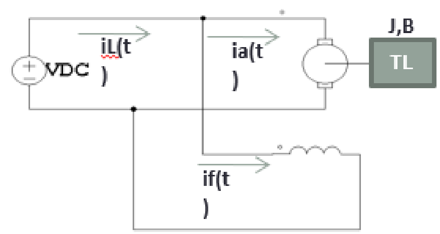
Title of the Exercise: Speed control of **Self Excited DC Shunt Motor**

Date: 13.10.2020

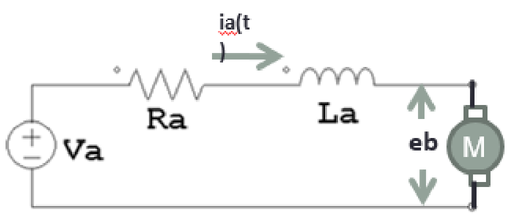
Aim: To obtain the speed control characteristics of Self Excited DC Shunt Motor.

Tool used: MATLAB and Simulink

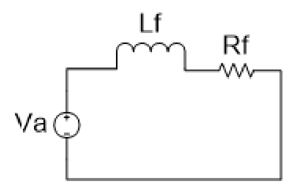
Electrical Circuit:



For Armature Circuit



For Field Circuit



Parameters used for the study:
Input Parameters -
Ra = 0.6 (Armature resistance in ohms.)
La = 0.012 (Armature Inductance in Henry)
Lf = 120 (Field Inductance in Henry)
Rf = 240 (Field Resistance in ohms)
J = 1 (Moment of Inertia)
B = 0 (Friction Coefficient)
Laf = 1.8 (Mutual Inductance between field and armature)
Va = 240 (Supply voltage)
W (Speed of the DC Motor)
P = 2.5 (Power)

Theoretical Analysis: A DC shunt motor is a type of self-excited DC motor where the field windings are shunted to or are connected in parallel to the armature winding of the motor.
Since they are connected in parallel, the armature and field windings are exposed to the same supply voltage.

For Armature Circuit

$$V_a = L_a \frac{di_a}{dt} + i_a R_a + e_b$$

$$e_b = i_f . L_{af} . w$$

For Field Circuit

$$V_a = L_f \frac{di_f}{dt} + i_f R_f$$

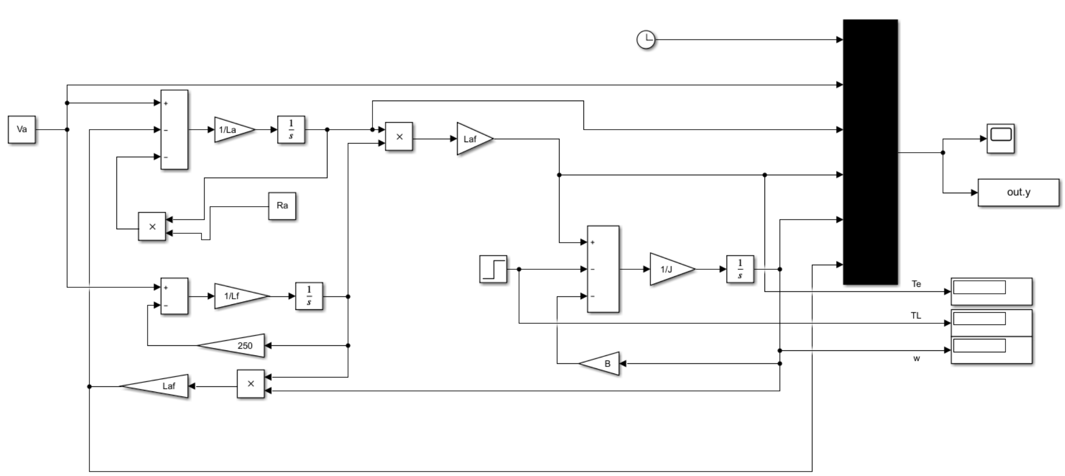
$$T_e = L_{af} . i_f . i_a$$

$$T_e = T_L + j \frac{dw}{dt} + B.w$$

Procedure for simulation study:

1. Initialize the input parameters and write the coding according to the requirement of plots in m file and save it.
2. Open a new Simulink, make the mathematical modelling as per circuit diagram and save it.
3. Run the m file first, followed by the Simulink file.
4. Vary the value of R_a, V_a, R_f and T_L as per the speed control method used and note the values of T_e and w .
5. Using the plot command in MATLAB, plot the graphs between speed(w) and electromagnetic torque(T_e) for each speed control method.

