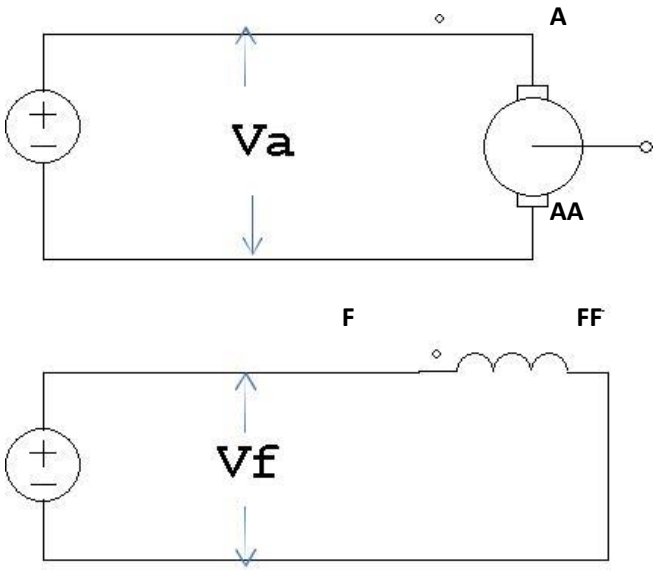
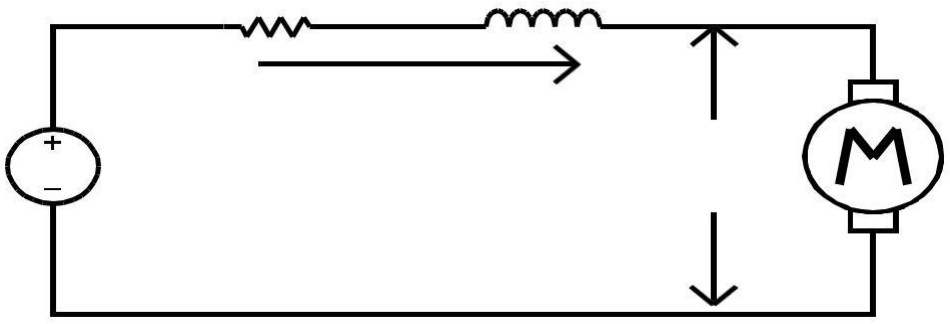
Title of the Exercise: Speed control Separately excited DC motor
Date: 13/10/2020
Aim: To obtain speed control characteristic of a Separately excited DC motor.
Tool used : MATLAB and SIMULINK

Electrical Circuit:



Parameters used for the study:
Armature Resistance R_a=1Ω,
Armature inductance L_a=0.046H,
Frictional coefficient B=0.008, Back emf constant k=0.55,
Input voltage V_a =220 volts,
Moment of inertia J=0.093 Rated load=2.5HP

Theoretical Analysis:



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

$$e_b = k.\omega$$

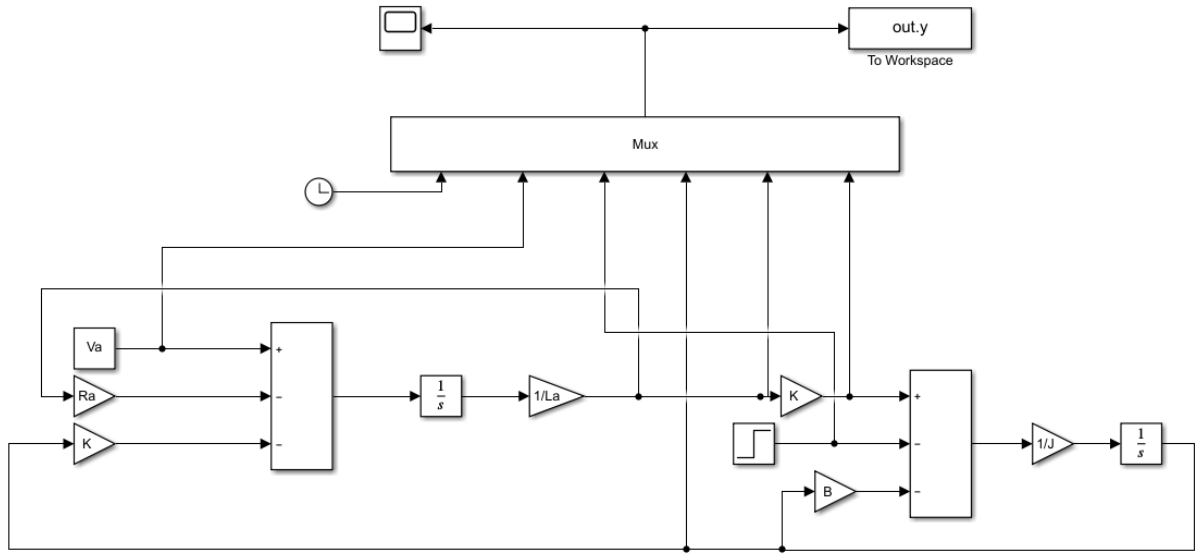
$$T_e = k.i_a$$

$$T_e = T_L + j\frac{d\omega}{dt} + B.\omega$$

Procedure:

- Step1-Initialize the input parameters and write coding for the as per requirement of plots in m file and save it
- Step 2-open new Simulink and make mathematical modelling as per circuit diagram and save it
- Step 3-Run the m file first, after that run Simulink file.
- Step 4- Vary the value of load torque T_L from 0 to +20 and then tabulate the corresponding values of armature current, speed and electromagnetic torque.
- Using the 'plot' command in MATLAB, plot the electrical and mechanical characteristics of the DC machine.

Simulink file:



M file for simulation study:

```
Ra = 1;
La = 0.046;
J = 0.093;
B = 0.008;
K = 0.55;
Va = 220;
tstop = 5;
```

```
disp('run simulation)
keyboard subplot(6,1,1)
plot(out.y(:,1),out.y(:,2),'b--')
title('Input volatage')
ylabel('Va in V')
subplot(6,1,2)
plot(out.y(:,1),out.y(:,3),'r--')
title('armature current')
ylabel('I in A') subplot(6,1,3)
plot(out.y(:,1),out.y(:,4),'g-o')
title('Electromagnetic Torque')
ylabel('Te in N/m')
subplot(6,1,4)
plot(out.y(:,1),out.y(:,5),'y-.')
title('Load Torque')
ylabel('Tl in N/m')
subplot(6,1,5)
plot(out.y(:,1),out.y(:,6),'m-o')
title('Speed')
ylabel('Wr in rad/sec')
```

M file for obtaining the characteristics:

```
% ---------Ra control----------------
a =[ 373.6 7.987
 357.5 12.86
 341.4 17.73
 325.3 22.6];

b=[349.3 7.656
 318.8 12.26
 288.3 16.87
 257.8 21.48];

c=[288.1 6.785
 231.7 10.17
 175.3 13.58
 118.9 16.98];

figure('Name','Ra control');

plot(a(:,2),a(:,1))
hold on
plot(b(:,2),b(:,1))
hold on
plot(c(:,2),c(:,1))
```

