of field current. If this generator is synchronized to a 120V (l-n), 60 Hz source and the field current is reduced to 1.0 Amp, the line current is 5 Amps at no load ($P=0$). At this field current, what is the maximum possible load (3 ϕ Watts) that this generator can deliver to the source?

Problem #2
25 Points

A 3 ϕ , 4 pole, 120V (l-n), 60 Hz Synchronous motor is suddenly loaded from zero to 2500 Watts (3 ϕ) and the torque angle was observed to change by 15° mechanical. It has a synchronous reactance of 12Ω .

(a) How many vars (3 ϕ) will it consume when it reaches this steady-state equilibrium?

(b) Is it overexcited or underexcited?

Problem #3 25 Points

A self-excited shunt DC generator has a residual voltage of 8 volts at 1100 RPM, with a total shunt field resistance of $100\ \Omega$, it has an open-circuit terminal voltage of 220V at 1100 RPM. (Neglect R_a)

- (a) Approximately what value of total shunt field resistance should be used to maintain an open-circuit terminal voltage of 220V at 800 RPM?
- (b) At 220V, 800 RPM, how much torque does it take from the prime mover to serve a 10 Amp load?

Problem #4 25 Points

An unloaded, 230V shunt (self excited) DC motor turns at 1150 RPM and draws 1.5A terminal current. It draws 5A terminal current at full load. The armature resistance is $4\ \Omega$. (Neglect r_f)

- (a) Find the full-load speed in RPM
- (b) How much resistance should be added to the field to bring the no-load speed to 1300 RPM?