Group5_Exp6

AIM : To study the following characteristics of a DC shunt generator.

- Open circuit characteristics (O.C.C) through no-load test to determine the critical field resistance and critical speed.
- External Characteristics through load test.

PROCEDURE :

1. **Open Circuit Characteristics (E_0/I_f) :**
   - Open a Blank Model in Simulink
   - Make a circuit as shown in Circuit Diagram in MATLAB section.
   - Observe the output in scope and tabulate the readings of E_0 and I_f for different Voltage values.
   - Plot the graph between E_0 and I_f which gives the O.C.C.
   - Calculate critical field resistance and critical speed from the plot.

2. **External Characteristics (V/I_L) :**
   - Open a Blank Model in Simulink
   - Make a circuit as shown in Circuit Diagram in MATLAB section.
   - Observe the output in scope and tabulate the readings of E_0 and I_f for different resistance values.
   - Once the generator output reaches the nominal value, take the readings of terminal voltage by increasing the load current, while keeping field current constant.
   - Plot the graph between V and I_L which gives the external characteristics.

OBSERVATIONS :

1. On increasing field current No load Voltage increases.
2. On increasing field voltage the voltage across the load resistor decreases.

TABLES :

Open Circuit Characteristics(O.C.C) :

S.No	No-Load Voltage(E_o)	Field Current(I_f)
1	3.1	0.018
2	12.3	0.06
3	30.7	0.17
4	61.6	0.35
5	92.5	0.54
6	123.4	0.71
7	154.3	0.89
8	185.1	1.07
9	216	1.24
10	240	1.38

External Characteristics :

S.No	Load Current(I_L)	Terminal Voltage(V)
1	4.52	225.9
2	0.94	235.2
3	0.52	236.5
4	0.365	236.7
5	0.279	236.9
6	0.226	237.06
7	0.19	237.15
8	0.164	237.22
9	0.144	237.27

10	0.128	237.31

CIRCUIT DIAGRAM IN MATLAB :

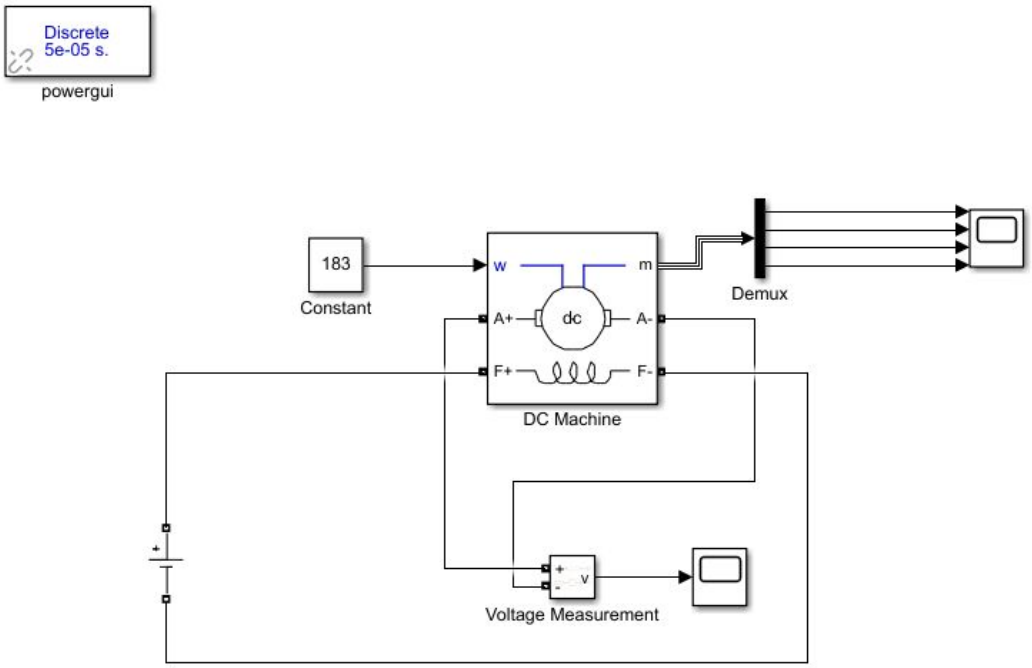

Figure 1 :Open Circuit (no load)