Simulink File:



M file for simulation study

```
Ra = 0.6 ;
La = 0.012 ;
Lf = 120;
Rf = 240;
J = 1;
B = 0 ;
Laf = 1.8 ;
Va = 240 ;
P = 2.5 ;
disp('run simulation, type "return" when ready to
return')
keyboard
subplot(6, 1, 1)
plot(out.y.signals.values(:, 1),
out.y.signals.values(:, 2))
xlabel('time')
ylabel('Applied Voltage')
subplot(6, 1, 2)
plot(out.y.signals.values(:, 1),
out.y.signals.values(:, 3))
ylabel('Ia')
subplot(6, 1, 3)
plot(out.y.signals.values(:, 1),
out.y.signals.values(:, 4))
ylabel('Te')
subplot(6, 1, 4)
plot(out.y.signals.values(:, 1),
out.y.signals.values(:, 5))
ylabel('W(omega)')
subplot(6, 1, 5)
plot(out.y.signals.values(:, 1),
out.y.signals.values(:, 6))
ylabel('Eb')
```

M file for obtaining the plots:

```
% Ra Control
%0.5 ohm
a= [5 5.333 132.6
   10 10.06 131.8
   15 15.13 131
   20 20.09 130.2
   25 25.24 129.5];
%1 ohm
b= [5 4.668 131.8
  10 9.949 130.2
  15 14.99 128.7
  20 19.94 127.2
  25 24.71 125.6];
%1.5 ohm
c=[5 4.837 131
  10 9.984 128.7
  15 14.96 126.4
  20 19.94 124.1
  25 24.84 121.8];


plot(a(:,2),a(:,3))
hold on
plot(b(:,2),b(:,3))
hold on
plot(c(:,2),c(:,3))
hold on
```

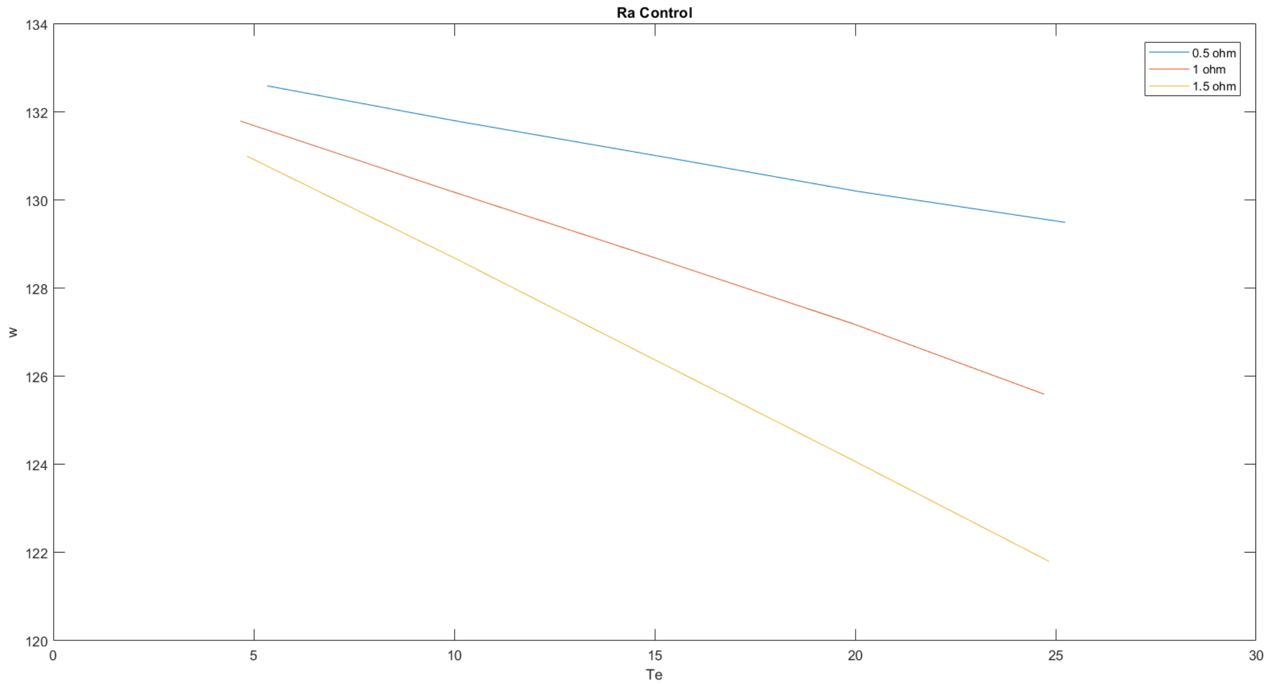
```
%Va Control
%230V
p= [5 4.647 132.3
   10 9.95 131.3
   15 14.97 130.3
   20 19.91 129.3
   25 24.98 128.3];
%240V
q= [5 4.973 132.4
   10 9.76 131.5
   15 14.96 130.6
   20 19.94 129.6
```

