



ABU DHABI UNIVERSITY

EEN 340 - ENERGY CONVERSION

Lab Report 3
DC Motors and Generators

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Section 1

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Abstract

In this useful experiment, we did three main parts. For DC motors, we studied about two forms of it which are DC Shunt Motor and DC Series Motor. For DC generators, we studied about DC separately excited generator. For DC Shunt Motor, we observed the relations between many parameters like Torque, Speed, I_2 , V_1 , V_2 , I_1 , and the field current as well as the effect of changing the shunt resistances on some parameters like I_2 , Torque, and Speed. For DC Series Motor, we noticed the relations between some parameters like Torque, Speed, I_1 , and V_1 and the effect of changing the voltage on the Speed parameter. For DC separately excited generator, we noticed the effect of field current and generator speed on the output voltage, and we studied about the load characteristics of this generator.

1 Introduction

In this experiment, we would like to do three important tasks in order to be familiar with main machines like DC motors and DC generators. The first two parts represent different forms of a DC motors, one represents a shunt DC motor (where we would change the shunt resistances and noticed the effect of that on other parameters) and the another represents a series DC motor (where we would change the voltage and noticed the effects of that on other parameters).[3] From these two tasks, we would like to notice the relationships between different parameters like Speed / torque relationship, Armature current / output torque relationship, Armature voltage / speed relationship, and Efficiency after seeing the plots that represent the relations between these certain parameters. The third part which is about dc Separately Excited Generator, we would like to notice the effect of field current on the output of a separately excited dc generator, to investigate and observe load characteristics of a separately excited dc generator, and to investigate the effect of generator speed on the output of a separately excited dc generator.[2]

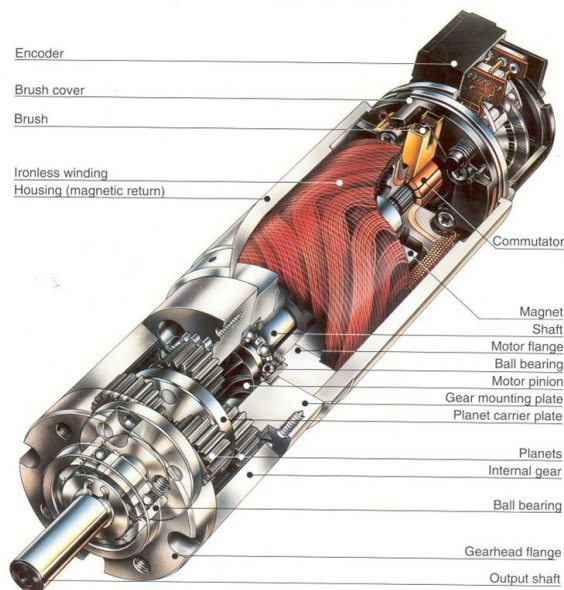


Figure 1: The insides of the the DC Generator.[1]

2 Experiment Set-up

The circuit was provided to us by the lab manual and instructions were also given for each step. First the tests were performed on DC Shunt Motor, then DC Series Motor, and then finally DC Generator.

2.1 DC Shunt Motor Experiment Set-up

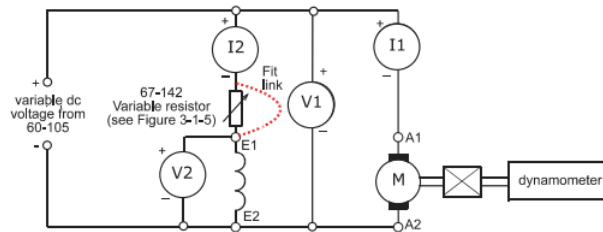


Figure 2: This is how the experiment was setup for DC shunt motor.[4]