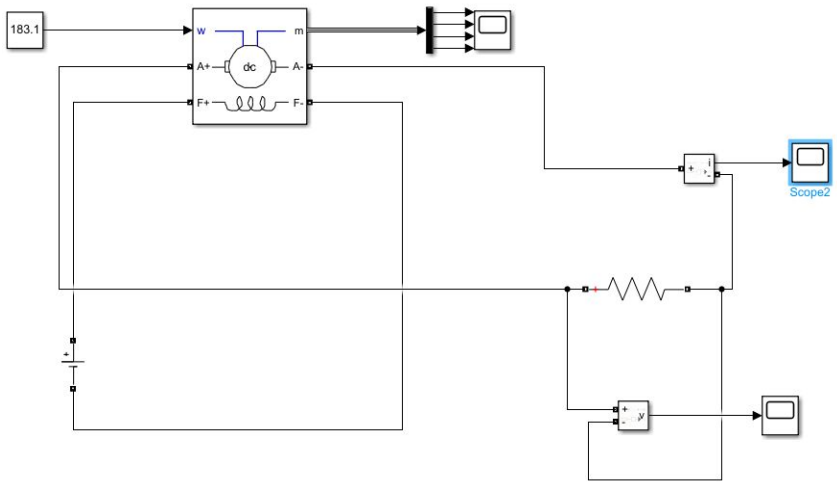

Figure 2: CIrcuit diagram for external characteristics

GRAPHS AND RESULTS :

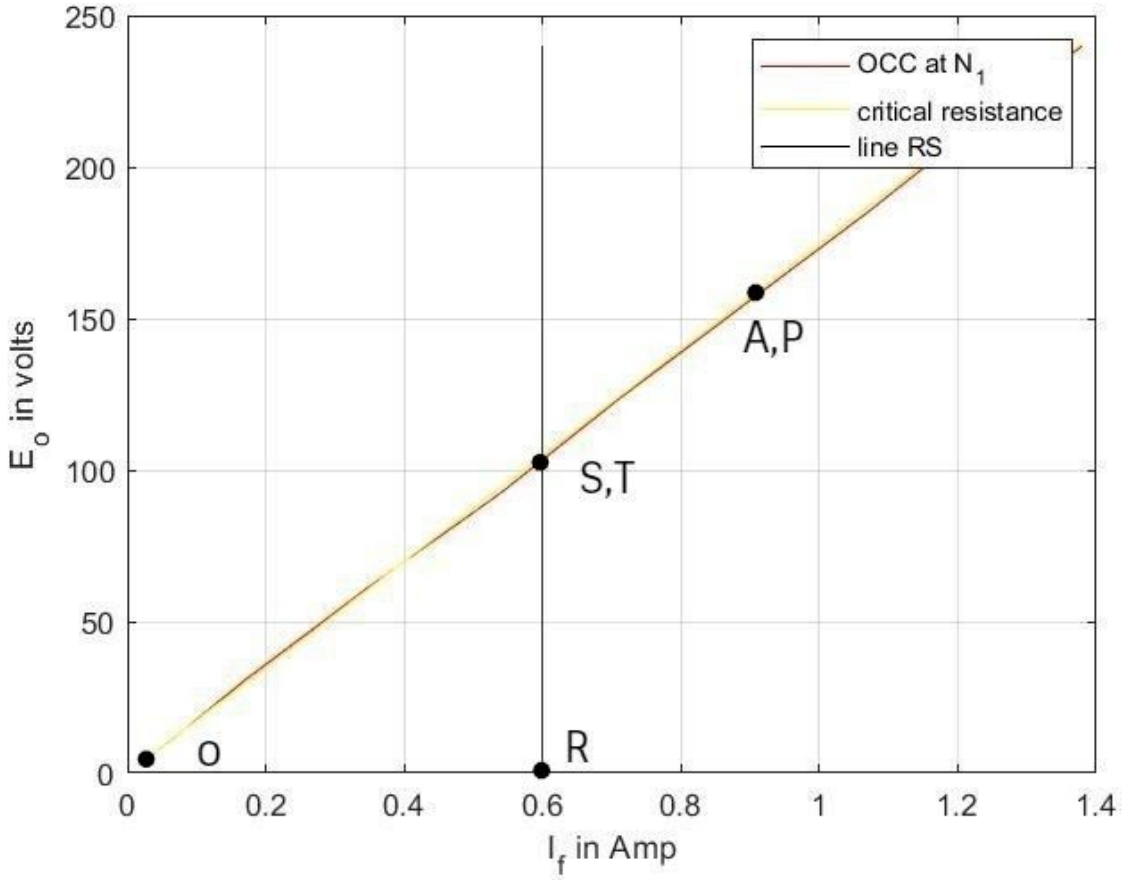

Figure 3:Plot of E_O vs I_f (O.C.C)

1. Plot of E_O vs I_f is a straight line at $N_{nominal}$.
2. Slope of the plot (E_O vs I_f) gives the critical resistance R_c at speed $N_{nominal}$.
3. OA is the tangent to the curve.
4. Now,taking a particular value of $R_{sh}(E_O/I_f)$ on the curve, say point P. Joining P from O gives line OP.
5. Here OA,OP and the curve coincide.
6. To find critical speed N_c we need a line from point R .
7. The line intersects OA and OP at the same point.So S,T coincide.
8. So,RT=RS.
9. We can find N_c from the below formula.
10. For R_c value the calculation is done in matlab.

