Experiment No. 3

AIM

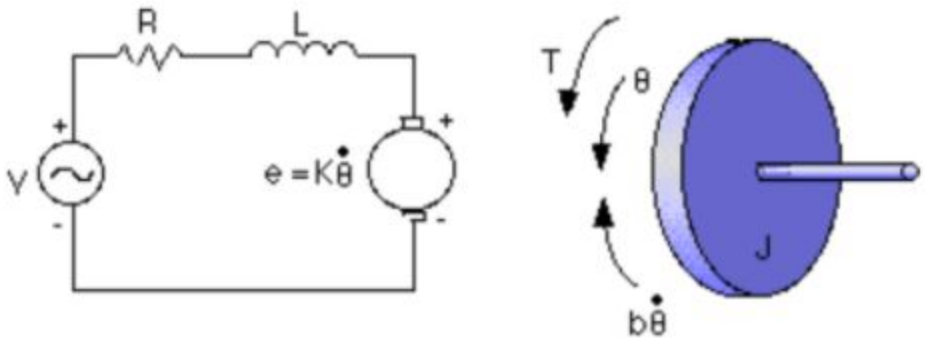
To study the open loop characteristics of a DC motor and experiment it with Matlab simulation File.

REQUIREMENTS

A Laptop, MATLAB Simulink software by MathWorks INC.

THEORY

The electric circuit of the armature and the free body diagram of the rotor for the DC motor are shown in the following figure:



- Moment of inertia of the rotor (J)
- Damping ratio of the mechanical system (b)
- Electromotive force constant (Kt = Km= K)
- Armature resistance (R)
- Armature inductance (L)
- Input (V): source Voltage
- Output (dθ/dt): rotating speed

Assumptions in Modeling a DC Motor

- Demagnetizing effect of armature is neglected.
- Magnetic Circuit is assumed linear (no hysteresis and saturation). As a result all inductances (which came into play in dynamic analysis) are regarded as constant.
- The rotor and shaft is assumed to be rigid.

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The transfer function of the motor system is given by:

$$\frac{\dot{\theta}(s)}{V(s)} = \frac{K/LJ}{s^2 + \frac{(RJ + bL)s}{LJ} + \frac{(bR + K^2)}{LJ}}$$

Or

$$\frac{\dot{\theta}(s)}{V(s)} = \frac{K}{LJ\,s^2 + (RJ + Lb)s + (bR + K^2)}$$

In the experiment, the following values of parameters are being taken:

```
J=0.75e-07;
b=1e-08;
Kt=0.0033;
Km=0.0033;
Kb=0.0033;
R=1.27;
L=0.000035;
```

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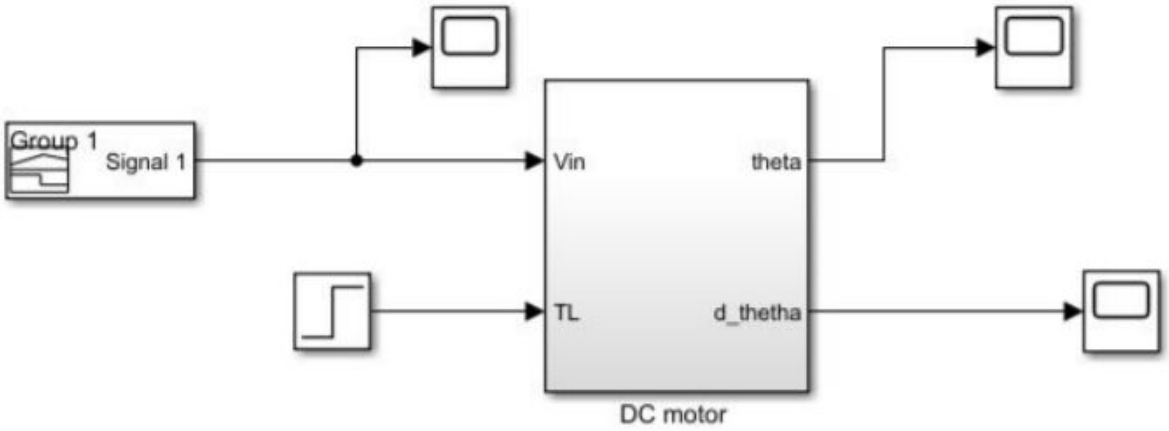
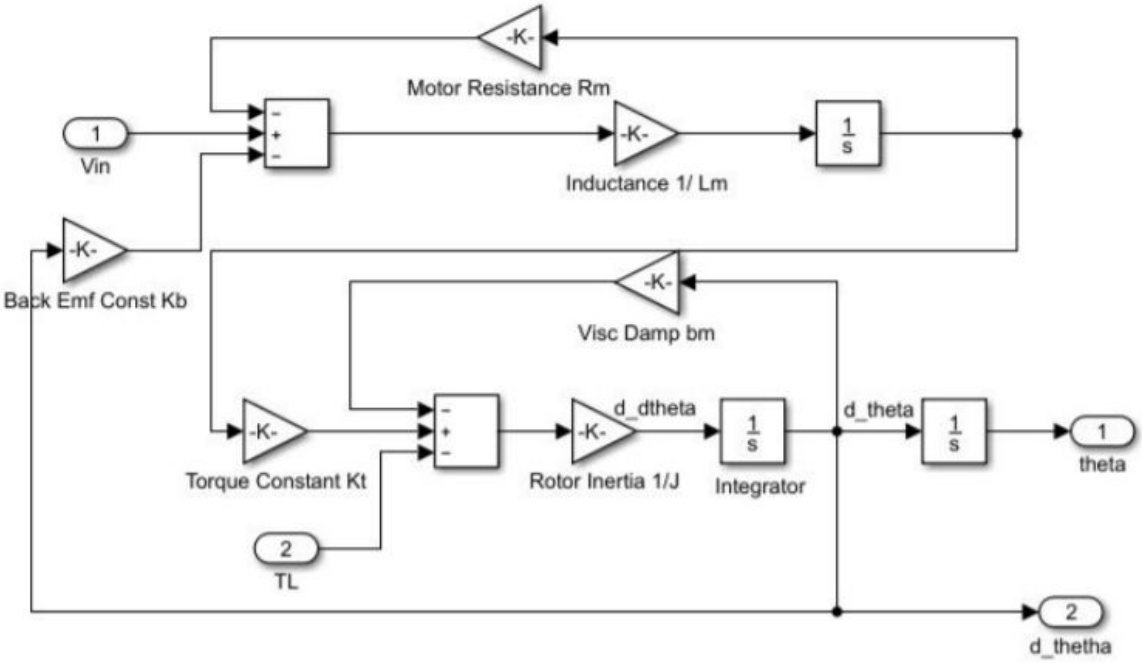
SIMULINK MODELS





