Exp. No. 1

Date:20-08-2021

SPEED CONTROL OF DC SHUNT MOTOR

OBJECTIVES

To perform the speed control of a d.c. shunt motor by

(i) Below the normal range by armature resistance control and to plot the Speed Vs armature voltage (N / Va) characteristics.

(ii) Above the normal range by field control and to plot Speed Vs field current (N / I_f) characteristics.

APPARATUS REQUIRED

S.NO	NAME	TYPE	RANGE	No. Qty
1	**Voltmeter**	**Digital**	**(0-300V), MC**	**1**
2	**Ammeter**	**Digital**	**(0-1A), MC**	**1**
3	**Rheostat**	**Variable**	**(290Ω/2A)** **(1000Ω/2A)**	**2**
4	**Tachometer**	**Digital**	**2000rpm**	

THEORY

The speed of a dc motor is given by the relation, $N = KE_b / \phi$ Where $Eb = V-IaRa$

Therefore $N = K (V-Ia\ Ra) / \phi$

Where R_a is the armature resistance

I_a is the armature current

ϕ is the flux and

E_b is the back emf.

V is the supply voltage

From the above equations it is clear that the speed of dc motors can be controlled by the following methods.

1. By varying the flux per pole (ϕ). This is known as flux or field control method.
2. By varying the armature drops i.e. by varying the resistance of the armature circuit. This is known as armature control method.
3. By varying the applied voltage. This is known as voltage control method.

.**Field Control Method**

The flux produced by the shunt winding depends on the current through it [i.e. $\phi \propto$ Ish and Ish = V / Rsh]. When a variable resistance R is connected in series with the shunt field winding as shown in the **Fig - 2**, the shunt field current [Ish = V / (Rsh + R)]is reduced and hence the flux is also reduced. So the motor runs at a speed higher than normal speed (since N α 1 / ϕ). The amount of increase in speed depends upon the value of the variable resistance R. This is valid only in the linear portion of If Vs flux ϕ curve and not in the saturation region.

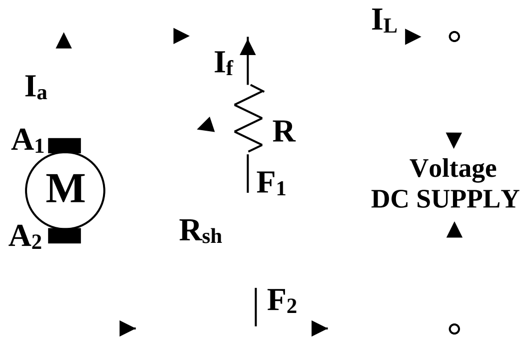


Fig -2

This method is most commercial as very little power is wasted in the shunt field variable resistance due to small field current. The main disadvantage is that only speeds above the normal speed can be obtained.

Armature Control Method

In this method speed control is done for constant field currents. This method is used when speed below the no load speed are required. As the supply voltage is normally constant, the voltage across the armature is varied by inserting a variable rheostat or resistance in series with the armature circuit. As the variable resistance is increased, potential drop across the armature is decreased thereby decreasing the armature speed. The maximum speed that can be obtained for a given field current occurs when there is no series resistance in the armature circuit, thus giving the armature the maximum voltage without any series drop. Lower speeds may be obtained by introducing armature resistance in series.

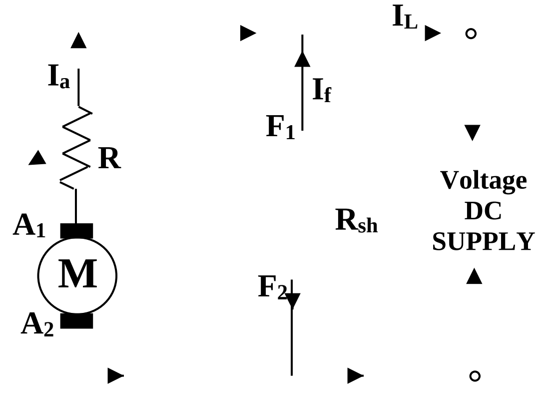
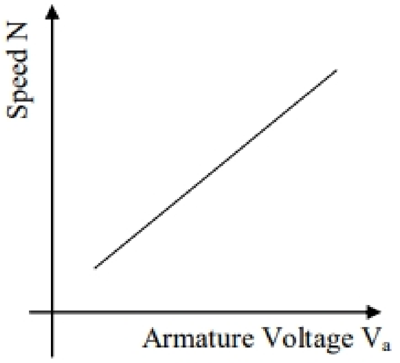
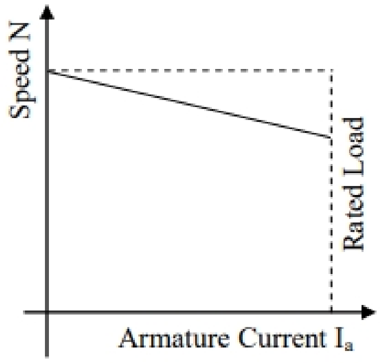