$$R_c = \frac{(E_o)_2 - (E_o)_1}{(I_f)_2 - (I_f)_1}$$

As we have 10 points for both E_o, I_f We can get different slopes. Averaging all the slopes gives,

$$\boxed{R_c = 174.6\ \Omega}$$

$$\Rightarrow \quad \boxed{N_c = N_{nomial} \times \frac{RT}{RS}}$$

Here $RT = RS \Rightarrow \frac{RT}{RS} = 1$

$$\therefore N_c = N_{nomial} \text{ (here)}$$

and $N_{nomial} = 1750$ rpm (from DC machine parameters)

$$\boxed{\therefore N_c = 1750 \text{ rpm}}$$

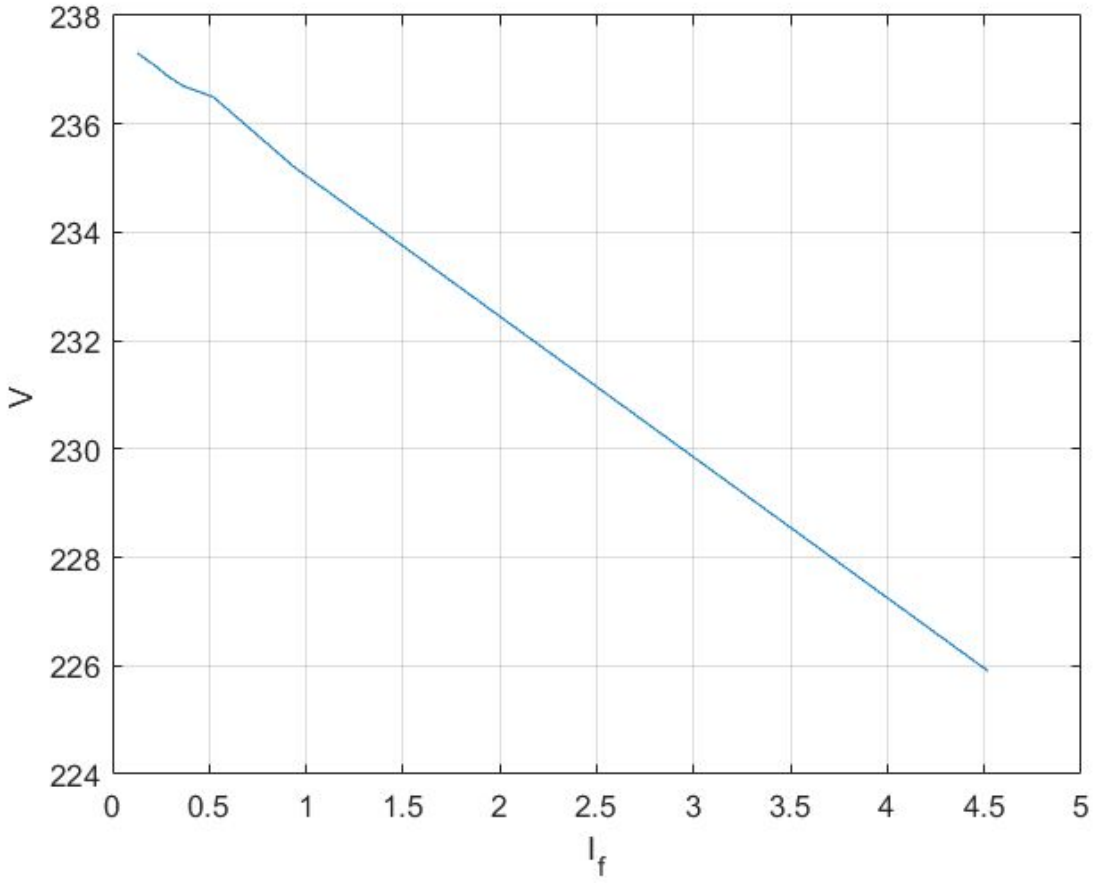

Figure 4: External Characteristics (V vs I_f)

CONCLUSION :

Nominal Speed = 1750 rpm
Critical Speed = 1750 rpm
Critical resistance = 174.6 Ω

COMMENTS :

1.Residual Magnetism is the small magnetic field left in the iron cores of the shunt fields when the generator is at rest. Without it the fields would have to be excited with a DC current in order to start the generator generating.

2.Residual voltage produces a weak current in the field circuit. If this current is in the proper direction, an increase in magnetic strength occurs with a corresponding increase in voltage output. The increased voltage output, in turn, increases the field current and the field flux which, again, increases the voltage output. As a result of this

action, the output voltage builds up until the increasing field current saturates the field poles. Once the poles are saturated, the voltage remains at a constant level, unless the speed of the armature rotation is changed.

Here,in this machine residual flux is zero.So Residual voltage in this machine is zero.That is the reason why we applied external field voltage to get required E_O.

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