EE234: Experiment 3
V-I Characteristics of DC Generator

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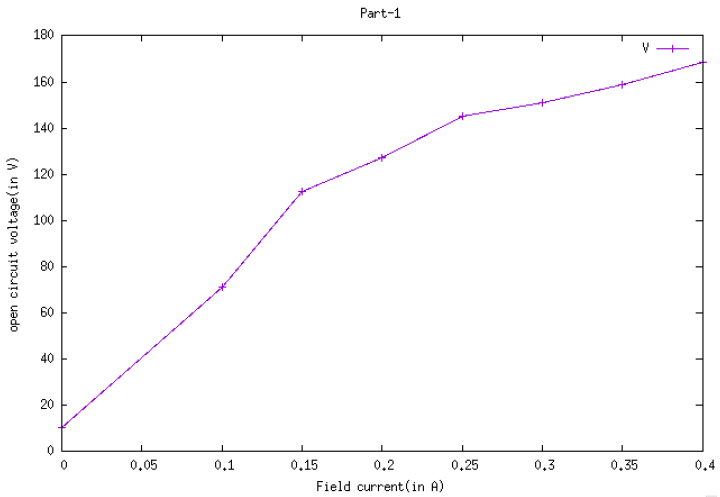
1 Observations :

1.1 Open circuit voltage with field current

w_r = 1500rpm(kept constant)



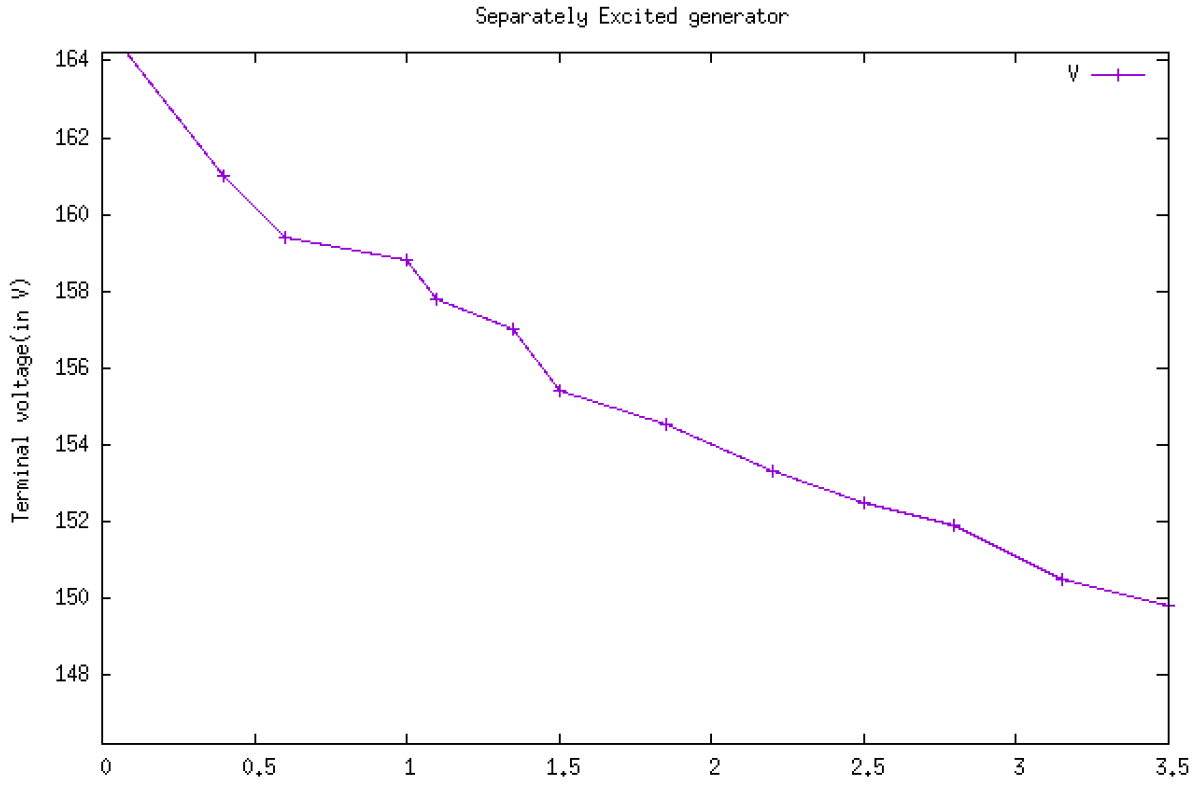
Open circuit voltage(v)	Field Current(A)
10.27	0
71.3	0.1
112.4	0.15
127	0.2
145	0.25
151	0.3
159	0.35
168.5	0.4

