EE114 Power Engineering – 1

Assignment-5

Question 1. The magnetization characteristic of a DC shunt generator can be approximated as

$$E_b = 10 + 40I_f$$

The resistance of the armature circuit is 0.035Ω and that of the field winding is 42 Ω. The field winding is connected to a rheostat which can be adjusted to any value between 0 and 28 Ω. The machine is connected to run as a shunt generator.

a. Calculate the maximum and minimum values of the no-load terminal voltage that can be obtained by varying the rheostat.

b. The rheostat is adjusted to obtain a no-load terminal voltage of 200 V. Calculate the value of the terminal voltage when the load current is 100A. Assume If to remain same as at no-load condition

(Ans. a. V_{max}=206.38V, V_{min}=23.3V, b. Vt = 196.83V)

Rated Power Nominal Voltage Base Speed

Question 2. A 24kW, 250V, 1600 rpm, separately excited DC generator has an armature resistance of 0.1 Ω. The machine is first, run at rated base speed and the field current is adjusted to give an open circuit voltage of 260V. When the generator is loaded to deliver its rated current, the speed of the driving motor (prime mover) is found to be 1500 rpm. Assuming that the field current remains unaltered, compute the terminal voltage of the generator. (Ans. 234.15 V)

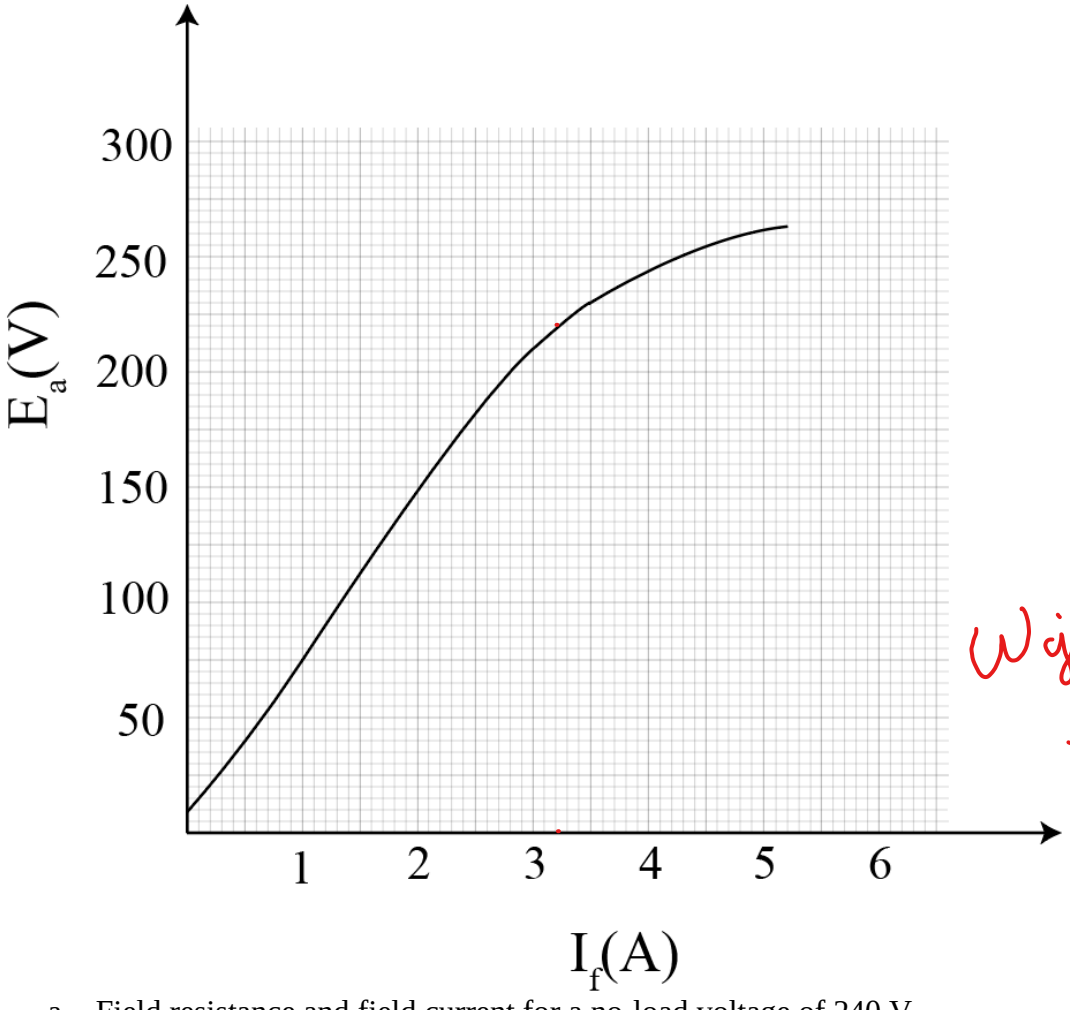
Question 3. A 5kW, 220V, 1000 rpm DC shunt generator is having 55 Ω field circuit resistance and 0.5 Ω armature resistance. The terminal voltage at full load is 220 V. Find the voltage regulation of the machine. If the frictional and windage loss is 200W, find the efficiency of the machine at rated output. Assume internal (generated) voltage remains the same for both no-load and full load conditions.
(Ans. Voltage regulation =5.11% & efficiency = 77.67%)

When rated voltage and power are given, immediately calculate the rated current.

Question 4. A 30 kW, 220V long shunt compound generator has an armature resistance of 0.02 Ω, series field resistance of 0.03 Ω, and shunt field resistance is 110 Ω. Find the induced emf at rated load. The total brush drop is 2V. The terminal voltage at full load is 220 V. Find the voltage regulation of the machine. Assume that at no load, the back emf is the same as that at the full load, and brush voltage drop at the no-load is neglected. (Ans. 4.1%)

Question 5. A 6 kW, 120 V, 1200 rpm dc separately excited generator has the following specifications: No-load voltage = 120V, at If=1.0A and 1200 rpm., armature resistance (r_a)=0.2 Ω. The rotational loss of the machine is 400 W at 1200 rpm and rotational loss is proportional to the speed of the machine. Determine (a) the terminal voltage, (b) output power, and (c) the efficiency, if the machine is driven at 1500 rpm with If=1.0 A. Assume the generator is delivering rated current.
(Ans. (a) 140V (b) 7kW (c) 87.5%)

Question 6: OCC of DC shunt generator at 1200 rpm is given below:



a. Field resistance and field current for a no-load voltage of 240 V.
b. The value of the critical field resistance
c. The value of the critical speed
d. In case a no-load voltage of 220 V is required, calculate the additional resistance that must be inserted in the field circuit.

(Ans. a. 62.33 ohms, I=3.85A, b.74.28 ohms, c. 1000 rpm, d. 5.36 ohms)