Fig -3

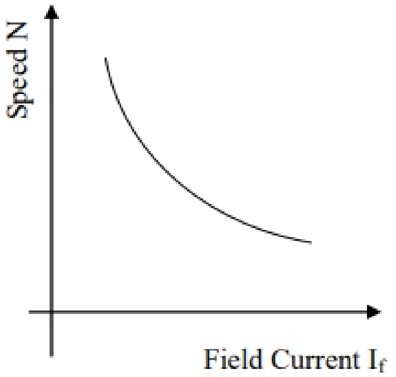
Model Graph



Armature Voltage Control method

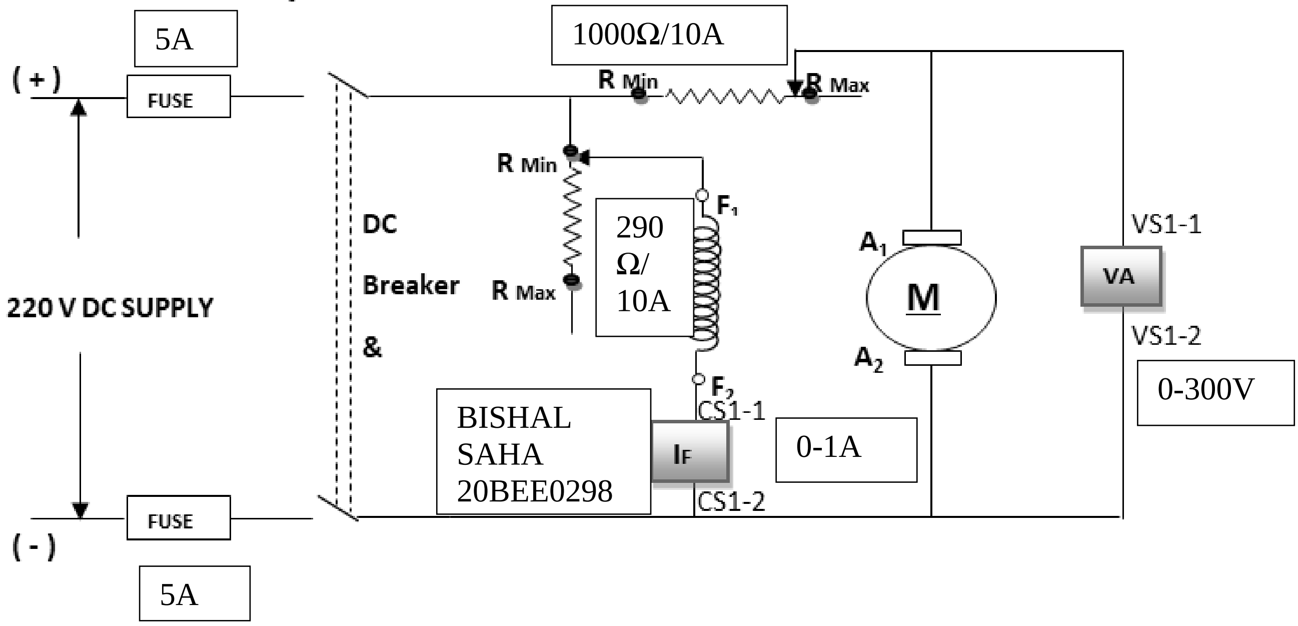


Armature Rheostatic Control method



Flux Control method

Speed Control of DC Shunt Motor



FUSE RATING CALCULATION:

No Load: 50 ° /. of Rated Current

=50100*6.5
=3.25A

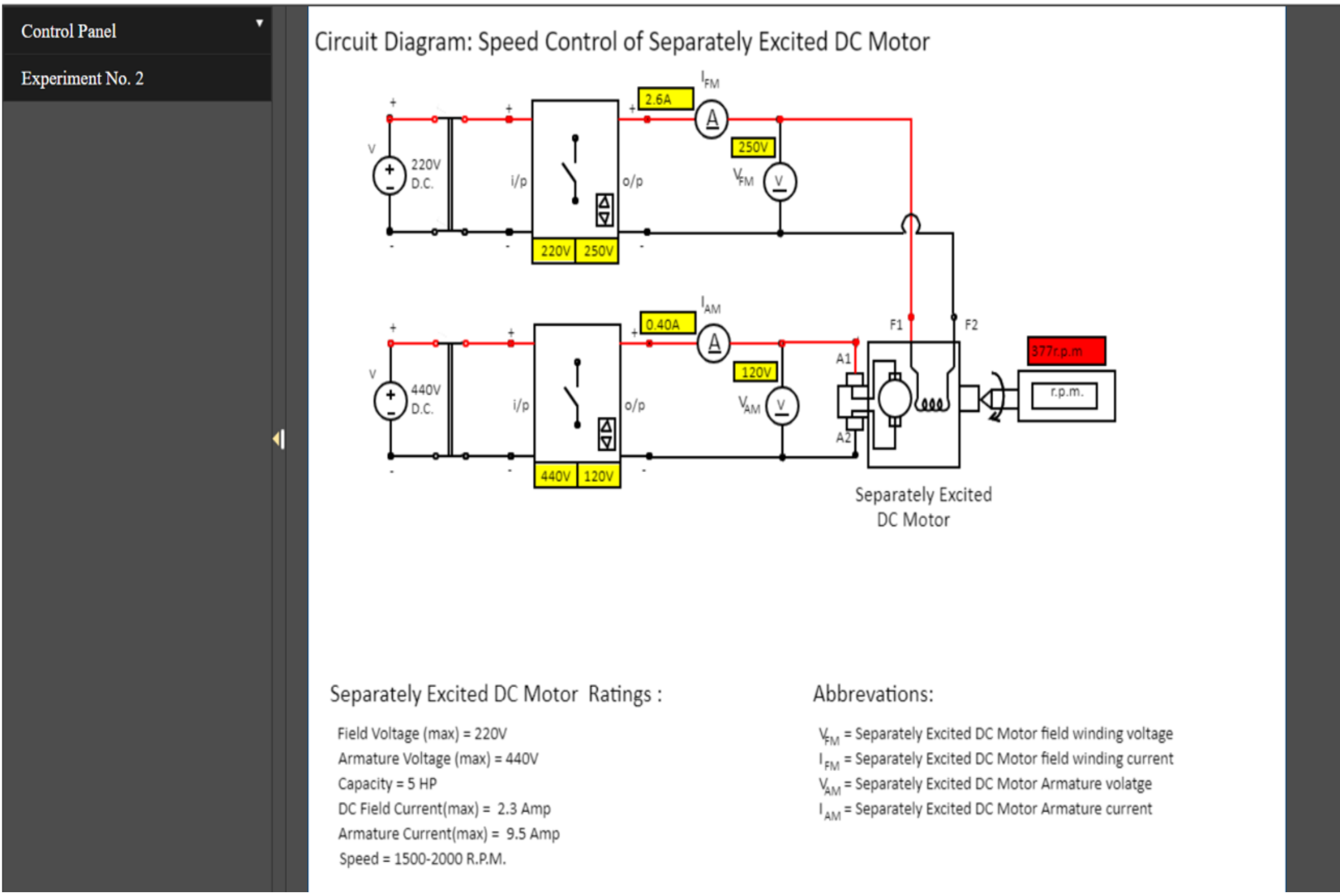
Full Load: 125%of Rated Current
=125/100*6.5
=8.125A

NAME PLATE DETAILS:

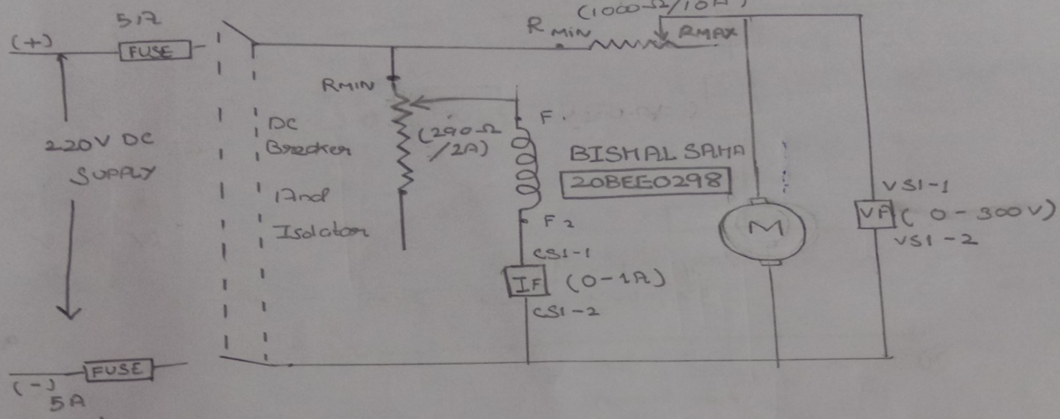
DC Motor

Rated Voltage	:	230V
Rated Current	:	6.5A
Rated Power	:	1.1kW
Rated speed		1500rpm
Excitation		220V,0.51A

Circuit Diagram – Speed Control of DC Shunt Motor (Virtual Lab)



Speed Control of DC SHUNT MOTOR



NAME PLATE DETAILS

Rated Voltage	:	230V
Rated current	:	6.5A
Rated Power	:	1.1kW
Rated Speed	:	1500rpm
Exitation	:	230V, 0.51A

