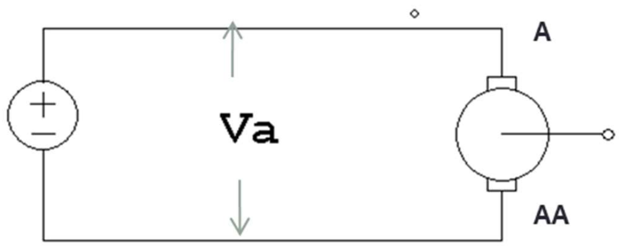
Title of the Exercise: Separately Excited DC motor

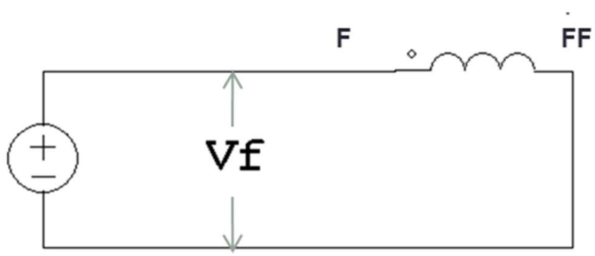
Date: 11.9.2020

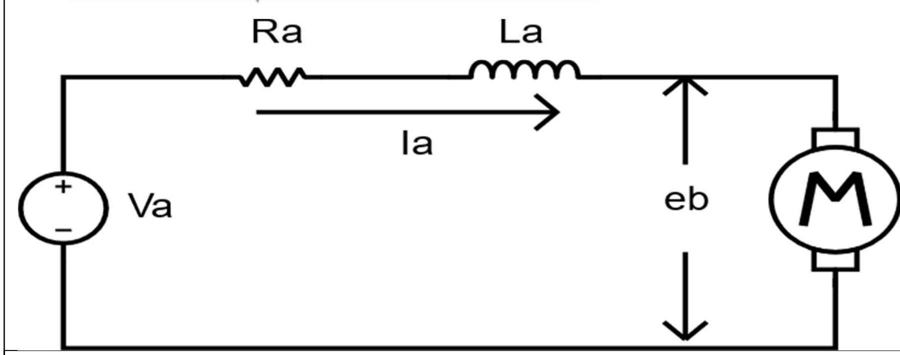
Aim: To Simulate the dynamic modal of Separately Excited DC motor with field current constant and plot the electrical and mechanical characteristics curves and also analyze with theoretical results.

Tool used: MATLAB

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:

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

$$e_b = k\omega$$

$$Te = ki_a$$

$$Te = T_L + \frac{j\,dw}{dt} + B\omega$$

Calculations (Predetermination):

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

$$e_b = k\omega$$

$$T_e = ki_a$$

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

at steady state

$$\frac{di_a}{dt} = 0, \quad \frac{d\omega}{dt} = 0$$

On substitution.

