THE HASHMITE UNIVERSITY
ELECTRICAL ENGINEERING DEPARTMENT

ELECTRICAL MACHINES LAP

Lab Sheet

DC-Shunt Motor.

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DC-Shunt Motor

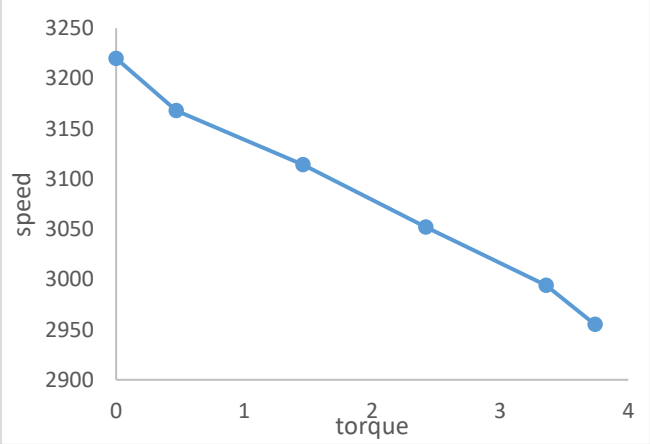
A) Measuring some Characteristics of DC Shunt Motor.

Table 4-1

I_f(A) constant	I_a(A)	V_t(v) constant	P in (W)	n(rpm)	τ(Nm)	P_{out}(W)	$\eta\%$
0.28	0.53	220	178.2	3220	0	0	0
0.28	1.5	220	391.6	3168	0.47	155.923	39.81%
0.28	3.0	220	721.6	3114	1.46	476.102	65.97%
0.28	4.5	220	1051.6	3052	2.42	773.443	73.55%
0.28	6.0	220	1381.6	2994	3.36	1053.463	76.25%
0.28	6.7	220	1535.6	2955	3.74	1157.331	75.36%

$$Pin = Vt * (Ia + If)$$
$$Pout = \tau * (\frac{2\pi n}{60})$$
$$\eta\% = \frac{Pout}{Pin} * 100\%$$
$$V_t = Ea + (Ia * Ra)$$

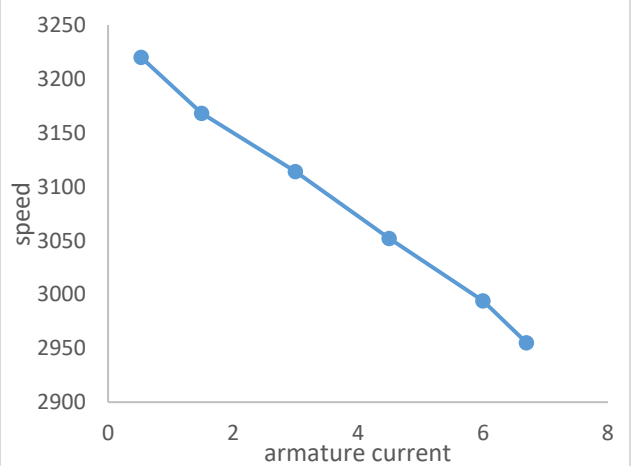
1. Plot speed versus torque curve. Explain the nature of the curve?



from the graph we note that it is almost a straight line (we said almost because of error).

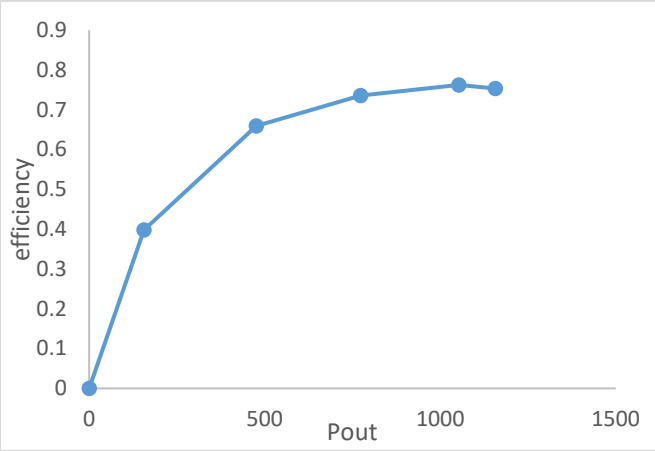
And as we can see from the graph there is inversely relationship between speed versus torque

