THE HASHMITE UNIVERSITY

ELECTRICAL ENGINEERING DEPARTMENT

ELECTRICAL MACHINES LAP

LAP REPORT # 2

DC-Separately Excited Generator

Instructor :Dr. Mohamed Al-Wedyan

Lap supervisor : Eng.Majid Al - Briqi

Bahaa Ishaq 833150

Objectives :

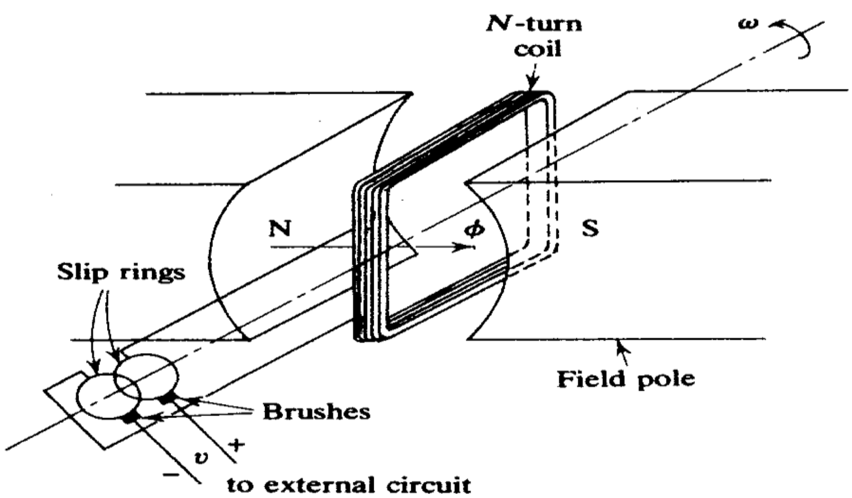
The objective of this experiment is determine both the no load characteristics and the full load characteristics of the DC-Separately Excited Generator and to learn to control the generator .

Theoretical Background :

DC machines are motors that convert electrical energy to mechanical energy to mechanical energy and generators that converts mechanical energy to electrical energy .

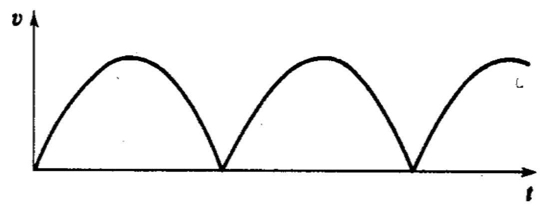
The construction for all DC machines are the same with few minor changes in the connection between armature and the field circuit .

The general Dc Machine Is shown below :



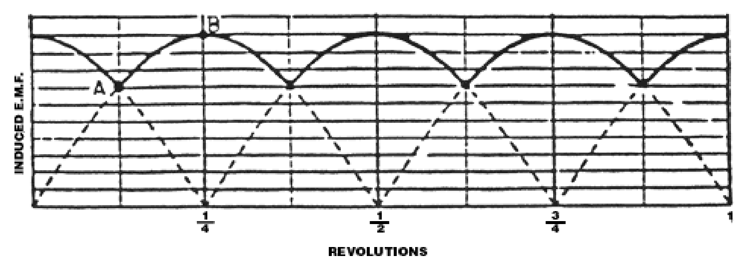
General Dc Machine

In this circuit If the coil is moved by a prime mover an AC voltage is induce across the coil and is converted to DC by the means of a "commutator" , the commutator segment consists of two semi circular slip rings , these slip rings rotates with the coil and a fixed brushes is connected in a way such that they are in touch with the rotating slip rings , and when the coil parity changes the external leads switch direction because of the commutator segment this will yield a unidirectional voltage as shown in the figure next page :



