

Speed Control of DC Shunt MotorAim :-

The aim of the experiment is to be familiar with the "armature control" and "field control" mechanisms of the DC shunt motor.

Description:

For a given input voltage, the speed of a motor falls down when the load on the motor is increased. In the same way, the motor speed increases when the load on the motor is reduced. However, for any practical purpose, it is intended to run the motor at constant speed for all the loading conditions. Therefore, it is necessary to implement some speed control mechanism so as to bring the motor speed back to the original value after any load variation.

The following scenarios give the applications of DC motors.

- \* where the speed is required to remain almost constant from no-load to full-load.
- \* where the load has to be driven at a number of speeds and any one of which is nearly constant.

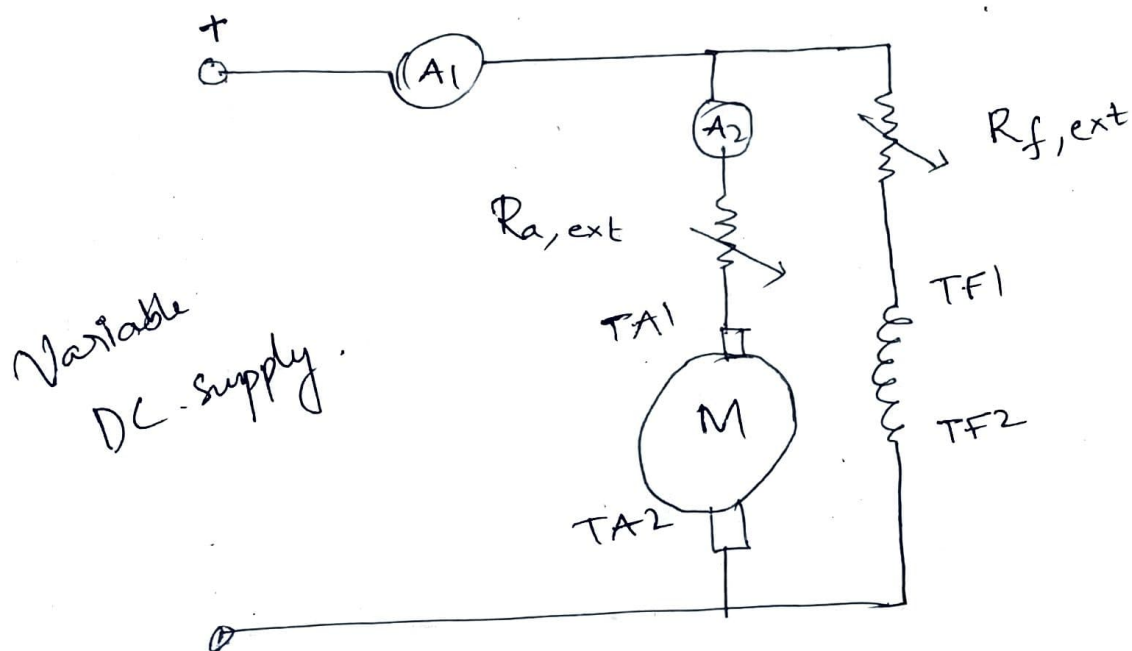
The speed control of a DC shunt motor can be effectively carried out by suitably adjusting the armature and field resistances based on the following relations.

$$E_b = \frac{NP\phi Z}{60A}$$

$$\Rightarrow N \propto \frac{E_b}{\phi} \quad , \quad E_b = V_s - I_a R_a$$

$$\therefore N \propto \frac{V_s - I_a R_a}{\phi}$$

### Circuit arrangement



## Procedure :

### Speed Control :

- ① Before starting the experiment, note down the readings of armature and field resistances.
- ② Now, connect the circuit diagram as Fig. 1
- ③ Set the armature rheostat at maximum position and field rheostat at minimum position.
- ④ ~~Try~~ Slowly increase the supply voltage up to 180V and keep it constant.
- ⑤ Try to bring the machine speed to 1500 r.p.m by first adjusting the armature resistance and then by adjusting the field resistance.
- ⑥ Note down the values of the armature/field resistance and currents when the machine speed is 1500 r.p.m.
- ⑦ Repeat the same procedure for input voltages of 190V, 200V, 210V and 220V. Ensure that the motor speed and armature current do not exceed rated values, which are 1500 r.p.m and 4.5A

## Speed Regulation:

- ⑧. Vary the field rheostat for different values and observe the occurrence of above rated speed values
- ⑨. Similarly observed the below rated speed values by varying armature rheostat.