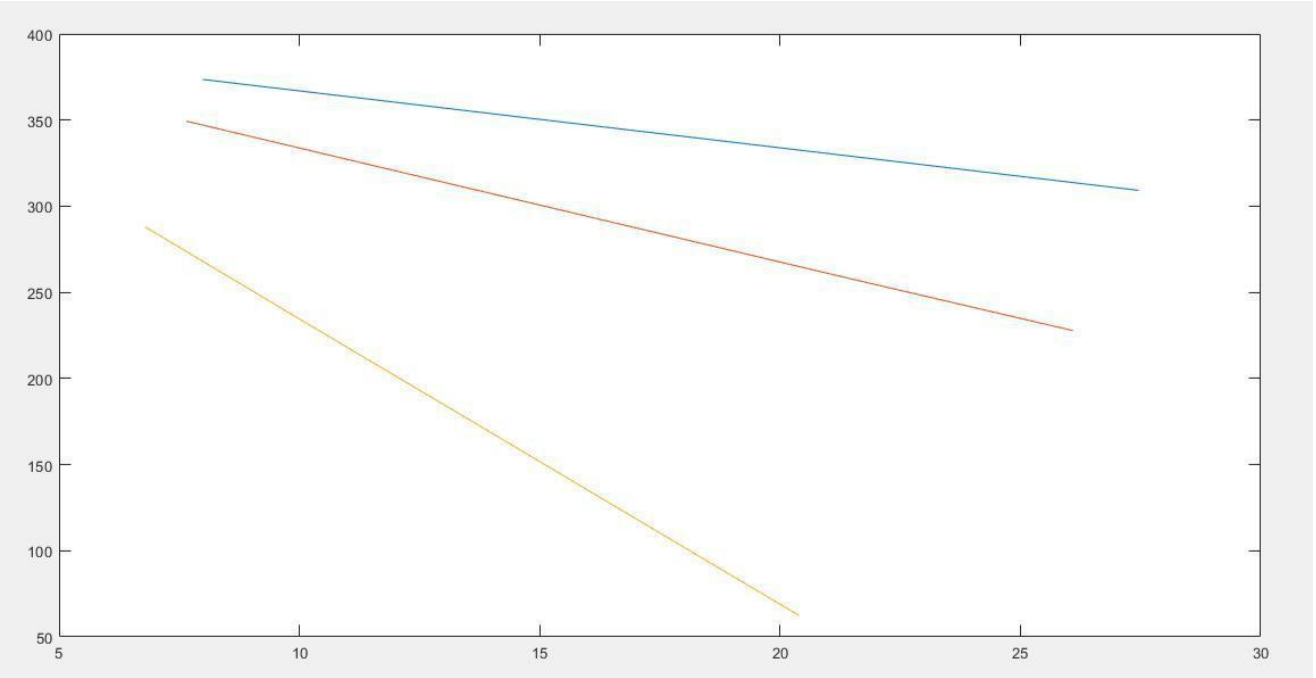
```
% ------Va control-------------------
a =[ 373.6 7.987
 357.5 12.86
 341.4 17.73
 325.3 22.6];

b=[ 391.3 8.13
    375.20 13
    359.1 17.87
    342.99 22.74];

c=[355.88 7.85
 339.0 12.72
 323.2 17.59
 307.6 22.46];

figure('Name','Va control')

plot(a(:,2),a(:,1))
hold on
plot(b(:,2),b(:,1))
hold on
plot(c(:,2),c(:,1))

% --------- Flux control-------------
a =[ 373.6 7.987
 357.5 12.86
 341.4 17.73
 325.3 22.6];

b = [345.1 7.761
 331.5 12.65
 317.9 17.54
 304.3 22.43];

c=[320.8 7.568
 308.9 12.47
 297.3 17.38
 285.7 22.29];

figure('Name','Flux control')

plot(a(:,2),a(:,1))
hold on
plot(b(:,2),b(:,1))
hold on
plot(c(:,2),c(:,1))
```

Results and Discussions:

CHARACTERISTICS:

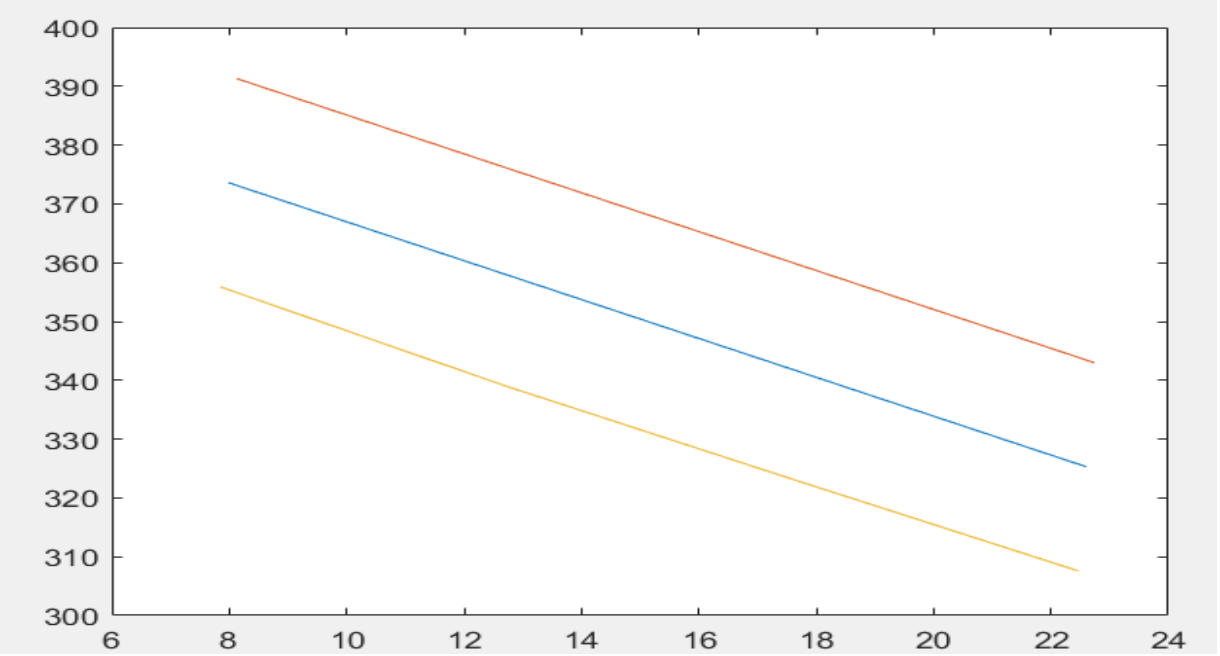
For Ra control:

W vs Te graph for Ra=1,2,5



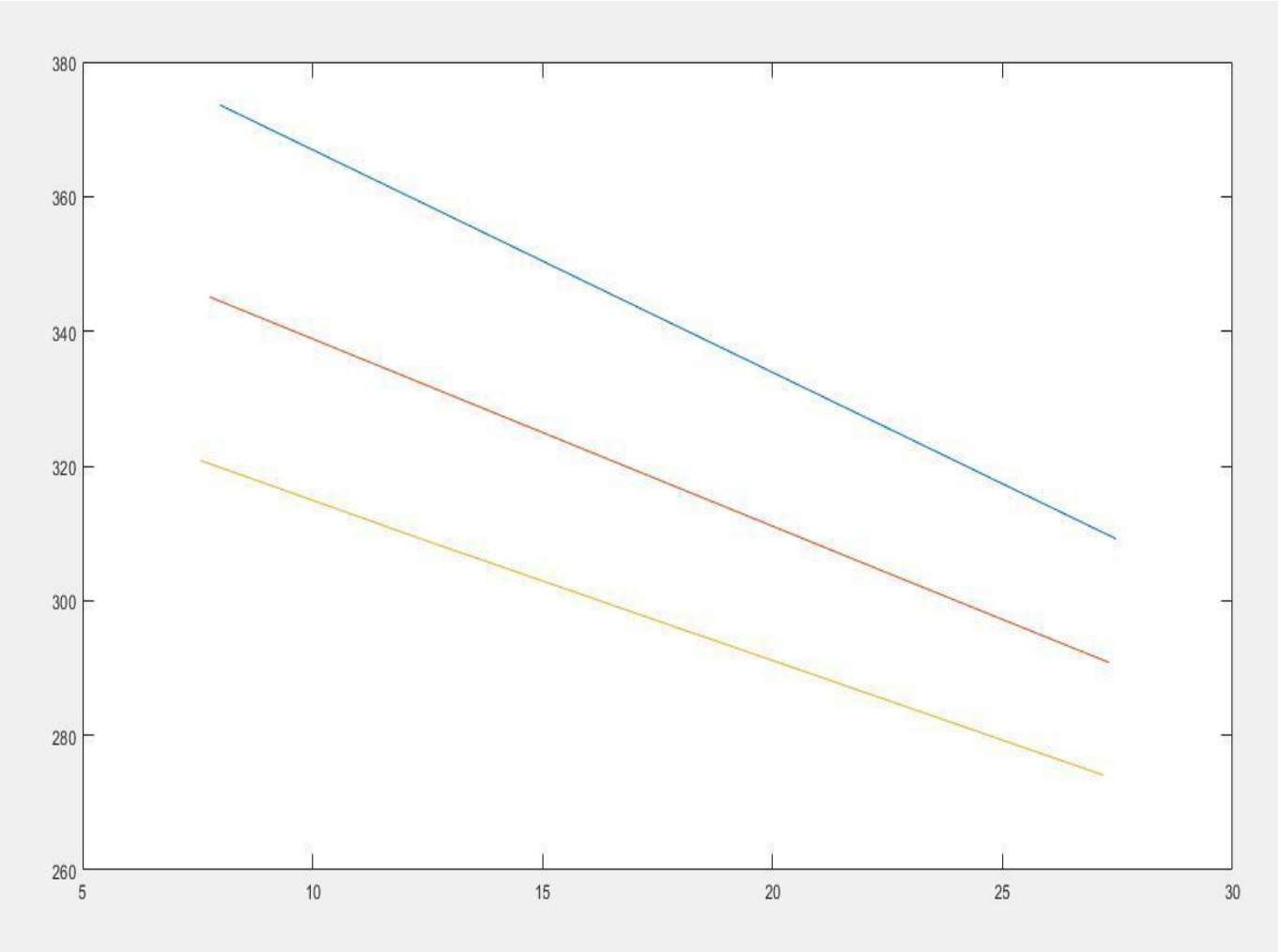
For Va control:

W vs Te graph for Va=210,220,230



For flux control:

W vs Te graph for k= 0.55,0.6.0.65



Observations:

Separately Excited DC motor:

Positive load torque (simulation values)

For Ra control:

Ra=1

Tl	W	Te
5	373.6	7.987
10	357.5	12.86
15	341.417.73	
20	325.322.6	

Ra=2

Tl	W	Te
5	349.3	7.656
10	318.8	12.26
15	288.3	16.87
20	257.8	21.48

Ra=5

Tl	W	Te
5	288.1	6.785
10	231.7	10.17
15	175.3	13.58
20	118.9	16.98

For Va control:

VA = 220

Tl	W	Te
5	373.6	7.987
10	357.5	12.86
15	341.417.73	
20	325.322.6	

VA=230

Tl	W	Te
5	391.30	8.13
10	375.20	13
15	359.1	17.87
20	342.99	22.74

VA=210

Tl	W	Te
5	355.88	7.85
10	339.0	12.72
15	323.2	17.59
20	307.6	22.46

For flux control:

K= 0.55

Tl	W	Te
5	373.6	7.987
10	357.5	12.86
15	341.4	17.73
20	325.3	22.6

K= 0.6

Tl	W	Te
5	345.1	7.761
10	331.5	12.65
15	317.9	17.54
20	304.3	22.43

K=0.65

Tl	W	Te
5	320.8	7.568
10	308.9	12.47
15	297.3	17.38
20	285.7	22.29

Conclusion:

Hence, the speed control characteristics of a separately excited DC Motor have been obtained for different values of Load torque.

Inference:

The speed control characteristics of a separately excited DC motor give the variation of: Speed vs electromagnetic torque

References

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