Unidirectional voltage obtained from two commutator segment

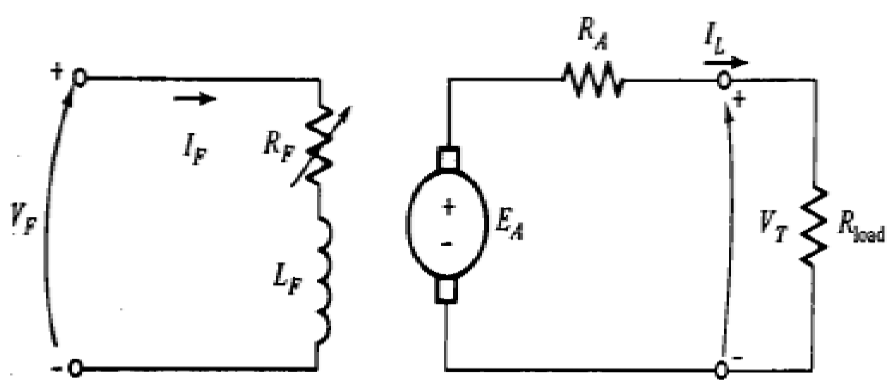
Adding more commutator segments will provide us with a more uniform voltage :



Voltage obtained from adding more commutator segment

This generally is how the DC machine works as a generator .

Now if the field circuit is supplied with a separate DC voltage other than the armature (i.e. the armature is not supplying the field in any way) then it is called separately excited generator and the equivalent circuit for this generator is shown in the figure below :



In previous circuit :

The field circuit is represented by the following :

Vf : is the voltage used to supply the field circuit .

If =field current used to produce the magnetic flux .

Rf = variable resistance used to control the field current .

Lf = to represent the field coil .

The armature circuit is represented by the following :

Ea : the internal generated voltage in the coils of the armature circuit .

Ra = the internal resistance of the armature circuit .

Il (Il = Ia) = the load current and it equals the armature current .

Vt : terminal voltage .

Rl = The load and it's represented by resistance because of The DC conditions .

We will perform two tests to see the no load and the load characteristics of the generator , the no load test is performed when there are no load (i.e. Rl=infinity) and the load characteristics is performed by changing the load Rl and to see how the current change .

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 separately 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 generated voltage of the generator (Vt = Ea when Rl = infinity) we set the speed of the prime mover to 1200 rpm and we started to increased the rheostat until we obtained zero and measured the internal generated voltage, it was 11 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	.8
Ea	9	57	100	172	140	150	156	162	166

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

1200 RPM									
derasing If									
If	0	.1	.2	.3	.4	.5	.6	.7	.8
Ea	10	72	110	131	144	152	158	63	166

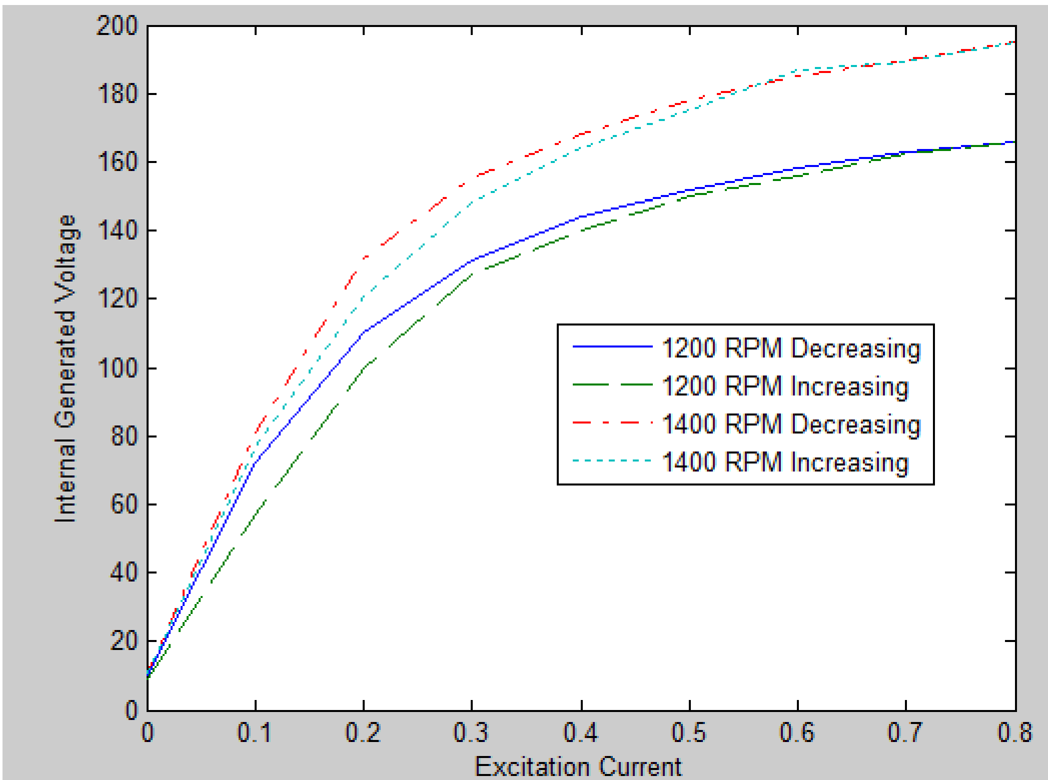
We repeated this process for 1400 RPM :

