

Third and Final Exam

SPRING 1990

Closed book, closed notes, one hour

Problem #1

25 POINTS

A balanced 3 ϕ source with $V_{LL} = 480V$ serves a balanced 3 ϕ , 3 wire load of 4500 voltamps at 0.8 power factor lag.

- (a) What is the source line current?
- (b) What value of capacitance should be added in a delta across the load to minimize the source line current? (use 60 Hz)
- (c) What is the source line current after the installation of the capacitors of part (b)?

Problem #2

25 POINTS

A balanced symmetrical 3 ϕ , 60 Hz, 6 pole 230VLL induction motor has negligible stator resistance, negligible stator and rotor leakage reactance. The magnetizing reactance referred to the stator is $60 \Omega/\text{phase}$. (assume Y connection) The rotor resistance referred to the stator is $2 \Omega/\text{phase}$. What is the magnitude of the line current if it delivers a load torque of 23 NM?

Problem #3
25 POINTS

A cumulative compound long shunt dc generator has the internal voltage given below:

$$V_a = .05\omega + 1.25\omega I_{sh} + .01\omega I_a$$

The 50Ω shunt field has a rheostat R in series. The series and armature coils each have a resistance of 1Ω . Find the value of R necessary to make the terminal voltage $120V$ when the terminal current is 10 amps and $\omega = 100$ rad/sec

Problem #4
25 POINTS

Suppose the series coil of problem #3 is removed and the internal voltage characteristic at 1200 RPM is found to be:

$$V_a = \begin{cases} 10 + 115 I_{sh} & 0 \leq I_{sh} \leq 2 A \\ 240 + 80(I_{sh} - 2) & I_{sh} \geq 2 A \end{cases}$$

If the machine is run as a motor with $V_t = 240V$,

- (a) Find R such that $RPM = 1000$ when $I_a = 0$
 (b) Find RPM if $I_t = 10A$ using R from (a)