2.2 DC Series Motor Experiment Set-up

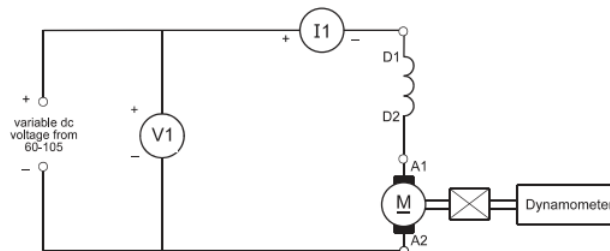


Figure 3-2-2: Circuit Diagram

Figure 3: This is how the experiment was setup for DC series motor.[4]

2.3 DC generator Experiment Set-up

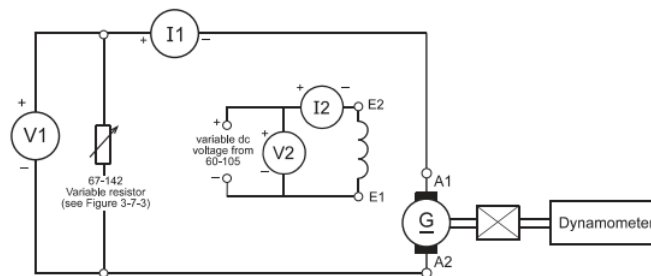


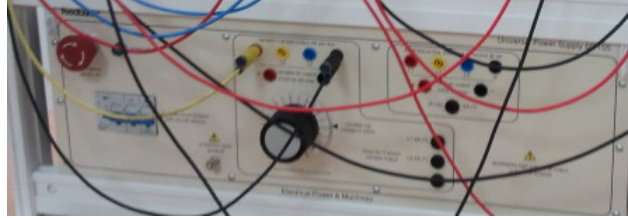
Figure 3-7-2: Circuit Diagram with resistance shorting link fitted

Figure 4: This is how the experiment was setup for DC Generator.[4]

3 List of Equipment used

We used the following equipment in order to take the accurate measurements :-

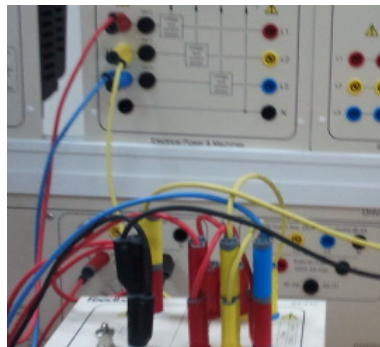
- Universal Power Supply.



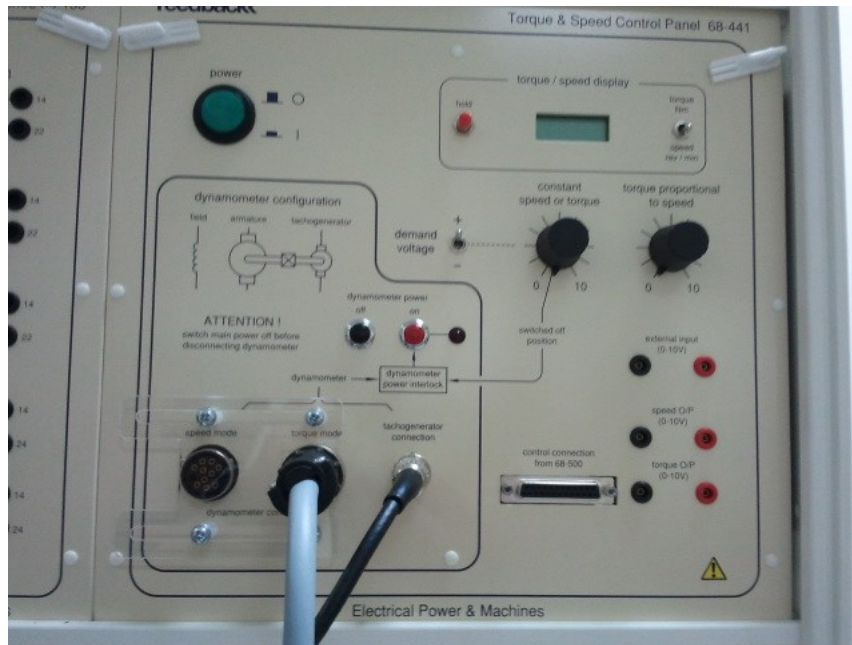
- DC Compound Wound Motor.