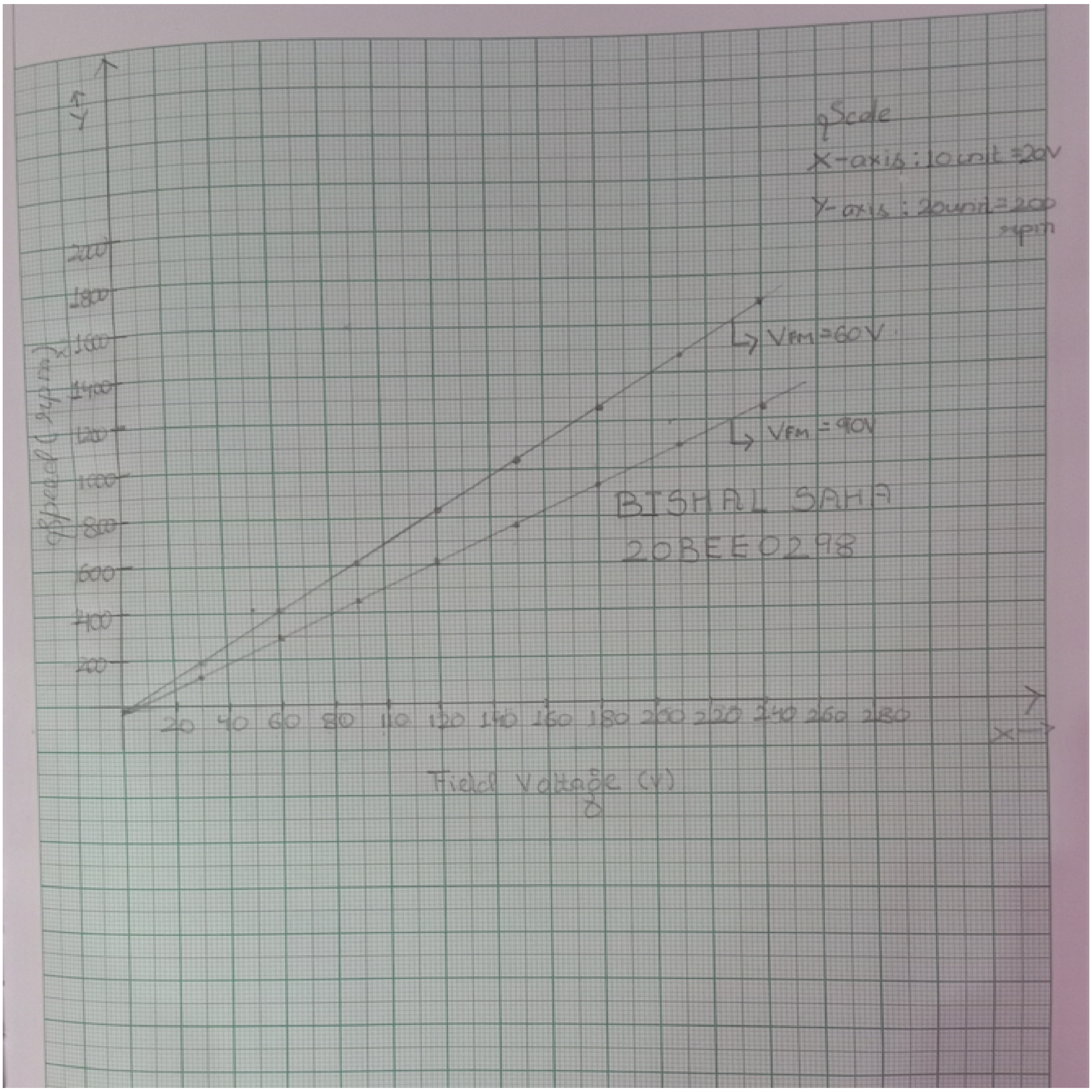
FUSE RATING

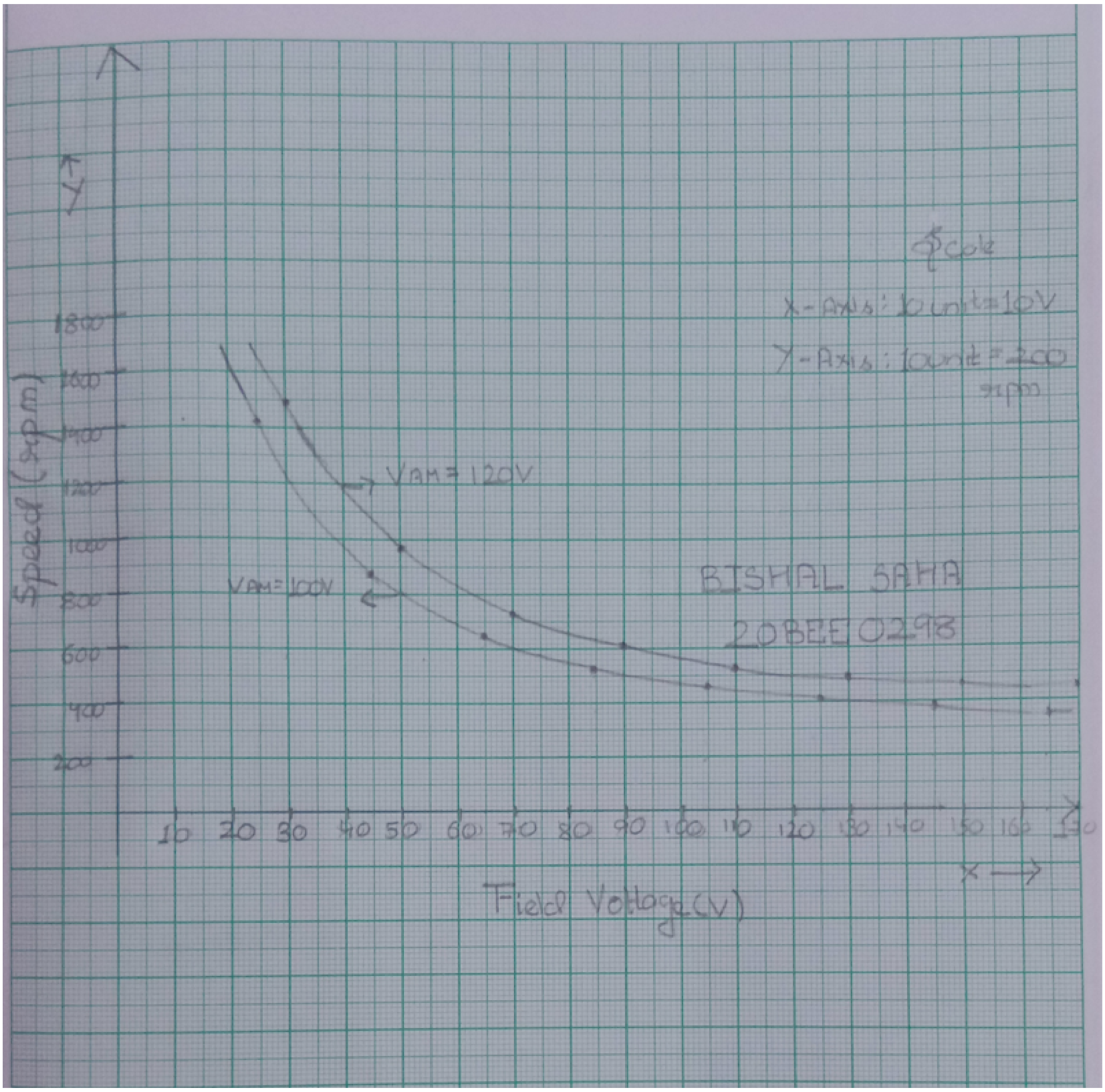
No Load: 50% of Rated current

$$\frac{50}{100} \times 6.5 = 3.25A$$

Full Load: 125% of Rated current

$$= \frac{125}{100} \times 6.5 = 8.125A$$


Scale
X-axis : 10 unit = 20V
Y-axis : 20 unit = 200 rpm
Vfm = 60V
Vfm = 90V
BISHAL SAHA
20BEE0298
Speed (rpm)
Field Voltage (V)


Speed (rpm)
Field Voltage (V)
Scale
X-Axis: 10 unit = 10V
Y-Axis: 10 unit = 200 rpm
VAM = 120V
VAM = 100V
BISHAL SAHA
20BEE0298

PRECAUTIONS

Before starting the experiment

1. The DC power supply, DC breaker and DC isolator should be in off position while making connections.
2. The field rheostat should be kept at minimum resistance position and armature rheostat should be kept at maximum resistance position.
3. There should not be any load on the motor throughout the experiment.

PROCEDURE

1. Close the DPST (double pole single throw) switch on field supply of motor, increase the voltage till rated value is reached, in steps.
2. Now close DPST (double pole single throw) switch on armature supply of DC motor, apply rated voltage in steps.
3. There are two methods for speed control of DC motor.

Armature Control Method:

1. Keeping field voltage constant at some value, vary the armature voltage the DC motor. Observe the speed readings on the tachometer.
2. The speed will vary proportionally in direct relation with armature voltage.
3. Store this data by clicking "Start Storing Data"
4. Now again armature voltage.
5. Store this data by clicking "Start Storing Data"
6. Go on repeating this procedure till zero speed and data is stored.
7. Now display the data by clicking "Show data".