1.2 Terminal voltage with load current

1.2.1 Separately Excited Generator

w_r = 1500 rmp(kept constant)

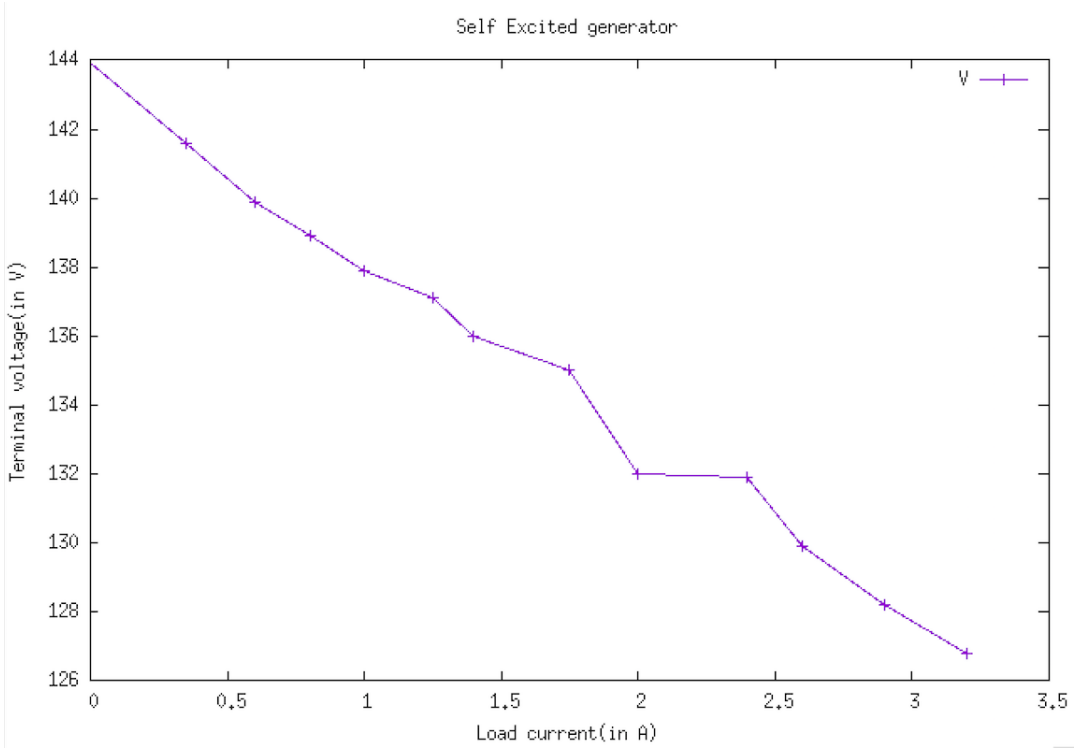
load	Terminal Voltage(V)	Load current(A)
0	165	0
1	161	0.4
2	159.4	0.6
3	158.8	1
4	157.8	1.1
5	157	1.35
6	155.4	1.5
7	154.5	1.85
8	153.3	2.2
9	152.5	2.5
10	151.9	2.8
11	150.5	3.15
12	149.8	3.5