- Torque and Speed Control Panel.



- Dynamometer Machine.



- Shaft Coupling and Key.



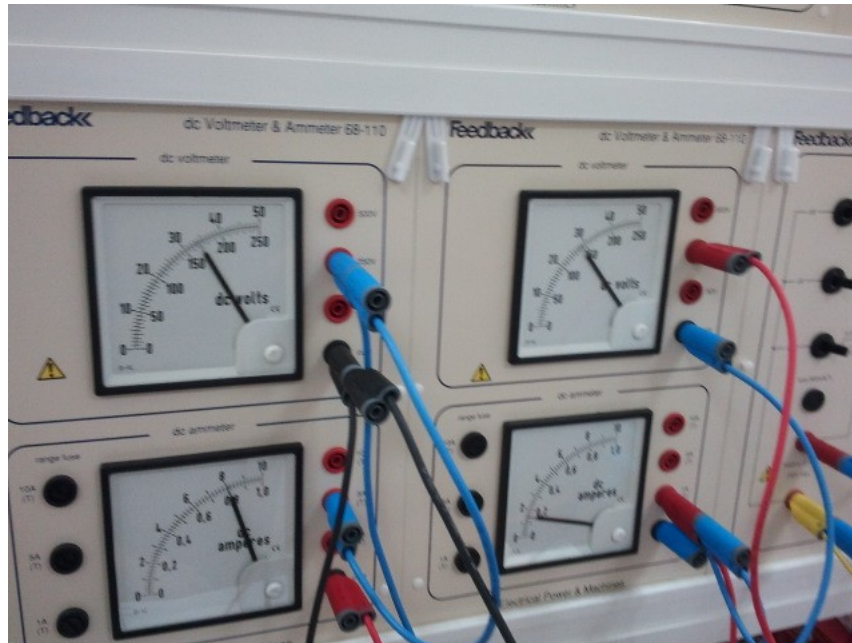
- System Frame.



- Stranded Set of Patch Leads.



- Voltmeter and Ammeter.



4 Procedure

The lab experiment was done in a beautiful manner by following the following steps in a good and ethical way. For DC motors, we studied about two forms of it which are DC Shunt Motor and DC Series Motor. For DC generators, we studied about DC separately excited generator. For DC Shunt Motor, we observed the relations between many parameters like Torque, Speed, I_2 , V_1 , V_2 , I_1 , and the field current as well as the effect of changing the shunt resistances on some parameters like I_2 , Torque, and Speed. For DC Series Motor, we noticed the relations between some parameters like Torque, Speed, I_1 , and V_1 and the effect of changing the voltage on the Speed parameter. For DC separately excited generator, we noticed the effect of field current and generator speed on the output voltage, and we studied about the load characteristics of this generator. The results were recorded in the table and mathematical operations were done in order to get the appropriate graph of the results. Then these graphs were analyzed so that accurate conclusions were drawn from them.

Three important tasks were done in order to be familiar with main machines like DC motors and DC generators. The first two parts represent different forms of a DC motors, one represents a shunt DC motor (where we would change the shunt resistances and noticed the effect of that on other parameters) and the another represents a series DC motor (where we would change the voltage and noticed the effects of that on other parameters). The results were recorded in the table and mathematical operations were done in order to get the appropriate graph of the results. Then these graphs were analyzed so that accurate conclusions were drawn from them.

5 Results and Discussions

5.1 DC Shunt Motor Results

V1	V2	I1	I2	TORQUE	SPEED
195V	193V	1A	0.218A	0.044	2547
190V	188V	1.25A	0.2A	0.1	2535
180V	176V	1.7A	0.195A	0.2	2418
175V	175V	2.15A	0.18A	0.3	2352
174V	172V	2.65A	0.18A	0.4	2330
172V	170V	3.05A	0.18A	0.5	2252

Figure 5: These are the results for Shunt DC Motor. Since the field windings and armature windings are in parallel, the V1 and V2 are approximately close. As we can see that the torque of the shunt motor increases with increase in field current but the speed of the motor decreases.

I2 (A)	TORQUE (Nm)	SPEED (rpm)
0.17	0.05	2887
0.16	0.1	2640
0.15	0.2	2524
0.15	0.3	2517
0.15	0.4	2511
0.15	0.5	2470

Figure 6: These are the results for Shunt DC Motor when shunt resistance is about 180Ω . When the field resistance is low, the rotational speed of the motor is high keeping the field current approximately constant.

I2 (A)	TORQUE (Nm)	SPEED (rpm)
0.15	0.05	2730
0.14	0.1	2677
0.139	0.2	2620
0.139	0.3	2610
0.139	0.4	2595
0.139	0.5	2590

Figure 7: These are the results for Shunt DC Motor when shunt resistance is about 317Ω . When the field resistance is increased, the rotational speed of the motor decreases keeping the field current approximately constant.

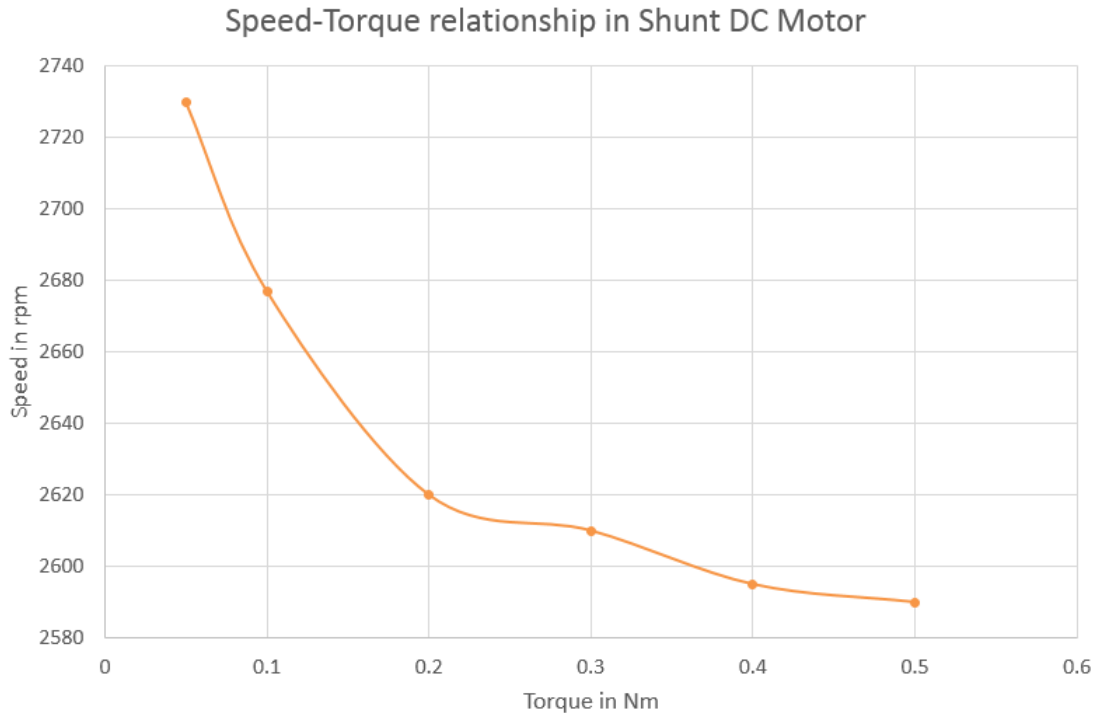


Figure 8: Keeping the field resistance constant at 317Ω . The speed decreases somewhat exponentially with the increase in torque. When the field current of the generator increases, the field windings become more stronger electromagnet generating more torque.