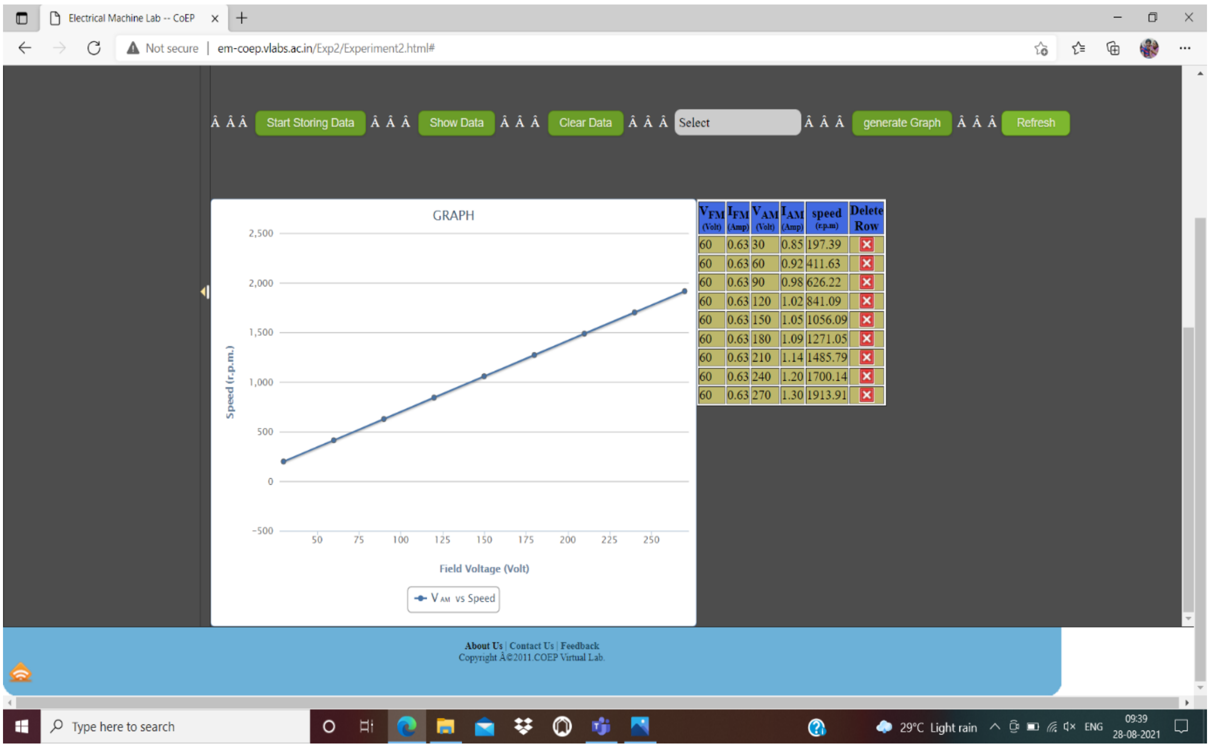
Field Control Method:

1. Now keep armature voltage constant at some value, and reduce the voltage applied to the field of motor. Observe the speed readings on the tachometer.

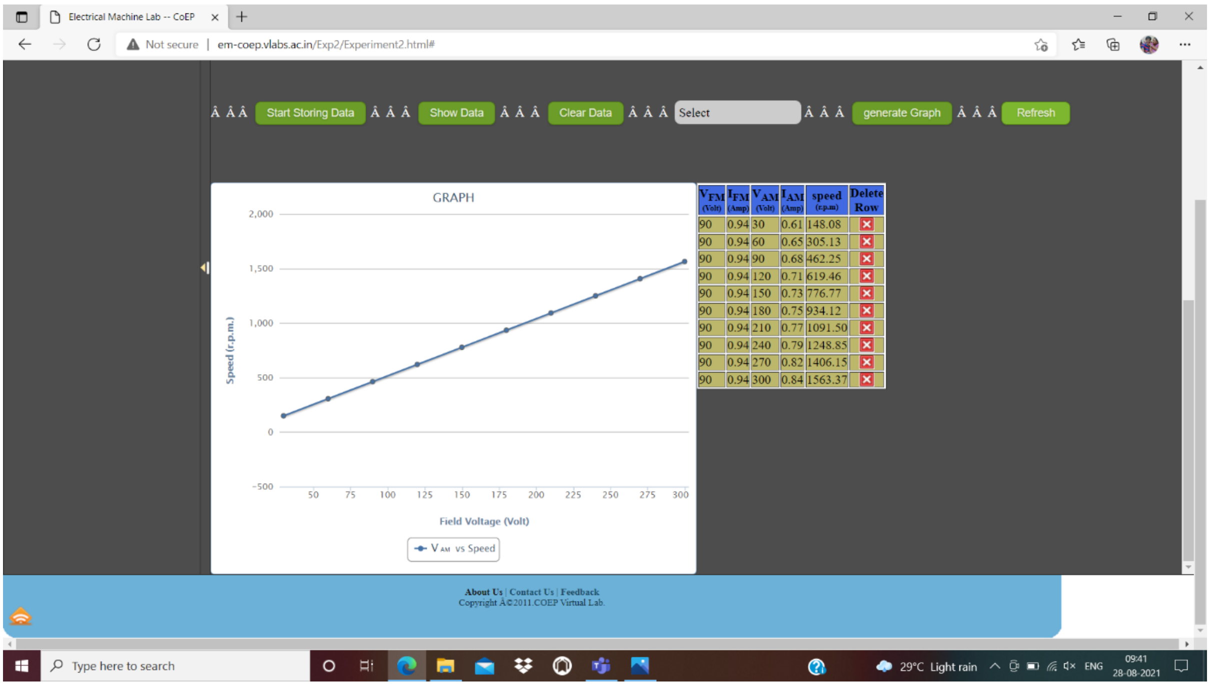
2. As we go on reducing field voltage in steps, the speed of motor will go on increasing. This relation observes inverse proportion.
3. Store this data by clicking “Start Storing Data”
4. Now again reduce the field voltage.
5. Store this data by clicking “Start Storing Data"
6. Go on repeating this procedure till 130% of rated speed (1500 rpm) and data is stored.
7. Now display the data by clicking “Show data”.

