Information Technology University, Lahore

Electrical Machines

BSEE-19 Fall 2021

Assignment No. 4

Issue Date: Tuesday Jan. 18, 2022

Due Date: Saturday Jan. 29, 2022 (Upload on Google classroom before 5:00 pm)

CLO1: Understand fundamental theories and laws on magnetics & magnetically coupled circuits.

CLO2: Understand the operation of Transformers, synchronous machines, induction motors and DC machines.

CLO3: Perform the equivalent circuit Analysis of transformers, AC Machines and DC machines.

Carefully Read Instructions

1. Please review the University Plagiarism Policy.
2. Late submission will not be accepted.
3. Assignment should be upload as pdf file.
4. The name of file should be your Roll Number as BSEEXXXX.
5. Handwriting must be very neat and legible. You may lose points otherwise.
6. Please submit your own work only.
7. Please show all steps for full credit.

Question 1:

The magnetization curve for a separately excited dc generator is shown in Figure 1.1. The generator is rated at 6 kW, 120 V, 50 A, and 1800 r/min and is shown in Figure 1.2. Its field circuit is rated at SA. The following data are known about the machine:

$R_A = 0.18\ \Omega$ $V_F = 120\ \Omega$ $R_{adj} = 0$ to $40\ \Omega$

$R_F = 20\ \Omega$ $N_F = 1000$ turns per pole

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?

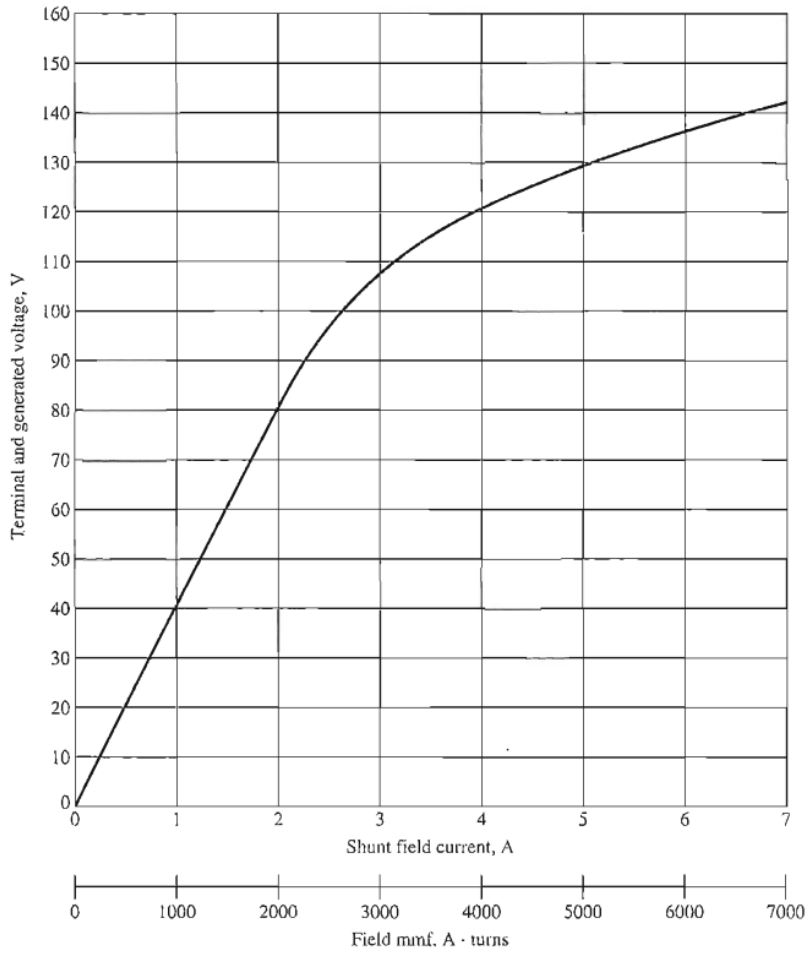

Figure 1.1 Magnetization curve for a separately excited dc generator.

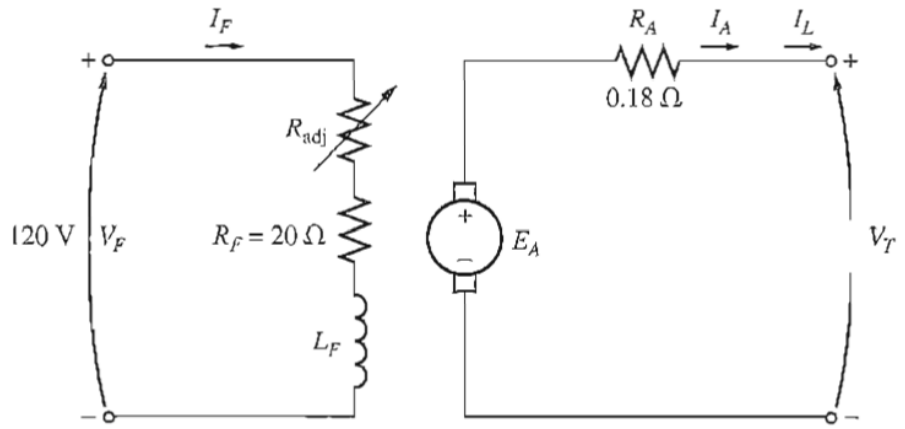

Figure 1.2

Question 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?