2. Plot speed versus armature current curve. Explain the nature of the curve?



As we can see from the graph there is inversely relationship between speed armature current, when armature current increase, the speed of motor decrease (and it almost liner relationship)

3. Plot efficiency versus output power curve. Explain the nature of the curve?



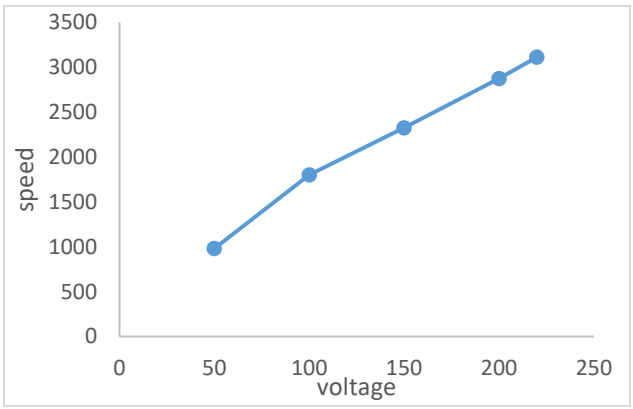
As we can see there is almost exponential relationship between efficiency and output power, that means that the efficiency will increase until a certain output power then it will be constant.

B) Speed control of a DC Shunt Motor.

Table 4-2

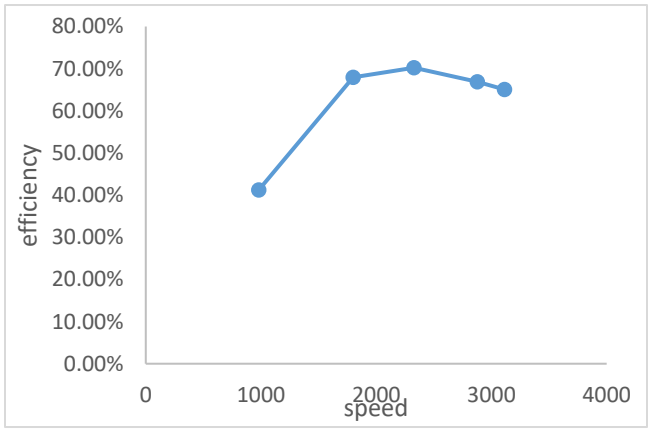
I_f(A)	I_a(A)	V_t(v)	P_{in} (W)	$n(rpm)$	τ(Nm)	P_{out}(W)	η%
0.28	3.0	220	721.6	3113	1.44	469.429	65.05%
0.25	3.06	200	662	2876	1.47	442.725	66.87%
0.18	3.29	150	520.5	2327	1.50	365.524	70.22%
0.12	4.07	100	419	1801	1.51	284.786	67.96%
0.05	7.47	50	376	980	1.51	154.964	41.21%

1. Plot speed versus voltage curve. Explain the nature of the curve?



When the voltage increase, the speed is also increase so it is a direct relationship

2. Plot efficiency versus speed curve. Explain the nature of the curve?



There is nonlinear relation between the efficiency and the speed, and we can see that for a certain value the curve increases and for others it is decrease.

3. Why the armature current is increasing when the terminal voltage is decreasing?
When (Vt) decrease, the (If) decrease, so that the flux progressively decreases, so (Ea) decrease then the Ia will increase.

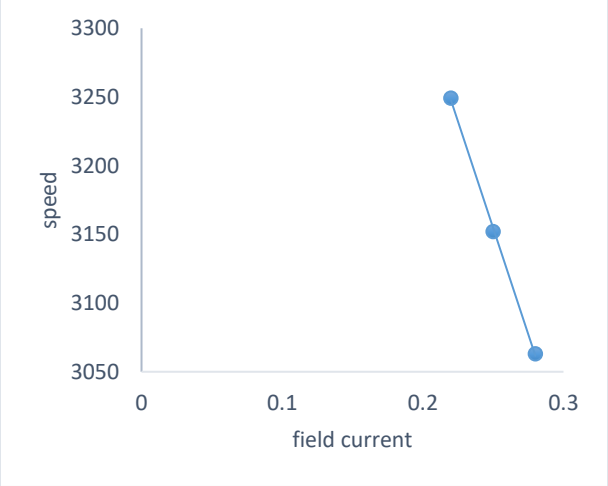
2 - By Altering the Field Resistance.