TABULAR COLUMN:

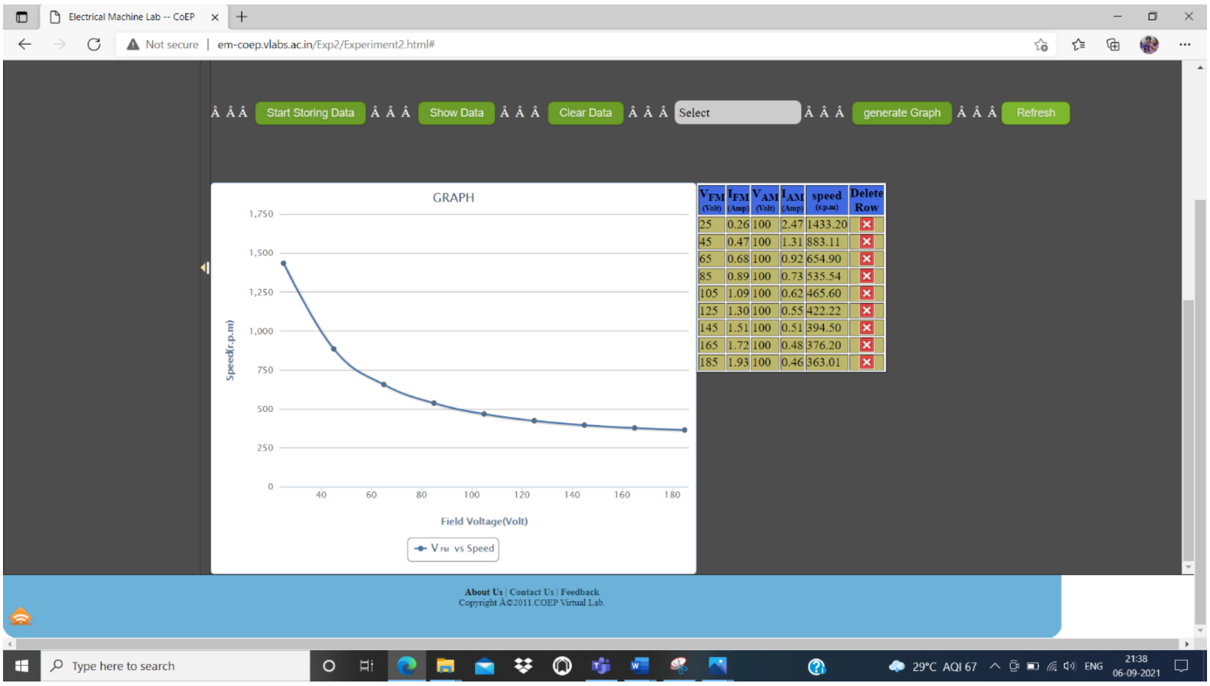
Sl.No	Armature control				Field Control			
	I_{f1} =0.63		I_{f2} =0.94		V_{a1} =100V		V_{a2} =120	
	Armature Voltage	Speed (Rpm)	Armature Voltage	Speed (Rpm)	Field Current	Speed (Rpm)	Field Current	Speed (Rpm)
1.	30	197.39	30	148.08	0.26	1433.20	0.31	1495.67
2.	60	411.63	60	30513	0.47	883.11	0.52	976.36
3.	90	626.22	90	462.25	0.68	654.90	0.73	744.75
4.	120	841.09	120	619.46	0.89	535.54	0.94	619.46
5.	150	1056.09	150	776.77	1.09	465.60	1.15	544.82
6.	180	1271.05	180	934.12	1.30	422.22	1.35	498.13
7.	210	1485.79	210	101.50	1.51	394.50	1.56	468.11
8.	240	1700.14	240	1248.85	1.72	376.20	1.77	448.04