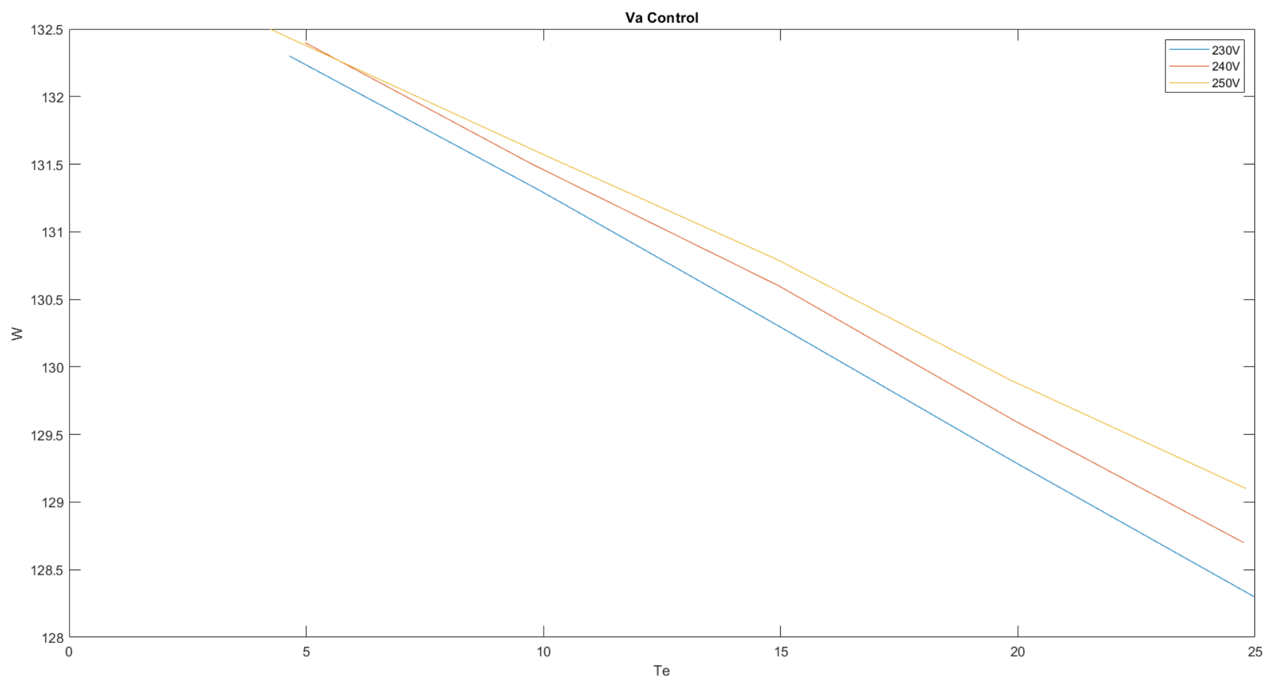
```
   25 24.76 128.7];
%250V
r= [5 4.233 132.5
   10 9.818 131.6
   15 14.89 130.8
   20 19.86 129.9
   25 24.81 129.1];


plot(p(:,2),p(:,3))
hold on
plot(q(:,2),q(:,3))
hold on
plot(r(:,2),r(:,3))
hold on
```

