THE HASHMITE UNIVERSITY

ELECTRICAL ENGINEERING DEPARTMENT

ELECTRICAL MACHINES LAP

LAP REPORT # 6

DC-Shunt Excited Generator

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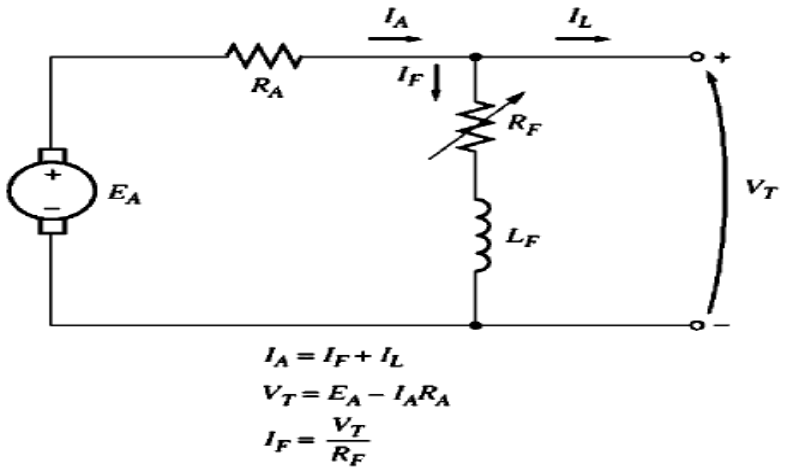
Objectives :

The objective of this experiment is determine both the no load characteristics and the full load characteristics of the DC-Shunt Excited Generator and to understand the external voltage characteristics and control characteristics.

Theoretical Background :

In the shunt excited generator the field circuit is directly connected across the armature circuit, an initial voltage is a result from residual flux within the core of the generator.

The equivalent circuit of the generator is shown next:



$$I_A = I_F + I_L$$
$$V_T = E_A - I_A R_A$$
$$I_F = \frac{V_T}{R_F}$$

In this circuit the current If depends on the terminal voltage, and as the load decreases (i.e. load resistance decreases) the field current also decreases and the internal generated voltage decreases which will result a further drop in terminal voltage , the reasons for the decrease of the terminal voltage as the load increases are summarized :

- *The drop voltage across the armature resistance.*
- *Armature reaction will reduce the effective flux that will affect the internal generated voltage.*
- *Ea will be less due to the previous reasons and the terminal will voltage will decrease further.*

There are two ways to control the voltage of a shunt generator:

1. Change the speed of rotation.
2. Change the resistance of the circuit which will change the field current.

If a shunt generator is started and no voltage builds up, there are three reasons for this problem, the reasons and solutions are :

- *There may be no residual flux in the core, the solution is simply to connect external DC source across the field circuit so it will produce a residual flux in the core, and this process is called "Flushing".*
- *The direction of rotation is reversed or the connection of the field is reversed, flux will produce Ea and Ea will produce flux in opposite direction to residual flux and no voltage build up will result.*
- *Field resistance may be too large, and voltage build up will not occur because steady state is at residual flux level, the solution is to simply decrease field resistance.*

Equipments :

We used a motor as prime mover , and a set of millimeters to measure currents and voltages a variable load , a torque measuring unit to measure the speed of the prime mover and of course the DC shunt exited generator .

Procedure :

1.The No load characteristics :

We first noted the rating plate an saw the values that we should not exceed in our experiment , then we used the practical diagram to connect the generator , we used torque measuring unit to measure the speed of the prime mover , this speed had to be constant in our experiment , then we used the variable resistance Rf (rheostat) to control the field current , and we took measurements on the internal terminal voltage of the generator we set the speed of the prime mover to1200 rpm and we started to increased the rheostat until we obtained zero and measured the terminal voltage, it was 12 V , this voltage is due to residual flux , the we started to decrease the rheostat(i.e. increase If) and take measurements of Ea as shown in the table:

1200 RPM								
Increasing If								
If	*0*	*.1*	*.2*	*.3*	*.4*	*.5*	*.6*	*.7*
Ea	*10*	*63*	*106*	*127*	*139*	*147*	*156*	*160*

The we started increasing the rheostat (i.e. decreasing If) and take measurements of Ea as shown in the table:

1200 RPM								
decreasing If								
If	*0*	*.1*	*.2*	*.3*	*.4*	*.5*	*.6*	*.7*
Ea	*10*	*63*	*110*	*130*	*163*	*151*	*156*	*160*

