Assignment -2

Problem 1

The magnetization curve for a separately excited dc generator is shown in Figure 1. The generator is rated at 6 kW, 120 V, 50 A, and 1800 r/min and is shown in Figure 2. Its field circuit is rated at 5A. The following data are known about the machine:

$R_A = 0.18\ \Omega$ $\quad V_F = 120\ \text{V}$

$R_{\text{adj}} = 0 \text{ to } 30\ \Omega$ $\quad R_F = 24\ \Omega$

$N_F = 1000$ turns per pole

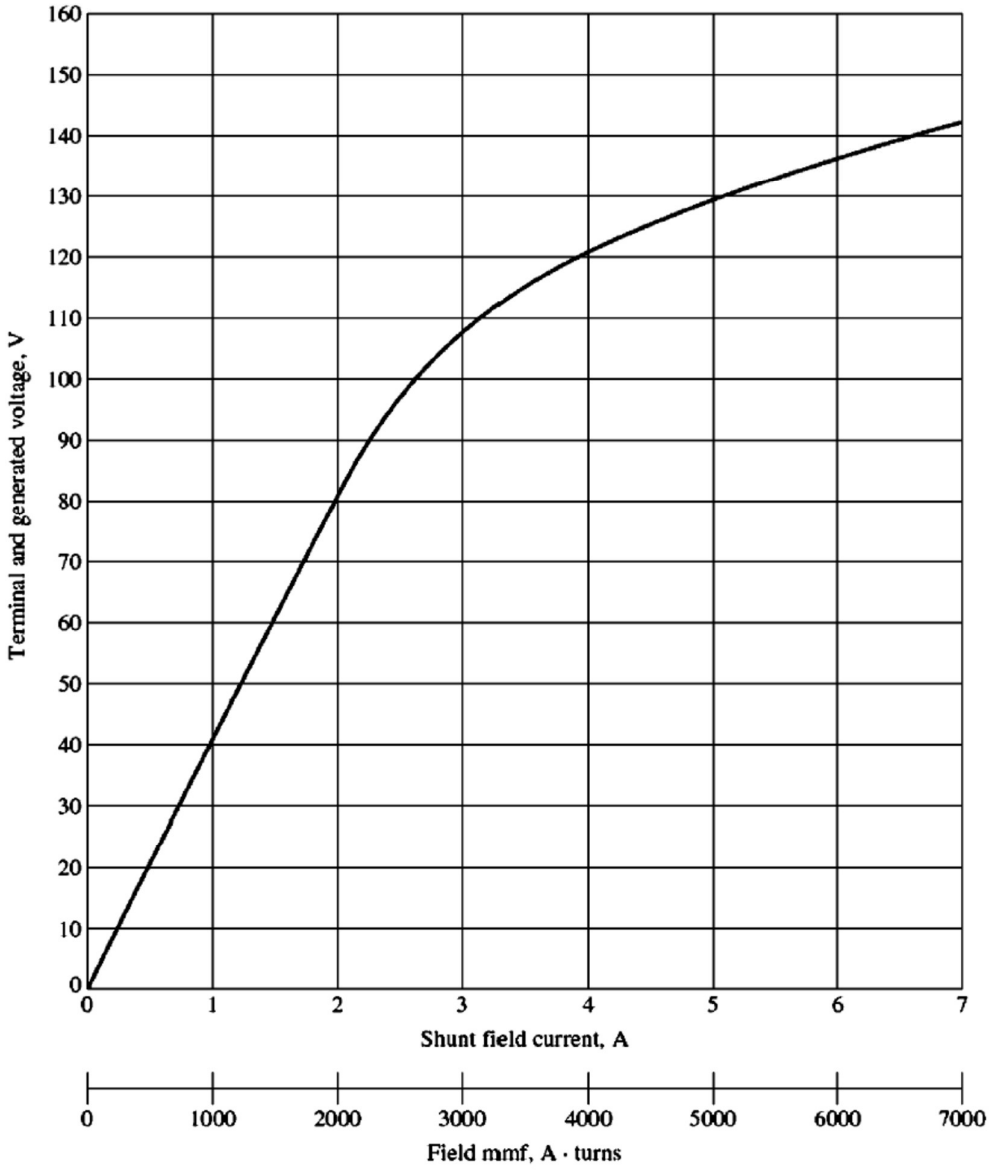

Figure 1

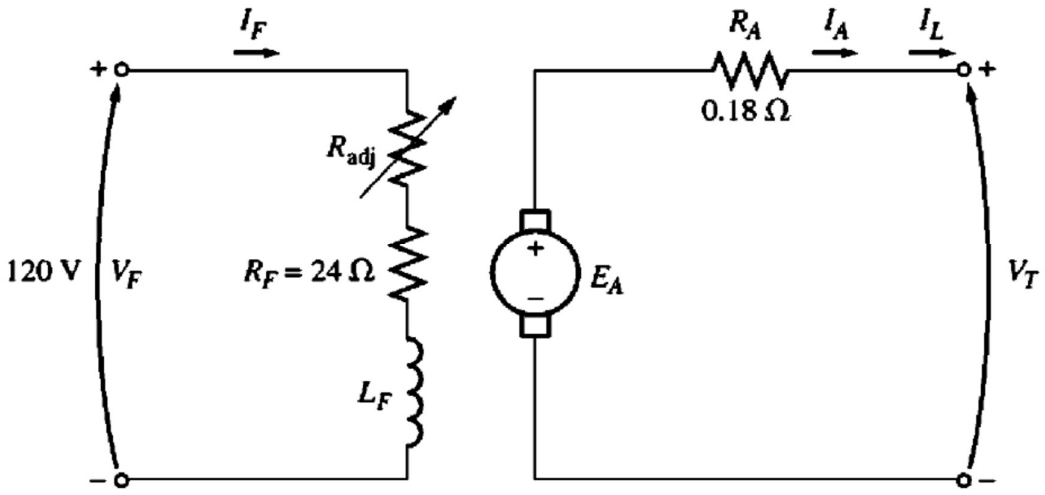

Figure 2

Answer the following questions about this generator, assuming no armature reaction.

(a) If this generator is operating at no load, what is the range of voltage adjustments that can be achieved by changing R_{adj}?

(b) If the field rheostat is allowed to vary from 0 to 30 Ω and the generator's speed is allowed to vary from 1500 to 2000 r/min. what are the maximum and minimum no-load voltages in the generator?

