HACETTEPE UNIVERSITY
Department of Electrical and Electronics Engineering

ELE 361 ELECTRICAL MACHINES I **Fall 2014**

HOMEWORK 4 (Section21)
HOMEWORK 5 (Section22)

Due Date: *02.01.2015*, Friday. Turn it in to teaching assistant Serkan Özturk.

1. A 10-hp, 120-V, 1000 rpm, shunt dc motor has a rated armature current of 70 A. The armature resistance of the motor is R_A= 0.12 Ω, and the field resistance is R_F= 40 Ω. The adjustable resistance in series with the field circuit (R_{adj}) may be varied over a range from 0 Ω to 200 Ω, and it is currently set to 100 Ω. Armature reaction is ignored in this problem. The magnetization curve for his motor, taken at a speed of 1000 rpm, is presented in the below table and figure:

E_A, V	*5*	*78*	*95*	*112*	*118*	126
I_F, A	*0.00*	*0.80*	*1.00*	*1.28*	*1.44*	*2.88*

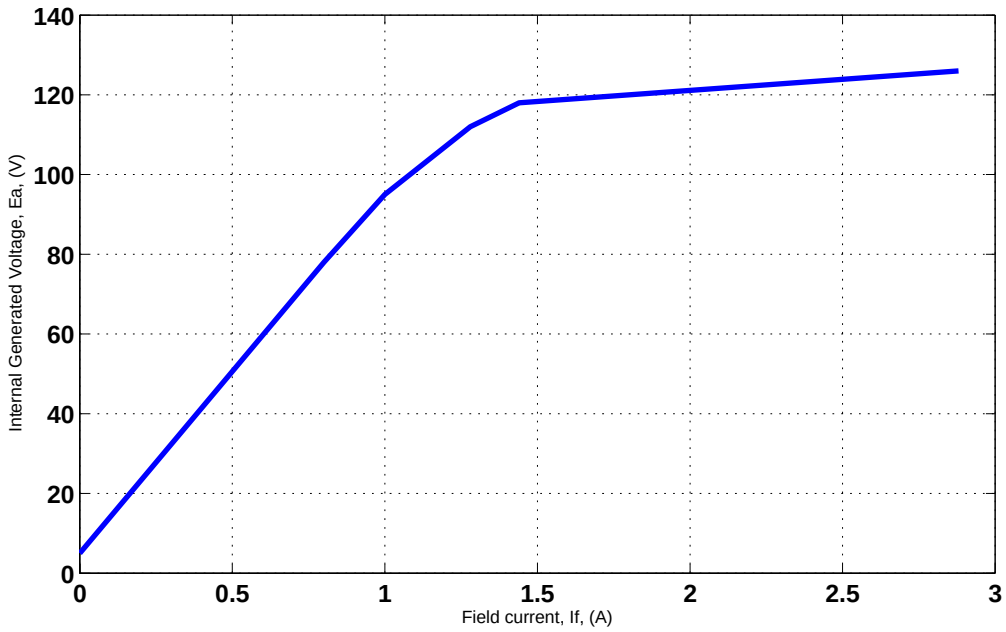

Fig. 1. Magnetization characteristic of the dc machine at 1000 rpm

a) What is the speed of this motor when it is running at the rated conditions specified above?
b) The output power from the motor is 10-hp at the rated conditions. What is net the output (load) torque of this motor?
c) What are the copper losses (P_{Cu}) and rotational losses (P_{rot}) in the motor at full-load?

d) What is the efficiency of the motor at full-load?
e) If the motor looses its load, i.e. becomes unloaded, what is the no-load speed of the motor (Terminal voltage and total field resistance do not change)?
f) Suppose that the motor is running at the no-load conditions described in part (e). What would happen to the motor if its field circuit were to open? Ignoring armature reaction, what would the final steady-state speed of the motor be under those conditions?

2. A DC machine with a shunt field winding is operated as a self-excited dc generator at a constant shaft speed of 1200 rpm. The magnetization characteristic of the machine, obtained by exciting the shunt field winding separately by a dc source and keeping the shaft speed constant at 1200 rpm, is approximated by two straight lines as given below:

$$E_a \cong 10 \text{ V} \qquad \text{for } I_f = 0$$
$$E_a \cong 250 I_f \qquad \text{for } 0 < I_f \leq 0.8 \text{ A}$$
$$E_a \cong 125 I_f + 100 \qquad \text{for } I_f > 0.8 \text{ A}$$

Armature winding resistance R_a and total field winding resistance R_f are measured as 1 Ω and 165.3 Ω, respectively.

a) Calculate the no-load terminal voltage of the generator.
b) The self-excited dc generator above is now loaded, and supplies a constant load current of I_L = 50 A. Calculate the induced armature emf E_a, field current I_f, armature current I_a and terminal voltage V_t.