EXPERIMENT NO 5

Object: To determine the speed- torque characteristics of a dc shunt motor.

Theory: In order to determine the speed- torque characteristics of a dc shunt motor, the experimental setup involves the use of two DC machines; one is used as DC shunt motor and another is used as DC generator. The circuit diagram of the experimental set up is as follows:

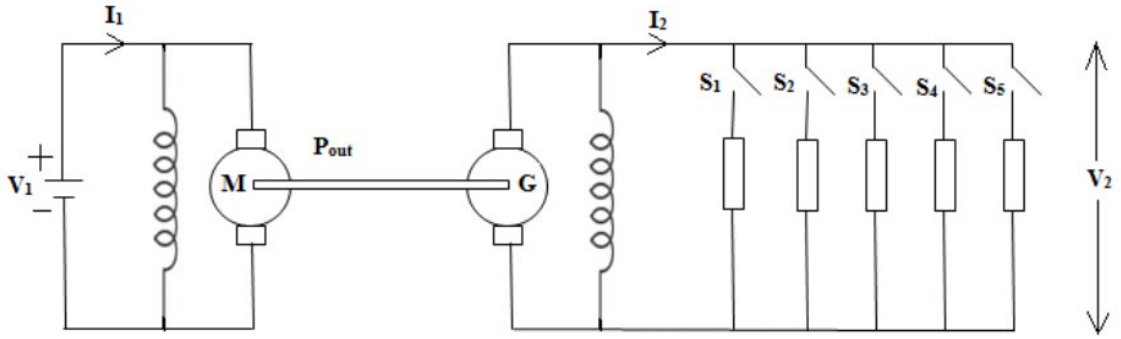

Fig: Experimental Set-up for determining speed- torque characteristics of a dc shunt motor

The electrical input power $P_{in} = V_1 * I_1$, is given at the input terminals of DC shunt motor. The mechanical output (P_{out}) thus developed is given as the input to the DC shunt generator which is initially at no load.
Now, as the electrical load at the output terminals of DC shunt generator increases by switching on the load one by one, the speed at every point is measured. Also the torque at every step is measured with the help of following equations.
The efficiency of a DC motor is given by:

$$\eta_{motor} = P_{out} / P_{in} \quad (1)$$

Therefore, the power outpur of the DC motor will be:

$$P_{out} = \eta_{motor} * P_{in} \quad (2)$$

Also, $P_{out} = \eta_{motor} * V_1 * I_1$

Here, $\eta_{motor} = 0.8$ (assuming)

Now, the expression for the electromagnetic torque developed by the DC motor is determined using the following expression:

$$P_{out} = T_e * \omega \text{ (Watts)} \quad (3)$$

$$T_e = P_{out} / \omega \text{ (Newton-metre)} \quad (4)$$

Here, $\omega = 2\Pi N/60$ (radians/sec)

Observation Table:

S. No.	V_1 (volts)	I_1 (amp)	P_{in} (watts)	P_{out} (watts)	N (rmp)	ω (rad/sec)	T_e (N-m)
No load	136	3.8	516.8	413.44	1171	122.564	3.373
L1	136	4.6	625.6	500.48	1166	122.041	4.100
L2	136	5	680	544	1159	121.308	4.484
L3	136	5.5	748	598.4	1147	120.052	4.984
L4	136	6.2	843.2	674.56	1136	118.901	5.673
L5	136	6.7	911.2	728.96	1125	117.75	6.190

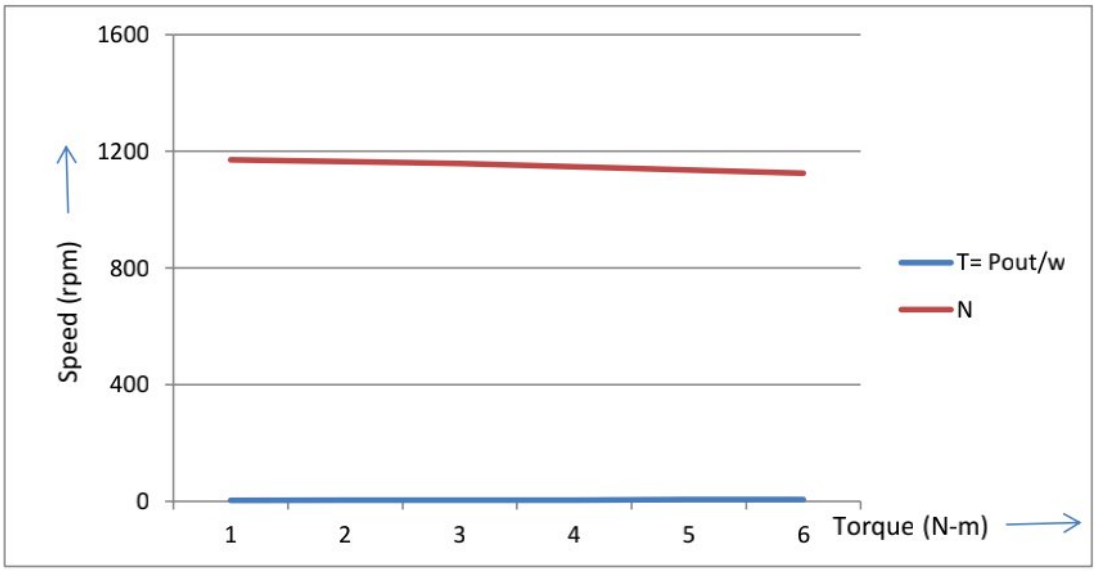

Fig:2 Speed-Torque characteristic of a shunt DC motor

Results: The effect on the speed of DC motor due to change in toque has been observed and the Speed-Torque characteristic of a DC shunt motor has been plotted on graph.

Discussion: As the torque and the load increases, armature current Ia increases, and therefore armature resistance drop (IaRa) increases. The back emf (Eb) decreases as the armature resistance drop (IaRa) increases (Eb = Vt – IaRa). Since speed is proportional to Eb/flux.

Therefore, speed of the dc motor also decreases as the torque on the motor shaft increases.