

3.1.1.12. Close the circuit breaker of the shunt-excited DC motor.

3.1.1.13. Using the 0-125 (V) DC-5 (A) rheostat, slowly increase the armature voltage, V_T , to 125 (V).

Note: Observe the ammeter measuring the current through the armature. As you increase the voltage the current will decrease as the back emf builds up in the motor.

3.1.1.14. Record the values of the armature and field current, terminal voltage, and mechanical speed in Table 8.1. Use the strobetach to measure the mechanical speed of the DC motor. Flash the strobetach on the rotor or shaft of the motor and adjust the dial until there appears to be one stationary block on the rotor. The number on the dial is the mechanical speed of the motor in rpm.

3.1.1.15. Adjust the rheostat until it is in between the minimum and maximum position. Record the results in Table 8.1.

3.1.1.16. Repeat the last step this time when the field is set to its maximum position.

Table 8.1: Measured values of the mechanical speed, armature and field current, and the voltages of a shunt-excited DC motor.

I_f (A)	Measured			Computed
	V_T (V)	I_a (A)	N_m (rpm)	E_a (V)
max	125.2	0.03062	1866 / 1550	123.9
mid	125.0	0.02902	1766 / 1850	123.4
min	125.1	0.02503	1666 / 2200	123.2

3.1.1.17. Calculate the back emf for each case and record the results in Table 8.1.

3.1.1.18. Comment on the results.

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2. Observing the operating characteristics of a shunt DC motor

3.1.2.1. Make sure the motor's field resistance is set to its "max" position.

3.1.2.2. Use a strobetach to measure the mechanical speed, n_m , of the shunt-excited DC motor. Select the high range of the strobetach labeled "HIGH TACH". Flash the light directly on the shaft or on the perpendicular to it. Adjust the dial until you see one stationary block on the shaft of the DC motor.

3.1.2.3. Measure the armature current, I_a , the mechanical speed, n_m , and the torque, T_m , of the DC shunt-excited motor, when the DC separately-excited generator is not loaded. Record the results in Table 8.2

Table 8.2: Measured and computed values of the shunt-excited DC motor

$V_T = 125$ (V)	No-load	1	12	123	1234	12345
N_m (rpm)	1675	1600	1580	?	?	
I_a (A)	0.84/0.15A	0.15A	1.5/0.3	1.45/0.6	1.45/0.6	
T_m (Nm)	0.25	0.95	0.4	0.50	0.55	
P_{in} (W) = $V_T I_a$	100W					
P_{out} (W)	0 W					
Efficiency (%)	100%					

3.1.2.4. Close the generator circuit breaker. Close the switch on the resistance load box labeled "1".

3.1.2.5. Using the generator's field rheostat adjust the generator's armature voltage to $V_{ag} = 110$ (V).

3.1.2.6. If necessary, re-adjust the motor's armature voltage to $V_T = 125$ (V).

3.1.2.7. Repeat steps 3.1.2.3. – 3.1.2.6. for each case in Table 8.2.

3.1.2.8. Once all the measurements are recorded, adjust the shunt-excited motor's field resistance to its minimum position and the separately-excited generator's field to its maximum position. Open each load on the load resistance box then open the separately excited generator's circuit breaker.

3.1.2.9. Adjust the armature voltage to zero volts then open the motor's circuit breaker. Then adjust the excitation voltage of the generator to zero then open the circuit breaker. Next open the circuit breaker labeled "Main AC".

3.1.3.6. Make sure the generator's field resistance is set to its "max" position

3.1.3.7. Close the circuit breaker of the 0-125 (V) DC-5(A) power supply, labeled "PRI.10 SEC. 8", and adjust the voltage of the shunt-excited DC motor to $V_T = 0$ (V).

3.1.3.8. Close the circuit breaker of the series-excited DC motor.

3.1.3.9. Using the 0-125 (V) DC-5 (A) rheostat, slowly increase the armature voltage, V_T , to 90 (V).

3.1.3.10. Using the generator's field rheostat adjust the generator's armature voltage to $V_{ag} = 120$ V.

3.1.3.11. Measure the armature current, I_a , the mechanical speed, n_m , and the torque, T_m , of the DC series-excited motor. Record the results in Table 8.3.

Table 8.3: Measured values of the mechanical speed, armature and field current, and the voltages.

$V_T = 90$ (V)	11680/1205	12	123	1234	12345
n_m (rpm)	1500/1100	1200/20	1500/1210	1780/1260	
I_a (A)	$I_g = 0.11 / E_m = 1.05$	1.2 / 0.22	1.35 / 0.33	0.41 / 1.4	
T_m (Nm)	0.15	0.2	0.27	0.32	

3.1.3.12. Close the switch on the resistance load box labeled "2".

3.1.3.13. If necessary re-adjust the armature voltage of the motor to $V_T = 90$ (V).

3.1.3.14. Re-adjust the armature of the generator to $V_{ag} = 120$ V.

3.1.3.15. Repeat steps 3.1.3.10.-3.1.3.14. for each case in Table 8.3.

3.1.3.16. Once all the measurements are recorded, adjust the the separately-excited generator's field resistance to its maximum position.

3.1.3.17. Adjust the armature voltage to zero volts then open the motor's circuit breaker. Then adjust the excitation voltage of the generator to zero then open the generator's circuit breaker. Next open the circuit breaker labeled "Main AC"

3.1.3.18. Open each load on the load resistance box.

3.1.3.19. Plot the speed-torque characteristics of a shunt-excited DC motor, i.e. $n_m = f(T_m)$

3.1.3.20. Plot the torque-armature current characteristics of a shunt-excited DC motor, i.e. $T_m = f(I_a)$

3.1.3.21. Compute the speed regulation of a shunt-excited DC motor using the