1400 RPM									
Increasing If									
If	0	.1	.2	.3	.4	.5	.6	.7	.8
Ea	11	77	121	148	164	175	187	189	195

1400 RPM									
derasing If									
If	0	.1	.2	.3	.4	.5	.6	.7	.8
Ea	11	82	132	155	168	178	185	190	195

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 on the same graph .



2.Why does the no load characteristics differ from increasing and decreasing excitation current ?

Because of the Hysteresis loss occurred in the armature of the DC machine.

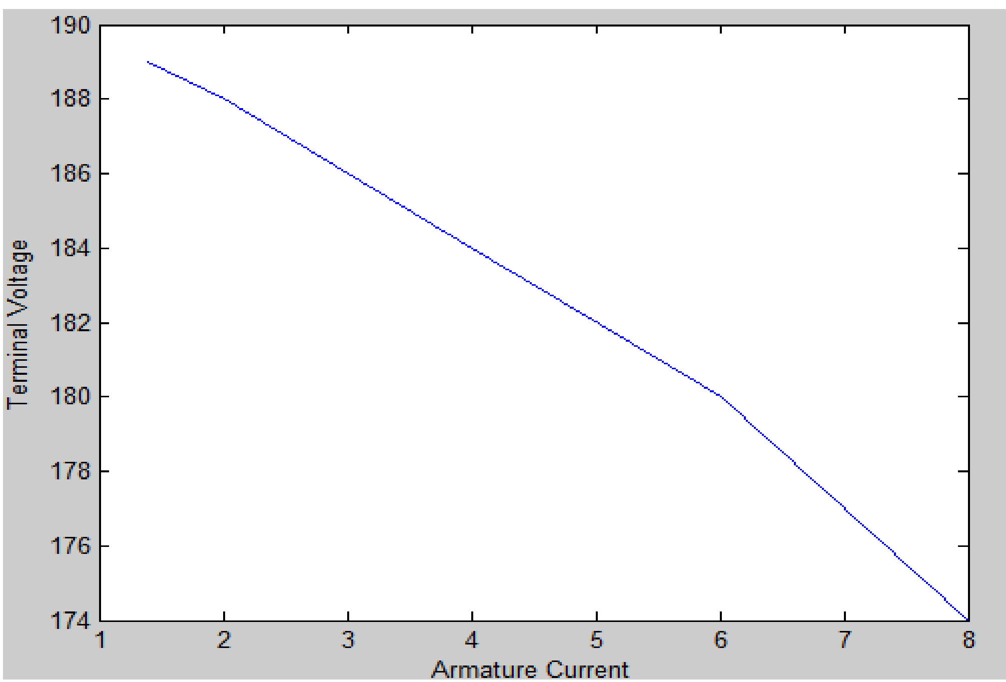
2.The load characteristics :

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 avery high resistance when we connected it , so it doesn't get over heated because of the high current) and took measurements of Ia and Vt as shown in the table :

Ia	1.4	2	4	6	8
Vt	189	188	184	180	174

Questions and Answers For the load characteristics :

1.Draw the external voltage characteristics with Ia on (x) axis ?



(Note : lowest Point on the (y) axis is 174 for accuracy)

2.Why does Vt increase with decrease Ia ?

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

*Vt = Ea – Ia * Ra (Ea is constant) .*

Conclusions :

1. We learned how to connect the prime mover to the separately 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 the internal generated 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 .

4.DC voltage is obtained from this generator by means of "commutation" .