1.2.2 Self Excited Generator

w_r = 1500 rmp(kept constant)

load	Terminal Voltage(V)	Load current(A)
0	143.9	0
1	141.6	0.35
2	139.9	0.6
3	138.9	0.8
4	137.9	1
5	137.1	1.25
6	136	1.4
7	135	1.75
8	132	2
9	131.9	2.4
10	129.9	2.6
11	128.2	2.9
12	126.8	3.2



2 Post-lab Questions :

Q1. Of the two machines which one did you choose to operate as motor? Justify your answer.
Ans. Generator: 1.1 KW
Motor: 1.5KW
The motor should be able to provide the rated power to the generator(as we are observing the Dc generator characteristics), so the power rating of the motor should be larger than the generator. If it is less then the motor would not be able to supply the required power.

Q2. Assume that a given machine has the following nameplate ratings: 220V, 1.5 kW, 1500 rpm dc generator. What do these numbers imply?
Ans 220V: The supply voltage
1.5KW: Power generated by the generator when it is operated at rated values

1500rpm:

Q3. There are motors without any rotor windings (e.g. stepper motor). Explain how the torque is produced in these machines.
Ans IN stepper motor the stator is made up of highly permeable magnetic material
Stepper motors effectively have multiple toothed electromagnets arranged around a central permanent magnet. The electromagnets forms the stator and the permanent magnet forms the rotor. The electromagnets are energized one by one. This causes the permanent magnet to rotate as it is constantly attracted by different toothed electromagnets. The torque output produced by the motor is proportional to the intensity of the magnetic flux generated when the winding is energized.

Q4. How is the voltage induced in the armature (coil is rotating in a magnetic field) which is ac, converted to dc?
Ans The ac voltage induced in the armature is converted to dc by the split rings, which act as the mechanical rectifier.

Q5. What is the effect of armature reaction?
Ans Due to armature reaction, their is a decrease in net flux. This decrease in the net flux further decreases the terminal voltage

Q6. Saturation of the magnetic material is a blessing in the case of self excited generator Is this statement true? Justify your answer.
Ans Yes, I agree with this statement as if there is no saturation of magnetic material the field saturation line and the magnetization curve won't intersect to give operating point. thus the voltage and the flux will keep on rising. This high value of flux and voltage will damage the generator.

Q7. In separately excited dc machine, the field winding carries a constant current. Hence, it dissipates power. Suggest a method to eliminate this power loss.
Ans

Q8. What may happen if load terminals are short circuited in (a) separately excited generator (b) self excited generator?
Ans In the self-excited dc motor the field winding is connected across the terminal of the armature, therefore the voltage across the field winding also reduces to zero if we sort the output terminals .hence the generator stops as there is no flux.
In separately excited Dc generator the field windings have a different source hence sorting the output terminal won't have any effect on flux or induced voltage. And as Ra is very less and V is finite so huge current will flow. This may damage the generator

Q9. You have been given the plot of Efficiency Vs input power of the prime mover. Explain how will you obtain the plot of efficiency Vs output power of the generator. How will you obtain this plot incase the plot of Efficiency Vs input power of the prime mover is not available?
Ans

3 Demo

In the demo we were shown the Stator Windings, Rotor coil, brushes,Split Rings of an generator. The stator windings creates the magnetic field inside the stator. The current required to set up this magnetic field is very high.So, we use an iron core which produces larger magnetic field for same the stator current.
Now if a conductor is rotated in the field then current will flow through the rotor.
Now the current carring rotor will also produce flux.This flux will reduce the flux which was established in the stator.The armature current sets up its own magnetic field. The effect of this armature flux on the distribution of main field flux is called Armature Reaction. This is called armature reaction.The armature reaction will reduce the generated EMF due to decrease in value of flux per pole.

The commutator rings and the brushes are used to convert alternating current generated in the armature winding of a dc machine to direct current. This is also call mechanical rectification

We use multiple poles in the DC motor because if we use one pole then it will create non uniform motion of the rotor. force on the rotor will be zero when rotor and magnetizing field is perpendicular
There will be eddy currents in the core. Due to Eddy currents the efficiency comes down. to decrease eddy current we usually laminate the core