5.2 DC Series Motor Results

V1 (V)	I1 (A)	TORQUE (Nm)	SPEED (rpm)
120	2.7	0.1	2362
120	3.35	0.2	1970
117	3.8	0.3	1606

Figure 9: These are the results for Series DC Motor. Since the field windings and armature windings are in series, increase in field current increases torque but reduces the torque.

MOTOR VOLTAGE (V)	SPEED (rpm)
130	4991
110	4441
90	3715
70	2880
50	1930
30	960
10	0

Figure 10: These are the results for Series DC Motor. When the terminal voltage increases the rpm speed of the motor.

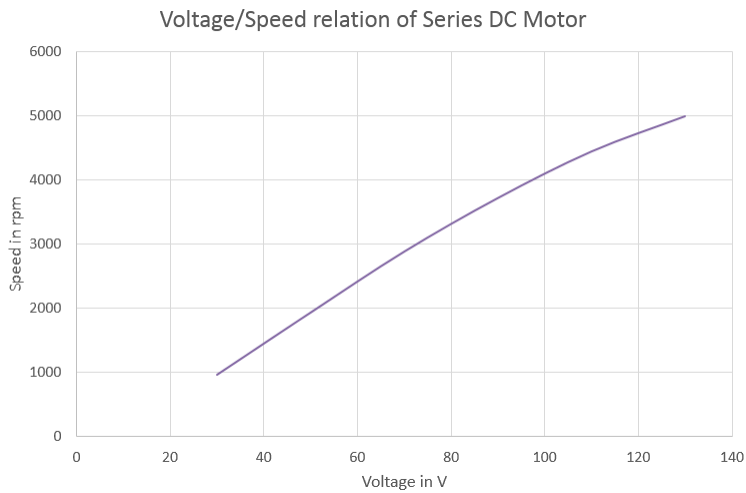


Figure 11: The graph shows almost linear relationship between terminal voltage and speed in rpm.

5.3 DC Generator Results

FIELD CURRENT (A)	OUTPUT VOLTAGE (V)
0.02	40
0.04	70
0.06	95
0.08	110
0.1	120
0.12	130
0.14	137
0.16	141

Figure 12: When the field current of the generator increases, the field windings become more stronger electromagnet generating more voltage.

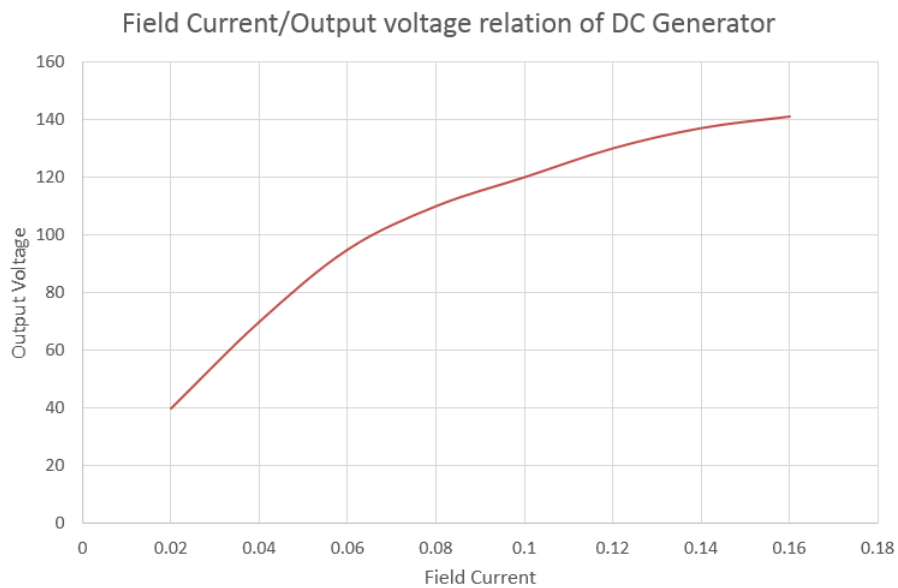


Figure 13: The relationship between the voltage and field current is somewhat exponential as seen in the graph.