Problem 2

If the armature current of the generator in Problem 1 is 50 A, the speed of the generator is 1700 r/min, and the terminal voltage is 106 V, how much field current must be flowing in the generator?

Problem 3

Assuming that the generator in Problem 1 has an armature reaction at full load equivalent to 400 A-turns of magnetomotive force, what will the terminal voltage of the generator be when $I_F = 5$ A, $n_m = 1700$ r/min, and $I_A = 50$ A?

Problem 4

A DC shunt motor shown in Figure 3 is having the following parameters:

$P_{rated} = 15$ hp
$V_T = 240$ V
$n_{rated} = 1200$ r/min
$R_A = 0.40\ \Omega$
$R_S = 0.04\ \Omega$
$I_{L,rated} = 55$ A
$N_F = 2700$ turns per pole
$N_{SE} = 27$ turns per pole
$R_F = 100\ \Omega$
$R_{adj} = 100$ to $400\ \Omega$

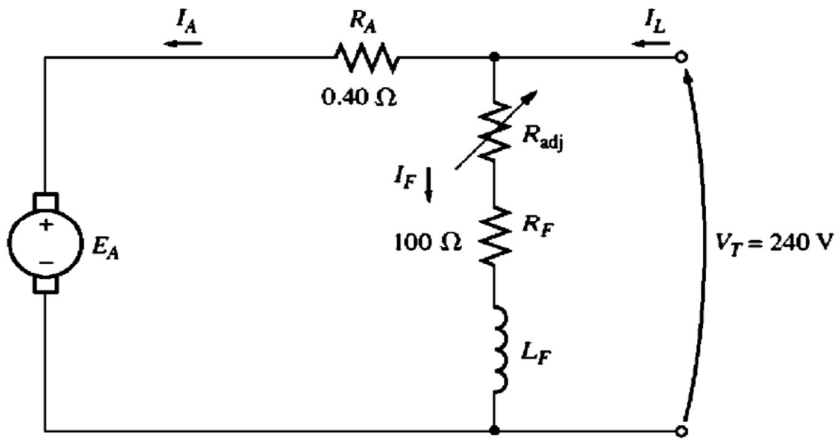

Figure 3

Rotational losses are 1800 W at full load. Magnetization curve is as shown in Figure 4.