## Results:

I (Rest Conditions)  
Field resistance ( $R_f$ ) =  $220\ \Omega$

Armature resistance ( $R_a$ ) =  $4.6\ \Omega$

## II (Speed Control test observations)

Input Voltage	Corresponding Speed	Total armature Resistance ( $1500\text{rpm}$ )	Total field resistance ( $1500\text{rpm}$ )	Armature Current ( $I_a$ )	Field Current ( $I_f$ )
180	1500	$153.8\ \Omega$	$375\ \Omega$	1.17	0.48
190	1500	$171.17\ \Omega$	$339.28\ \Omega$	1.11	0.56
200	1500	$185.2\ \Omega$	$333.34\ \Omega$	1.08	0.6
210	1500	$196.26\ \Omega$	$318.18\ \Omega$	1.07	0.66
220	1500	$215.7\ \Omega$	$297.3\ \Omega$	1.02	0.74



### III . (SPEED REGULATION)

Above rated speed measurements:

Input Voltage	Speed	Total field resistance	Field current ( $I_f$ )
220 V	1520	314.28 $\Omega$	0.74
220 V	1542	318.33 $\Omega$	0.69
220 V	1557	338.46 $\Omega$	0.65
	1570	333.33 $\Omega$	0.64
220 V	X	X	X
220 V	X	X	X

Below rated speed measurements:

Input Voltage	Speed (r.p.m)	Total Armature resistance	Armature Current ( $I_a$ )
220V	524.8	289.47 $\Omega$	0.76 A
	786	265.06 $\Omega$	0.83 A
	1072	241.75 $\Omega$	0.91 A
	1230	231.57 $\Omega$	0.95 A
	1345	229.16 $\Omega$	0.96 A
	1400	226.80 $\Omega$	0.97 A

Supply Voltage	Speed	Armature resistance	Armature current
220V	1443	222.22 $\Omega$	0.99 A
	1480	220 $\Omega$	1 A

## Conclusions :-

### ① Speed Control application

Speed Control application are generally used where constant speed is a requirement like fans and all.

### Speed regulation:

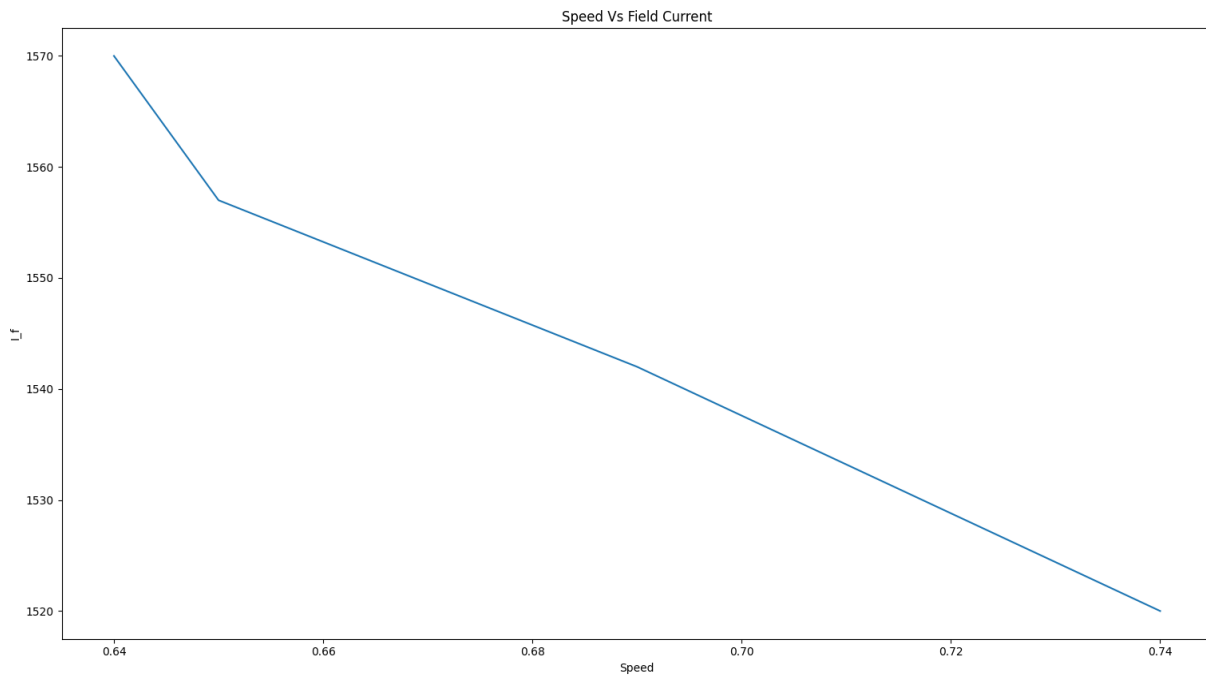
Speed regulation is used in places where we need to change speed on requirement.

② Armature control methods can be used in applications that require speed variation for shorter period of time, not continuously.

field control methods field is weakened to increase speed or it can be <sup>used to</sup> reduce speed.

To attain speed above rated speed we use field control.

### Speed Vs Field Current:



### Speed Vs Armature Current:

