

FINAL EXAM

SPRING 1991

1. Closed book, official class formula sheet provided
2. Work all problems in exam book - 3 hours

Problem #1
25 PTS

A balanced, symmetrical, 3ϕ , 6 pole, 60 Hz, 230V (l-l), 2 h.p. induction motor has a full voltage starting current of 20 Amps and a full load speed of 1180 RPM

Estimate the starting torque. (1 h.p. = 746 watts)

Problem #2
25 PTS

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

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

$$I_f = 1 \text{ A} \quad |V_{as}| = 0 \text{ V} \quad |\bar{I}_{as}| = 6 \text{ A}$$

Find the field current needed to make the power factor at the terminals unity when it is running as a generator with $|V_{as}| = 120 \text{ V}$ and $|\bar{I}_{as}| = 6 \text{ A}$

Problem #3
25 PTS

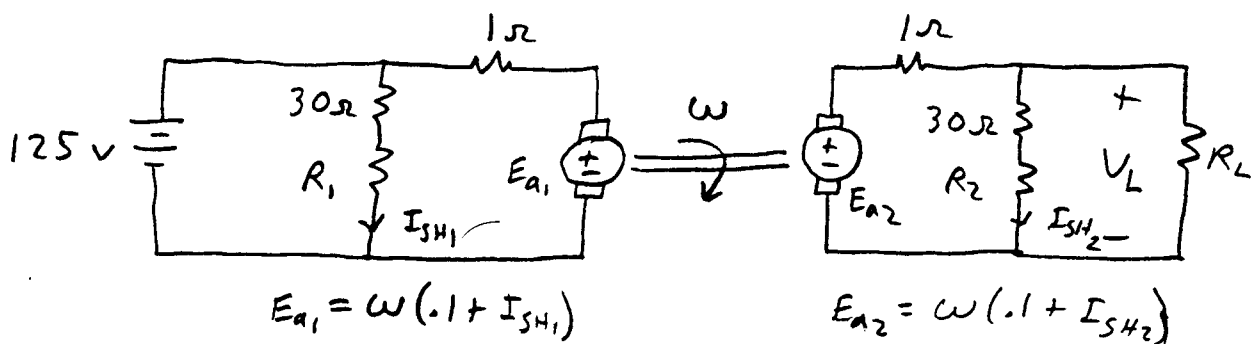
The magnetization curve of a self excited shunt DC generator is approximated at 1160 RPM as,

$$E_a \approx \left(12 + \frac{500 I_{SH}}{3 + I_{SH}} \right)$$

If the machine has $r_a = 1 \Omega$, $r_{SH} = 50 \Omega$, what value of shunt field rheostat should be used to obtain an open circuit voltage of 120 V when it is run at 1200 RPM?

Problem #4
30 PTS

Given the following motor/generator set of DC machines,



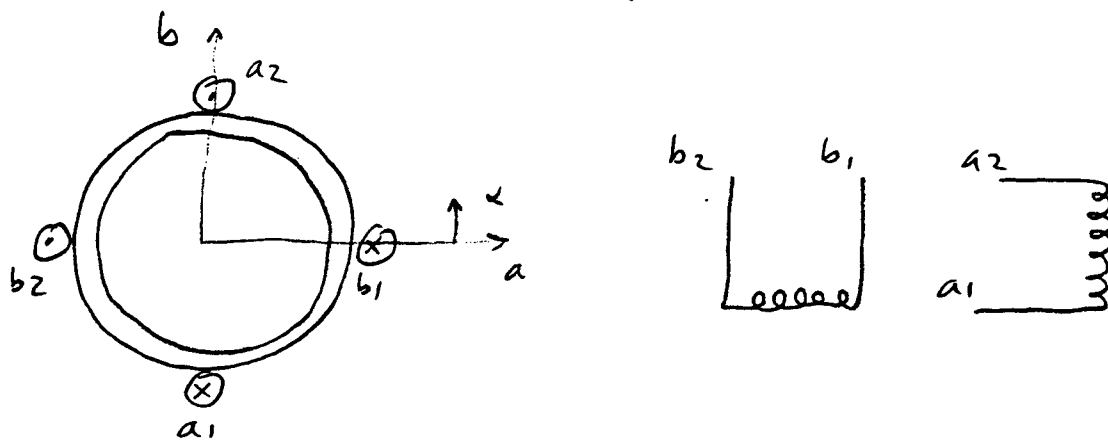
Find R_1 and R_2 so that $\omega = 100 \text{ r/s}$ and $V_L = 120 \text{ V}$ when $R_L = 10 \Omega$

Problem #5
25 PTS

Derive an expression for the T vs Speed Characteristic of a 120 volt Series DC motor with $r_a = r_{se} = 1 \Omega$ and $k_f^{SE} = .01$ Henrys

Problem #6
30 PTS

A machine has the following Stator configuration (coils have sinusoidal spatial distribution)



Only one voltage source is available ($V \cos \omega_s t$)

Explain how it may be possible to produce a revolving magnetic field using only the single voltage source plus circuit elements (R, L, C).

Give the basic equations needed to justify your explanation.