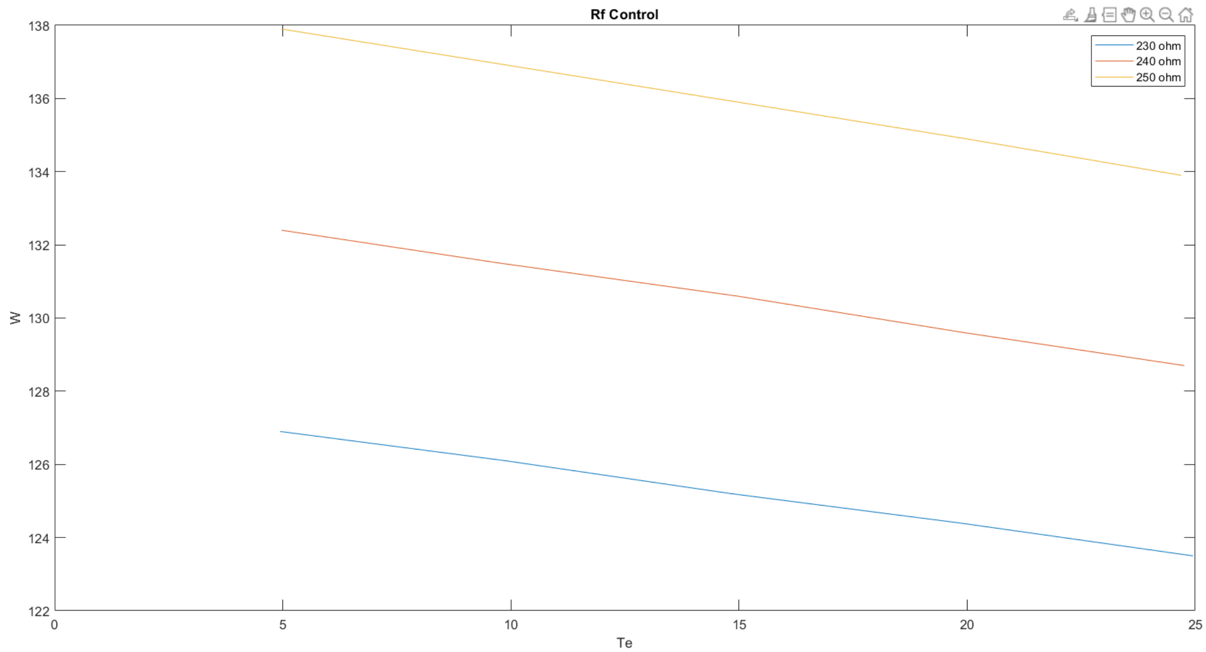
```
%Rf Control
%230 ohm
x= [5 4.941 126.9
   10 9.881 126.1
   15 14.83 125.2
   20 19.83 124.4
   25 24.95 123.5];
%240 ohm
y= [5 4.973 132.4
   10 9.76 131.5
   15 14.96 130.6
   20 19.94 129.6
   25 24.76 128.7];
%250 ohm
z= [5 4.965 137.9
   10 9.975 136.9
   15 14.98 135.9
   20 19.97 134.9
   25 24.69 133.9];


plot(x(:,2),x(:,3))
hold on
plot(y(:,2),y(:,3))
hold on
```

```
plot(z(:,2),z(:,3))
hold on
```

Results and Discussions:







Observation Tables:

For Ra control:

Ra= 0.5 ohm

T_L	T_e	W
5	5.333	132.6
10	10.06	131.8
15	15.13	131
20	20.09	130.2
25	25.24	129.5

Ra= 1 ohm

T_L	T_e	W
5	4.668	131.8
10	9.949	130.2
15	14.99	128.7
20	19.94	127.2
25	24.71	125.6

Ra= 1.5 ohm

T_L	T_e	W
5	4.837	131
10	9.984	128.7
15	14.96	126.4
20	19.94	124.1
25	24.84	121.8

For Va control:

Va= 230V

T_L	T_e	W
5	4.647	132.3
10	9.95	131.3
15	14.97	130.3
20	19.91	129.3
25	24.98	128.3

Va= 240V

T_L	T_e	W
5	4.973	132.4
10	9.76	131.5
15	14.96	130.6
20	19.94	129.6
25	24.76	128.7

Va= 250V

T_L	T_e	W
5	4.233	132.5
10	9.818	131.6
15	14.89	130.8
20	19.86	129.9
25	24.81	129.1

For Rf control:

Rf= 230 ohm

T_L	T_e	W
5	4.941	126.9
10	9.881	126.1
15	14.83	125.2
20	19.83	124.4
25	24.95	123.5

Rf= 240 ohm

T_L	T_e	W
5	4.973	132.4
10	9.76	131.5
15	14.96	130.6
20	19.94	129.6
25	24.76	128.7

Rf= 250 ohm

T_L	T_e	W
5	4.965	137.9
10	9.975	136.9
15	14.98	135.9
20	19.97	134.9
25	24.69	133.9

Conclusion:
Hence, speed control characteristics of a self excited DC shunt motor has been obtained for different values of load torque.

Inference:
The speed control characteristics of a self excited DC shunt motor gives the variation of speed vs electromagnetic torque.

References:
Nil