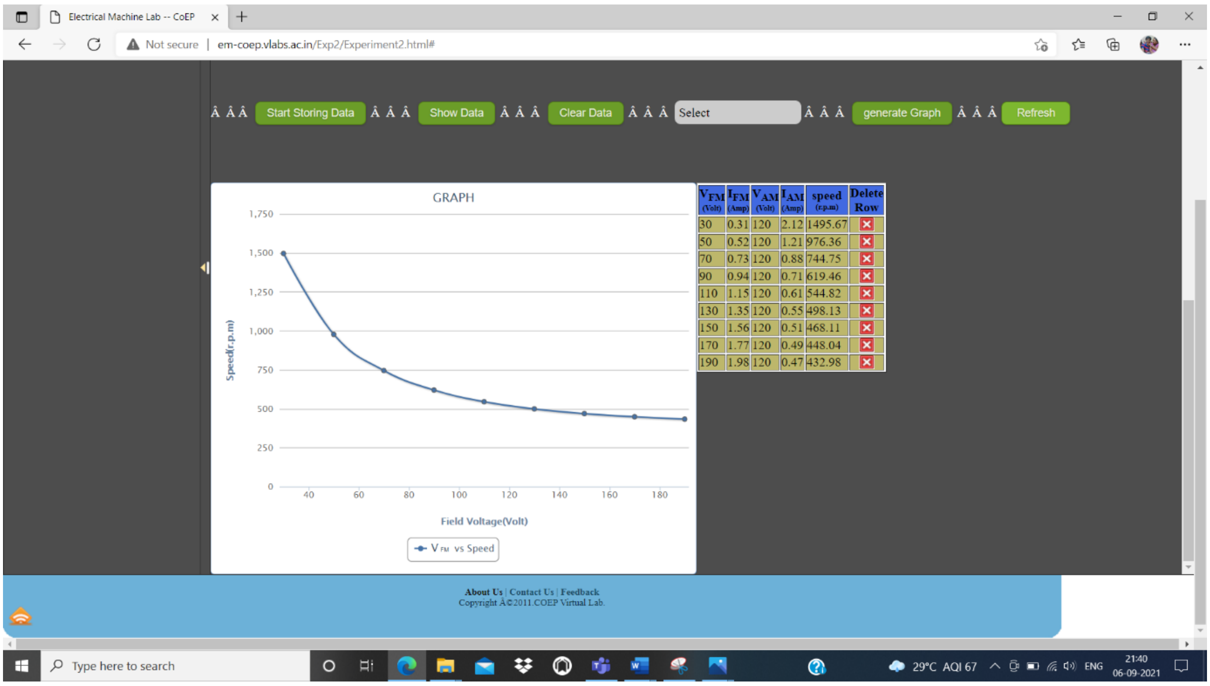
V_{FM} (Volt)	I_{FM} (Amp)	V_{AM} (Volt)	I_{AM} (Amp)	speed (r.p.m)	Delete Row
60	0.63	30	0.85	197.39	
60	0.63	60	0.92	411.63	
60	0.63	90	0.98	626.22	
60	0.63	120	1.02	841.09	
60	0.63	150	1.05	1056.09	
60	0.63	180	1.09	1271.05	
60	0.63	210	1.14	1485.79	
60	0.63	240	1.20	1700.14	
60	0.63	270	1.30	1913.91	



V_{FM} (Volt)	I_{FM} (Amp)	V_{AM} (Volt)	I_{AM} (Amp)	speed (r.p.m)	Delete Row
90	0.94	30	0.61	148.08	
90	0.94	60	0.65	305.13	
90	0.94	90	0.68	462.25	
90	0.94	120	0.71	619.46	
90	0.94	150	0.73	776.77	
90	0.94	180	0.75	934.12	
90	0.94	210	0.77	1091.50	
90	0.94	240	0.79	1248.85	
90	0.94	270	0.82	1406.15	
90	0.94	300	0.84	1563.37	



V_{FM} (Volt)	I_{FM} (Amp)	V_{AM} (Volt)	I_{AM} (Amp)	speed (r.p.m)	Delete Row
25	0.26	100	2.47	1433.20	
45	0.47	100	1.31	883.11	
65	0.68	100	0.92	654.90	
85	0.89	100	0.73	535.54	
105	1.09	100	0.62	465.60	
125	1.30	100	0.55	422.22	
145	1.51	100	0.51	394.50	
165	1.72	100	0.48	376.20	
185	1.93	100	0.46	363.01	



V_{FM} (Volt)	I_{FM} (Amp)	V_{AM} (Volt)	I_{AM} (Amp)	speed (r.p.m)	Delete Row
30	0.31	120	2.12	1495.67	
50	0.52	120	1.21	976.36	
70	0.73	120	0.88	744.75	
90	0.94	120	0.71	619.46	
110	1.15	120	0.61	544.82	
130	1.35	120	0.55	498.13	
150	1.56	120	0.51	468.11	
170	1.77	120	0.49	448.04	
190	1.98	120	0.47	432.98	

RESULT:

Hence with proper theory and virtual lab simulation we are able to perform speed control of DC shunt Motor.

From the results and graph obtained we can now say that:-

The speed of the DC motor is directly proportionally to the armature voltage. And also The speed of the DC Motor is inversely proportionally to the Field Voltage.

Reference

http://em-coep.vlabs.ac.in/Exp2/Experiment2.html