Table 4-4

I_f(A)	I_a(A)	V_t(v) constant	P_{in}(W)	$n(rpm)$	τ(Nm) ≈constant	P_{out}(W)	η%
0.28	3.82	220	902.7	3063	2	641.513	71.06%
0.25	3.86	220	904.2	3152	2	660.153	73.01%
0.22	3.91	220	908.6	3249	2	680.468	74.89%

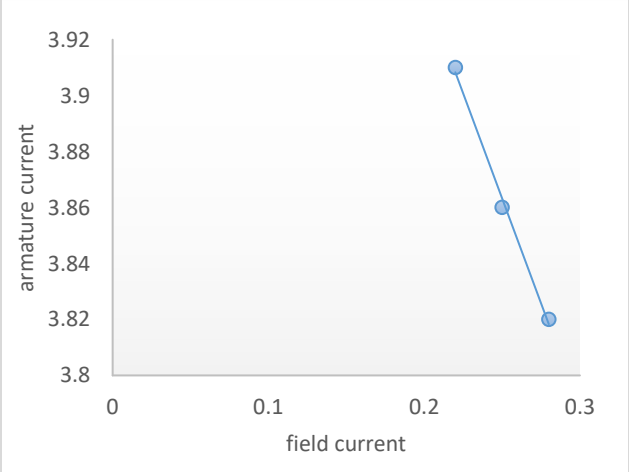
Questions:

1. Plot the curve of speed versus field current and explain the nature of the curve.



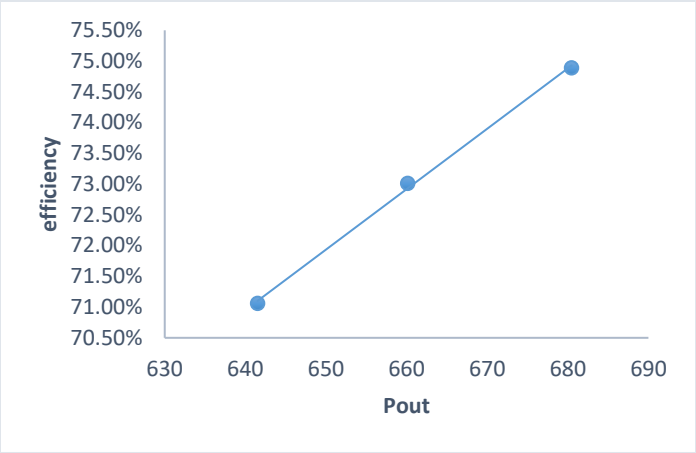
The relation between the speed and the field current is inverse relation and it is linear

2. Plot the curve of armature current versus field current and explain the nature of the curve.



When the field current increase, the armature current decrease so the relation is inverse and linear.

3. Plot the efficiency versus output power curve.



When the efficiency increase, the output power increase so the relation is direct and linear.

4. What happens to speed when the excitation rheostat is increased?

   when the field rheostat is increased, field current decreases, which decreases the flux (speed inversely proportional to flux), thereby increasing speed.

5. Can the speed of shunt motor be reduced by varying field resistance? Why?
   since Ea= Kϕw, when the field resistance decreases, the field current increase so flux also increase and the internal generated voltage increase e, but (Ia) decrease and with its decrease overcome the increase in the flux, the induced torque decrease (τ=Kϕ Ia) and the speed also decreased. With the speed decreased, (Ea) decrease and (Ia) increased until the induced torque equals the load torque at lower speed.

C) Reversing the Direction of Rotation of DC shunt Motor.

Questions:

1. If the direction of the current through the field is changed, what happens?

   If we change the direction of the field current, the direction of the motor will be reversed.

2. If the direction of the current through the armature is changed, what happens?

   If we change the direction of the armature current, the direction of the motor will be reversed.

3. If the direction of the current through both the armature and field is changed, what happens? Explain why?

   when we reversed both directions of the armature and field current, it will cancel the effect so that the motor will rotate in the original direction.

Conclusions:

1) it is flux and back emf is Almost constant according to N is directly proportional to Eb/flux.
2) This motor is used where constant speed and moderate torque is required like as leath machine.
3) we cannot control speed below rated speed.
4) It has a steady torque speed char, allowing for smooth speed control.