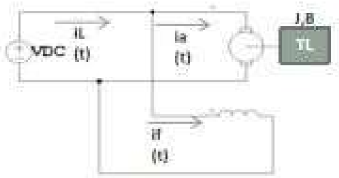
Title of the Exercise: Self Excited DC Shunt Motor

Date: 11.9.2020

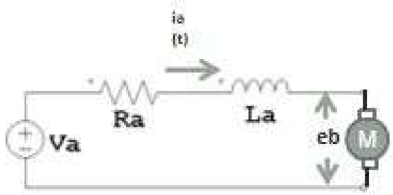
Aim: To Simulate the dynamic modal of a Self Excited DC Shunt Motor and plot various Characteristics curves and analyzes the result.

Tool used: MATLAB and Simulink

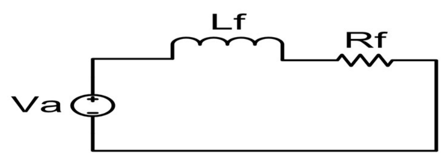
Electrical Circuit:



Armature circuit :



Field Circuit:



$V_a = L_a(di_a/dt) + i_a.R_a + E_b$

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

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

$T_e = T_L + j(dw/dt) + Bw$

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.

Calculations (Predetermination):

$V_a=L_a(di_a/dt)+i_a.R_a+E_b$

$E_b=(i_f).(La_f).(w)$

$V_a=L_f(di_f/dt)+(i_f.R_f)+E_b$

$T_e=i_f.La_f.ia_a$

$T_e=T_L + j(dw/dt) + Bw$

At steady state, $di_a/dt = 0$, $di_f/dt = 0$, $dw/dt = 0$

$V_a= ia.R_a+R_b$

$E_b = i_f.La_f.w$

$V_e = i_f.R_f$

$T_e = La_f.i_f.i_a$

$T_e = T_L + B.w$

Substituting the given values, we get

$- 240 = 0.6i_a+R_b$

$E_b = 1.8.i_f.w$

$240 = 240i_f$

$T_e = 180.i_f.i_a$

$T_e = 20+ 0w=20$

Solving the above equations at steady state (t=10), we get,

$i_f = 1A$

$T_e = 20V$

$I_a= 11.11A$

$E_b = 1.8i_f.$

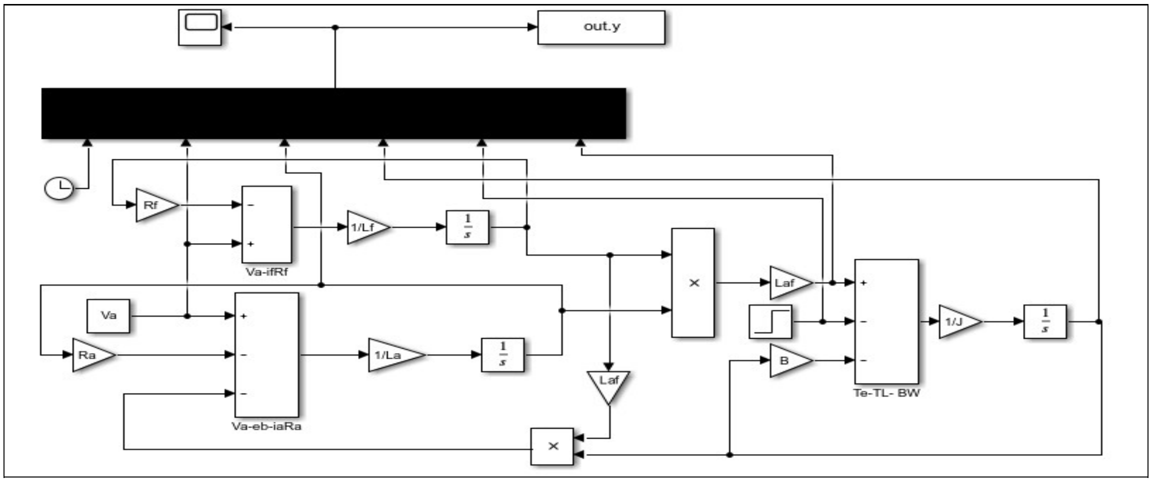
$E_b= 233.28V$ $W = 129.6$ rad/sec

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. View the result in Scope.
5. Run the m file again and view the plots.
6. Make various plots and write the results.