LOAD RESISTANCE (Ohm)	LOAD CURRENT (A)	OUTPUT VOLTAGE (V)	POWER (W)
950	0.22	210	46.2
634	0.32	205	65.6
317	0.64	200	128
253	0.79	197	155.63
213	0.92	195	179.4
182	1.05	192	201.6

Figure 14: When the load resistance reduces, the current through the load increases.

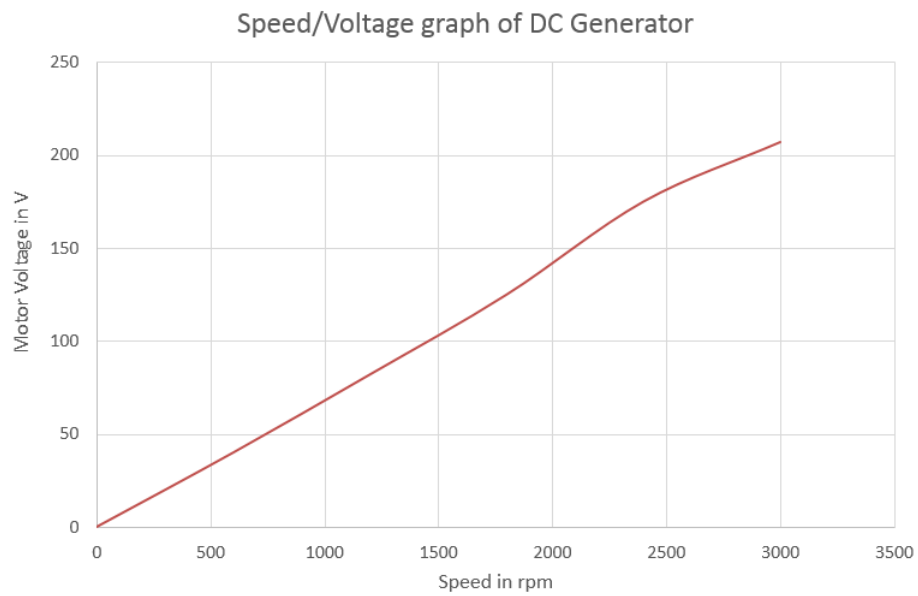


Figure 15: The relationship between the voltage and speed of the rpm is nearly linear. As the voltage increases, the speed of rotation increases.

6 Conclusion

In conclusion, we did three main parts in our experiment. First, for the DC Shunt motor and familiarization, we learned and studied about the trainer and how it works and about the DC motor operation principles, and we learned about where to use the DC shunt motor and how to be aware of certain parameters used in measuring the DC motor performance. Second, for the DC Series motor, we learned and noticed the main differences between a DC shunt motor and DC series motor, and we learned how to use dc series and shunt motors in certain applications. Third, for the dc Separately Excited Generator, we studied the principles of a dc separately excited generator operation and to be aware of certain parameters used to measure dc motor generator performance ; so that, we concluded many important relations among these certain parameters such as (Directly proportional and Inversely Proportional) and we learned how to take an appropriate measurements while changing one of the parameters and noticing the effect on the others.

7 Team Dynamics

Part and Member	Weight Grade	Muhammad Obaidullah	Ali Raza	Abdulla Hamoud
Abstract	10%	33.3%	33.3%	33.3%
Introduction	15%	33.3%	33.3%	33.3%
Procedure Part 1	15%	33.3%	33.3%	33.3%
Procedure Part 2	15%	33.3%	33.3%	33.3%
Results Part 1	15%	33.3%	33.3%	33.3%
Results Part 2	15%	33.3%	33.3%	33.3%
Conclusion	15%	33.3%	33.3%	33.3%
Total	100%	33.3%	33.3%	33.3%

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- [2] DC Motors and Generators *Basic Theory* [Electronic]. Available: <ftp://ftp.dei.polimi.it/outgoing/Massimo.Ghioni/Power%20Electronics%20/Motor%20control/DC/DC%20motors%20and%20generators.pdf> [7 June 2013].
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