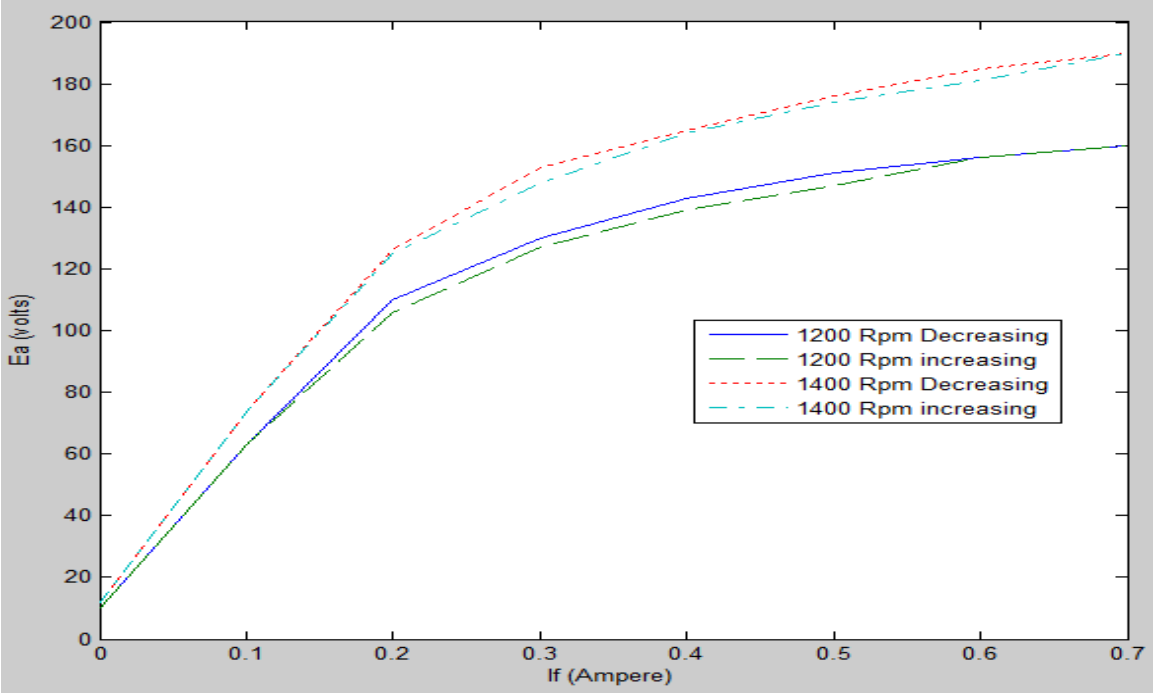
We repeated this process for 1400 RPM:

1400 RPM								
Increasing If								
If	*0*	*.1*	*.2*	*.3*	*.4*	*.5*	*.6*	*.7*
Ea	*12*	*74*	*125*	*148*	*164*	*174*	*181*	*190*

1400 RPM								
decreasing If								
If	*0*	*.1*	*.2*	*.3*	*.4*	*.5*	*.6*	*.7*
Ea	*12*	*74*	*126*	*153*	*165*	*176*	*185*	*190*

Questions and Answers for the No load characteristics:

1.Draw the No load characteristics for increasing and decreasing If on (x) axis at 1400 RPM and 1200 RPM on the same graph.