Question 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 be the terminal voltage of the generator, when I_F = 5 A, n_m = 1700 r/min, and I_A = 50 A?

Question 4

The machine in Problem 1 is reconnected as a shunt generator and is shown in Figure 1.3. The shunt field resistor R_{adj} is adjusted to 10 Ω and the generator's speed is 1800 r/min.

a) What is the no-load terminal voltage of the generator?
b) Assuming no armature reaction, what is the terminal voltage of the generator with an armature current of 20 A? 40 A?
c) Assuming an armature reaction equal to 300 A · turns at full load, what is the terminal voltage of the generator with an armature current of 20 A? 40 A?
d) Calculate and plot the terminal characteristics of this generator with and without armature reaction.

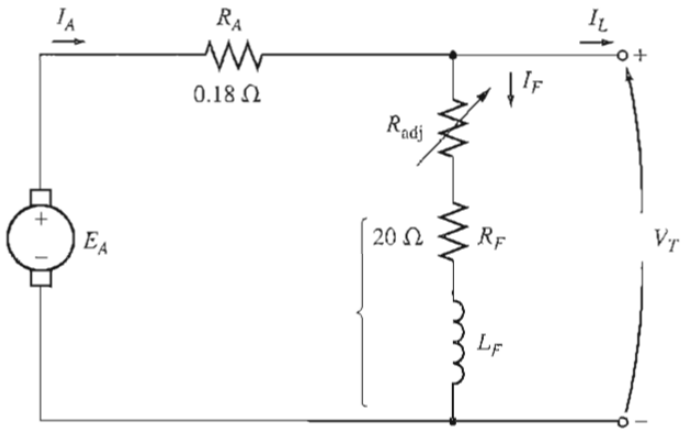

Figure 1.3

Question 5

If the machine in Problem 4 is running at 1800 r/min with a field resistance R_{adj} 10Ω and an armature current of 25 A, what will the resulting terminal voltage be? If the field resistor decreases to 5 Ω while the armature current remains 25 A, what will the new terminal voltage be? Assume no armature reaction.

Question 6

A 120-V, 50-A, cumulatively compounded dc generator has the following characteristics:

$R_A + R_S = 0.21\Omega$ $N_F = 1000$ turns $R_F = 20\ \Omega$

$R_{adj} = 0$ to 30 Ω, set to 10Ω $N_{SE} = 25$ turns $n_m = 1800$ r/min

The machine has the magnetization curve shown in Figure 1.1. Its equivalent circuit is shown in Figure 1.4.

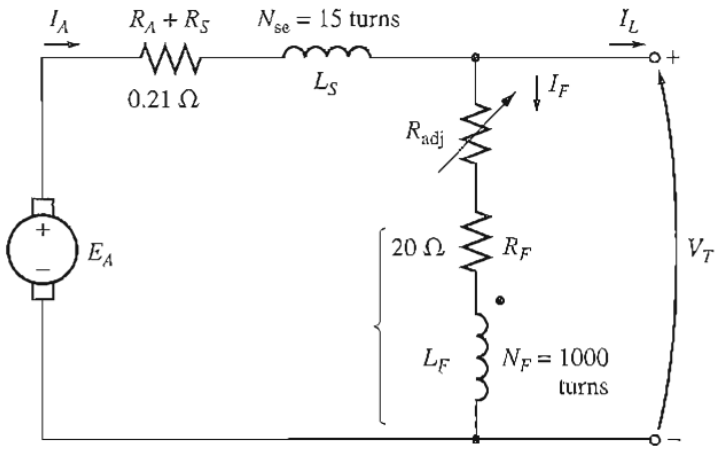

Figure 1.4

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

a) If the generator is operating at no load, what is its terminal voltage?
b) If the generator has an armature current of 20 A, what is its terminal voltage?
c) If the generator has an armature current of 40 A, what is its terminal voltage?
d) Calculate and plot the terminal characteristic of this machine.

Question 7

If the machine described in Problem 6 is reconnected as a differentially compounded dc generator, what will its terminal characteristic look like? Derive it in the same fashion as in Problem 6.