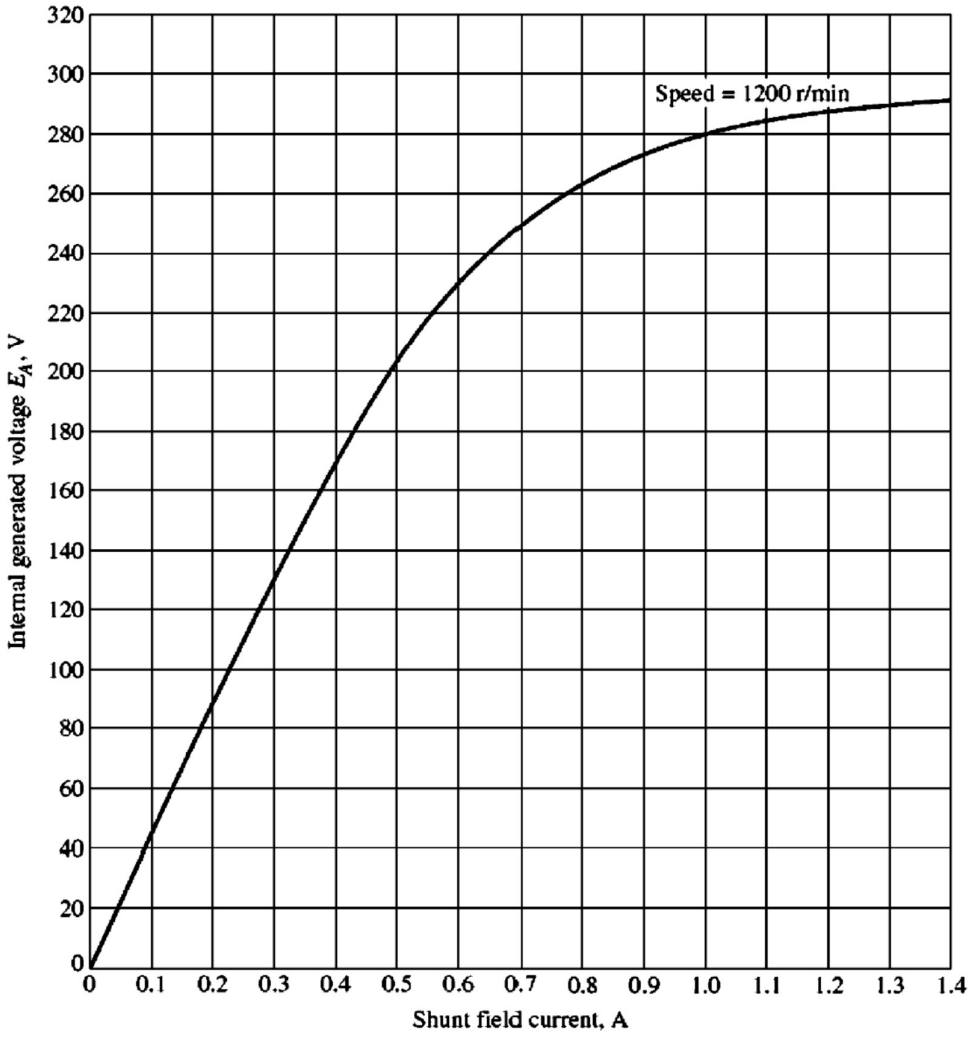

Figure 4

If the resistor R_{adj} is adjusted to 175 Ω, what is the rotational speed of the motor at no-load conditions?

Problem 5
In the above question, assuming no armature reaction, what is the speed of the motor at full load?

Problem 6
In Q 4, if the motor is operating at full load and if its variable resistance R_{adj} is increased to 250 Ω, what is the new speed of the motor? Compare the full-load speed of the motor with R_{adj} = 175 Ω to the full-load speed with R_{adj} = 250 Ω. (Assume no armature reaction, as in the previous problem).

Problem 7
In Q 4, assume that the motor is operating at full load and that the variable resistor R_{adj} is again 175 Ω. If the armature reaction is 1200 A-turns at full load, what is the speed of the motor? How does it compare to the result for Problem 5?

Problem 8
If R_{adj} can be adjusted from 100 to 400 Ω, in Q.4, what are the maximum and minimum no load speeds possible with this motor?