Simulation Diagram and m.file coding :

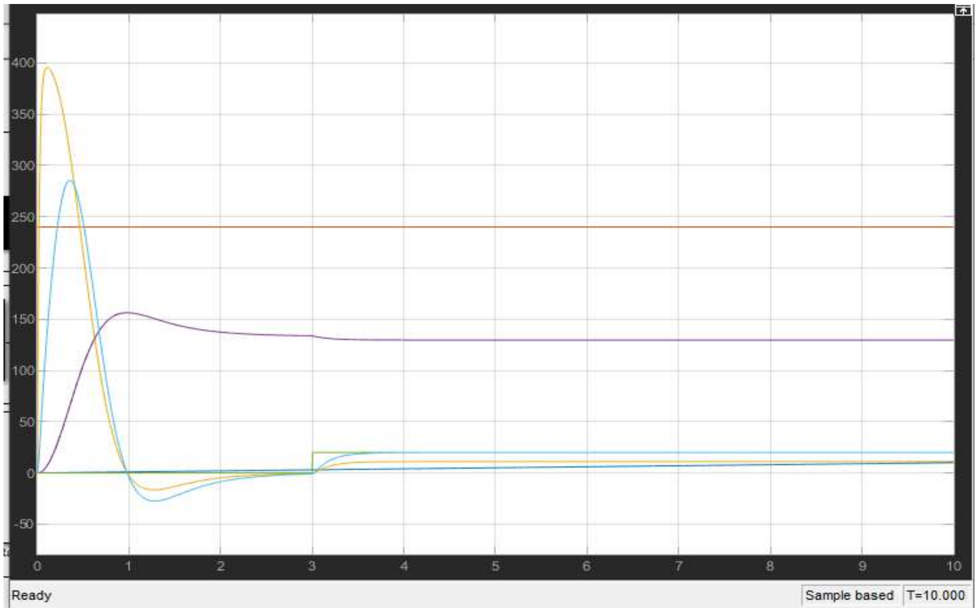
Simulation diagram:

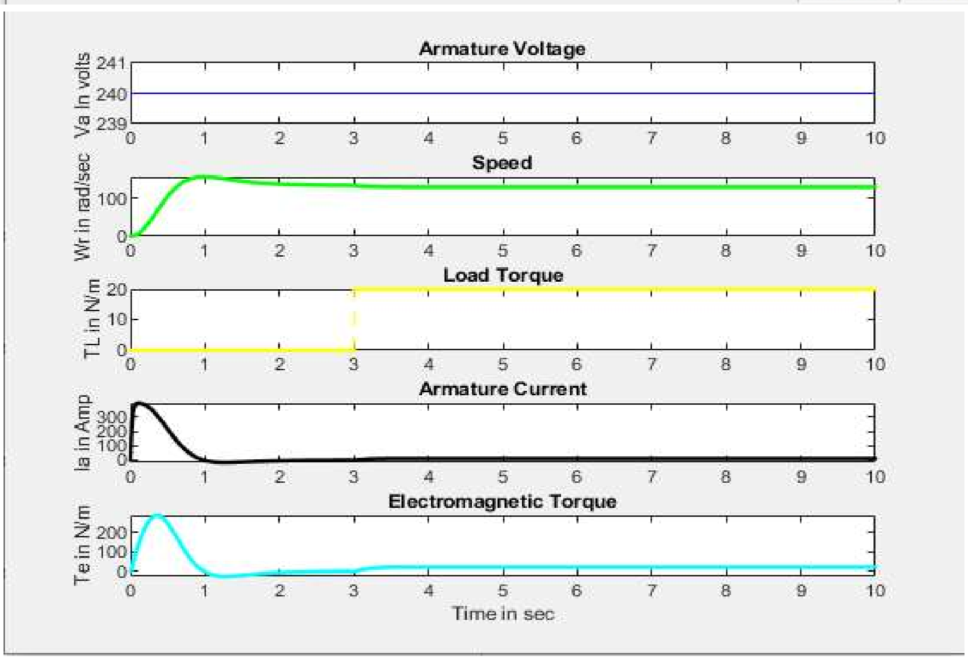


m.file coding:

```
Ra=0.6;
La = 0.012;
Lf= 120;
Rf= 240;
J= 1;
B= 0;
Laf = 1.8;
Va= 240;
P= 2.5;
keyboard
subplot(5,1,1)
plot(out.y.signals.values(:,1),out.y.signals.values(:,2),'b-')
title('Armature 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(:,5),'y--.')
title('Load Torque')
ylabel('TL in N/m')
subplot(5,1,4)
plot(out.y.signals.values(:,1),out.y.signals.values(:,3),'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')
```

STIMULATION RENDERED WAVEFORM:





Comparison(observation):		
Variable at (t=10s)	**Theoretical value**	**Stimulation value**
Ia	**11.11A**	**11.11A**
W	**129.63 rad/sec**	**129.6 rad/sec**
Te	**20 N/m**	**20 N/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)A shunt DC motor is able to regulate its speed on its own by loading.

2)As the load is applied, Armature current, electromagnetic torque and speed of motor change before settling down to a constand value.

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

4)The armature volatage remains constant.

5)The increased torque allows the motor to increase its speed and compensate for the slowdown due to loading.

REFERENCES:NIL