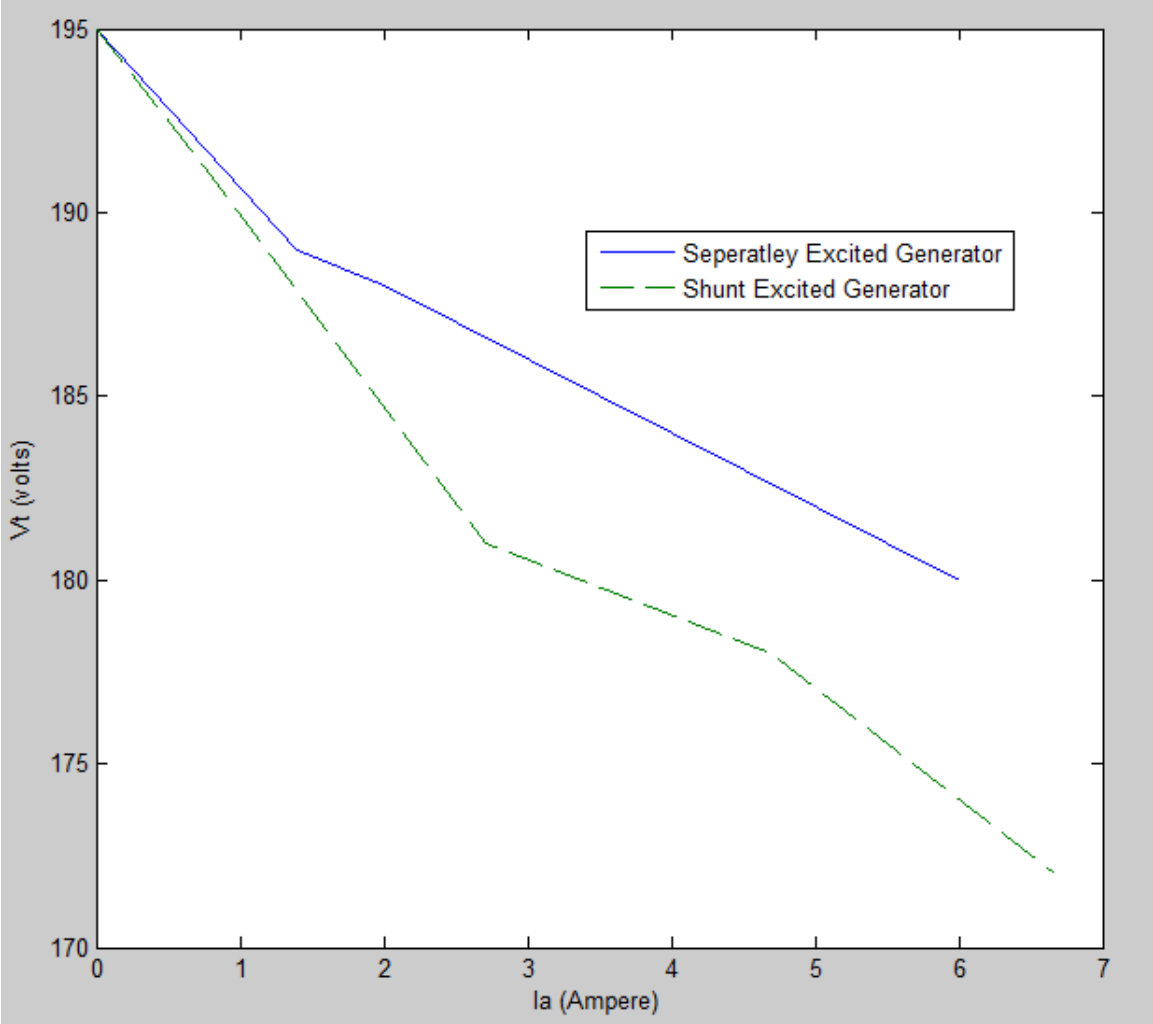
2.The load characteristics :

Now we adjusted the motor to 1400 RPM and maintained this value through the experiment, and we adjusted the rheostat until we had an excitation current of .8 Ampere , then we connected the load (the load was adjusted at a very high resistance when we connected it , so it doesn't get over heated because of the high current) and took measurements of Ia , Vt , and IL as shown in the table :

Im	*.8*	*.71*	*.69*	*.69*
IL	*0*	*2*	*4*	*6*
Vt	191	181	178	172

Questions and Answers For the load characteristics:

1.Draw the external voltage characteristics separately and shunt excitation in the same graph with Ia on (x) axis ?



(Note : lowest Point on the (y) axis is 170 for accuracy)

2.Why does Vt decrease with increase Ia ?

Because of the drop voltage over the internal resistance (Ra) of mathematically :

*Vt = Ea – Ia * Ra .*

3. Why does Vt decrease more with shunt than with separately excited ?

In the Shunt DC Generator when Vt decreases, the field current in the machine decreases with it. This causes the flux in the machine to decrease, decreasing EA. Decreasing EA causes a further decrease in the terminal voltage Vt = EA-IaRa (Ea is lowered) .

the voltage drop-off is steeper than just the IaRa drop in a separately excited generator. In other words, the voltage regulation of this generator is worse than the voltage regulation of the separately excited generator .

4. Why does the generator not take up voltage in measurement if the field is wrongly connected?

the residual flux will produce an internal generated voltage EA, The voltage EA produces a field current which produces a flux opposing the residual flux , in other words residual flux decreases and the generator doesn't build up voltage .
The solution is to reverse connection.

Conclusions :

1. We learned how to connect the prime mover to the shunt excited generator and how loads and millimeters are connected and how to take measurements on this generator .

2. we used different values for the excitation current to obtain different values of terminal voltage , and from plotting these values we have been able to obtain the magnetization curve .

3.We saw how loads are connected to the generator , and how changing the load would change the armature current .

4We leaned how to control voltage obtained from the generator.