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

$$\Rightarrow 220 = i_a + 0.55\,\omega \qquad - (1)$$

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

$$\Rightarrow 0.55 i_a = 20 + 0.008\,\omega \qquad - (2)$$

$$e_b = 0.55\omega, \quad T_e = 0.55 i_a \qquad - (3, 4)$$

Solving (1), (2), (3) & (4) we get

$i_a = 41.09$ A

$\omega = 325.28$ rad/sec

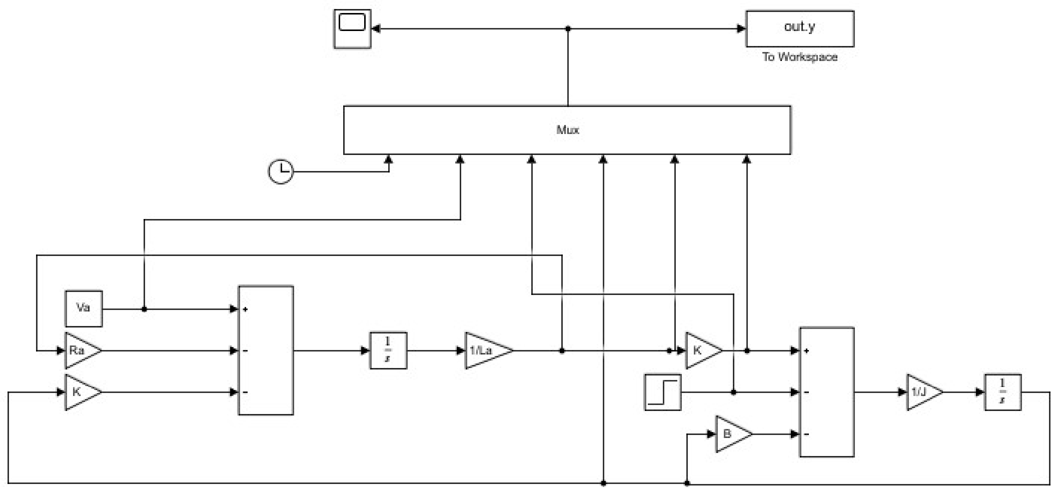
$e_b = 178.9$ V

$T_e = 22.60$ Nm

Procedure for simulation study:

- **Step1-Write the coding for Initialize the input parameters and as per requirement of plots in m file and save it**
- **Step 2-open new Simulink file and make mathematical modelling as per circuit diagram and save it**
- **Step3-Run the m file first, after that run Simulink file**
- **Step4-View the result in Scope**
- **Step5- Again run m file and view the plots**
- **Step6-Make various plots and write the Results**

Simulation Diagram and m.file coding:



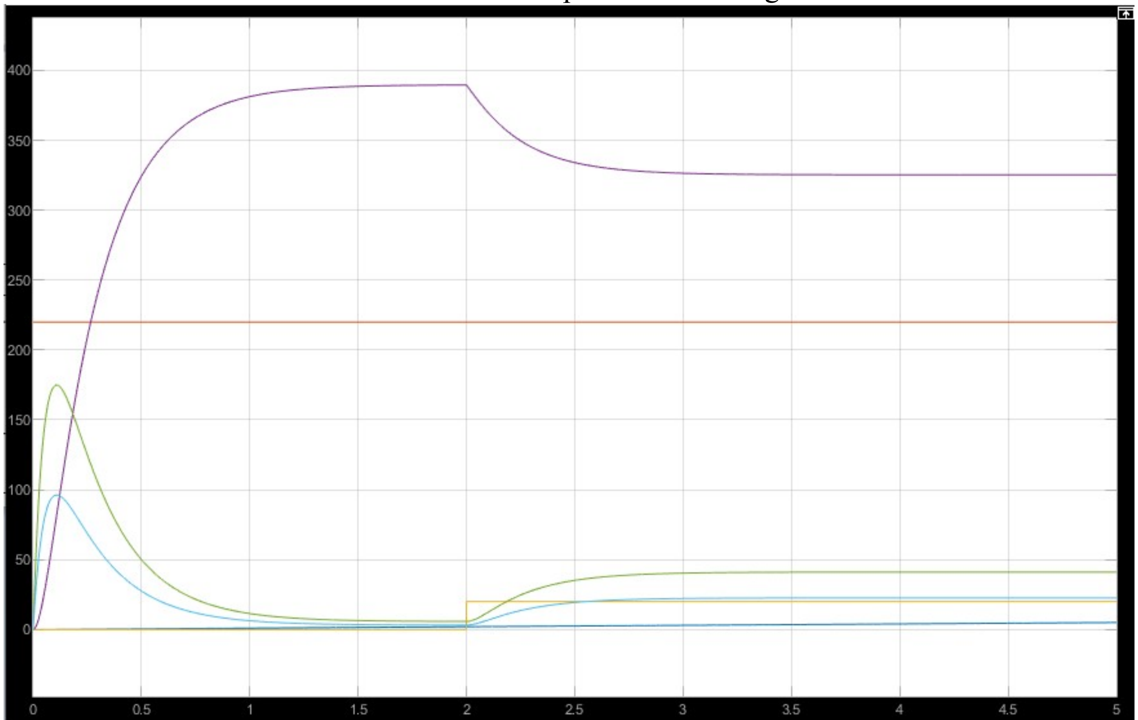
Mfile coding:

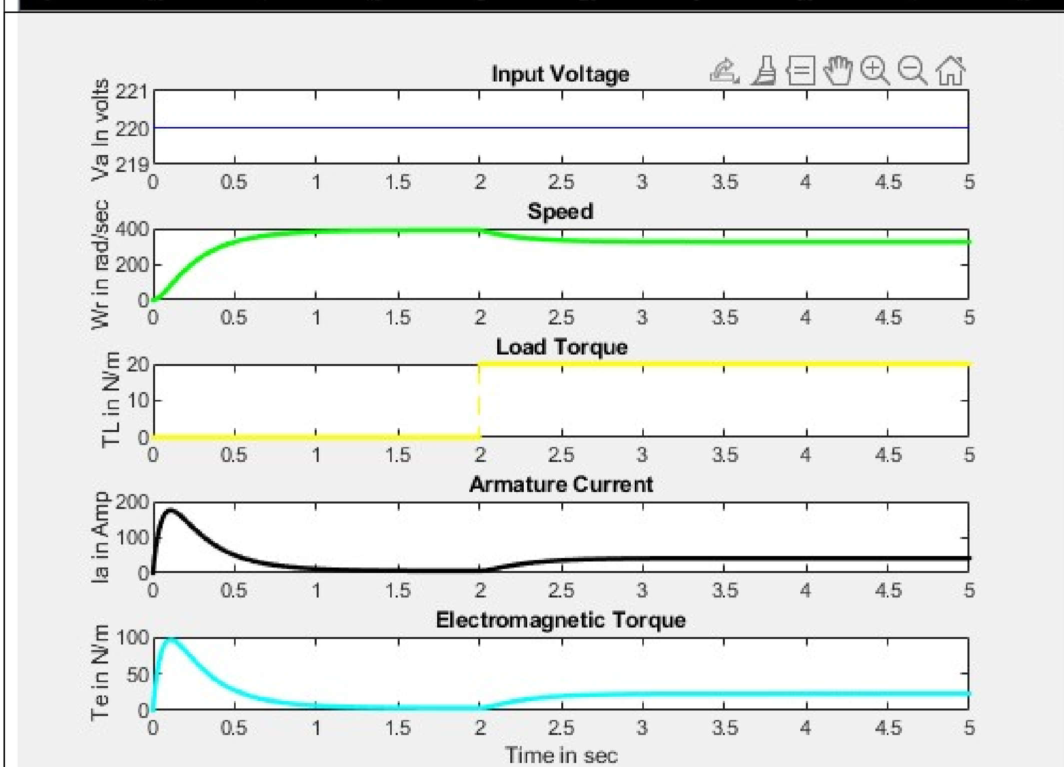
```
Ra= 1;
La = 0.046;
B= 0.008;
K= 0.55;
Va= 220;
J= 0.093;
Load= 2.5;
keyboard
subplot(5,1,1)
%nexttile
plot(out.y.signals.values(:,1),out.y.signals.values(:,2),'b-')
title('Input Voltage')
ylabel('Va In volts')
subplot(5,1,2)
plot(out.y.signals.values(:,1),out.y.signals.values(:,4),'g--.')
title('Speed')
ylabel('Wr in rad/sec')
subplot(5,1,3)
plot(out.y.signals.values(:,1),out.y.signals.values(:,3),'y--.')
title('Load Torque')
ylabel('TL in N/m')
subplot(5,1,4)
plot(out.y.signals.values(:,1),out.y.signals.values(:,5),'k--.')
title('Armature Current')
ylabel('Ia in Amp')
subplot(5,1,5)
```

```
plot(out.y.signals.values(:,1),out.y.signals.values(:,6),'c--.')
title('Electromagnetic Torque')
ylabel('Te in N/m')
xlabel('Time in sec')
```

Results and Discussions:

This section contains both waveforms with respect to time along with the theoretical value.





Comparison (Observations):

Variable at (t=5sec)	Theoretical value	stimulation
ia	41.09A	41.08A
W	352.28 rad/sec	325.3 rad/sec
Te	22.60N/m	22.60N/m

Conclusion: The theoretical value is the same as the simulation results

Inference: Analysis of the outputs obtained from this experiment allow us to make the following conclusions –

1) The speed can be control by changing the armature voltage and changing field flux.

2) The electro magnetic torque is proportional to armature current.

REFERENCES:NIL