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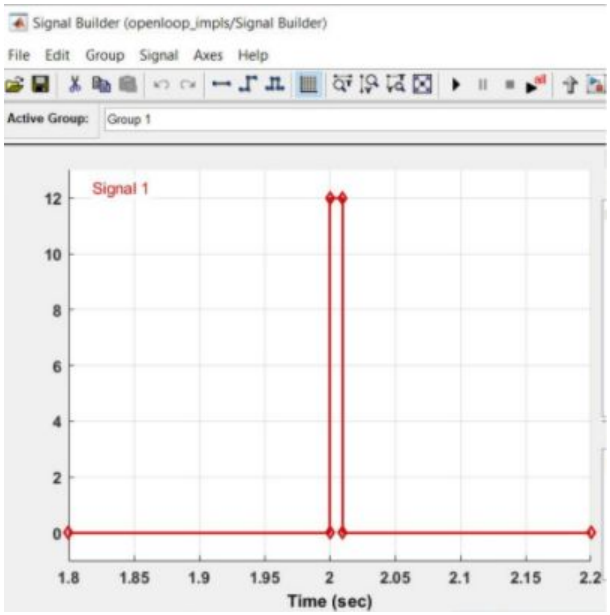
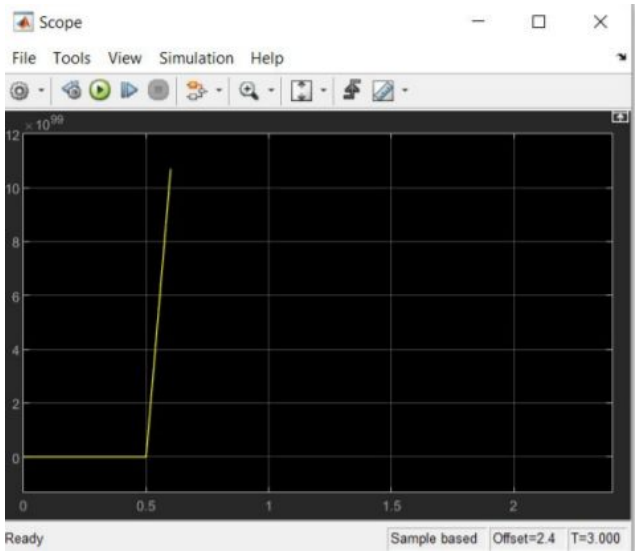
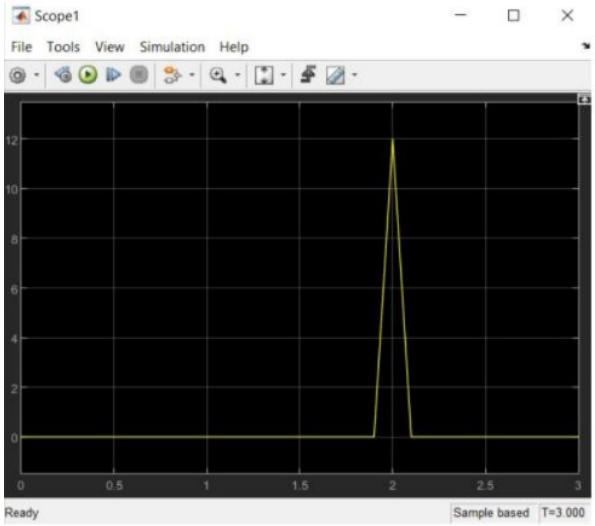
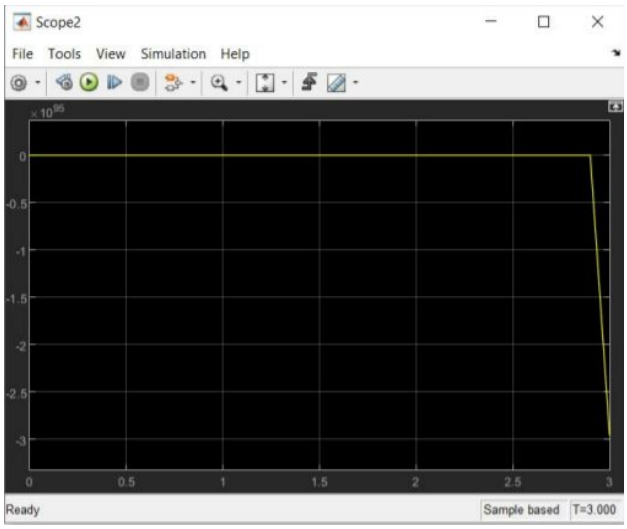
OBSERVATIONS

1) IMPULSE RESPONSE









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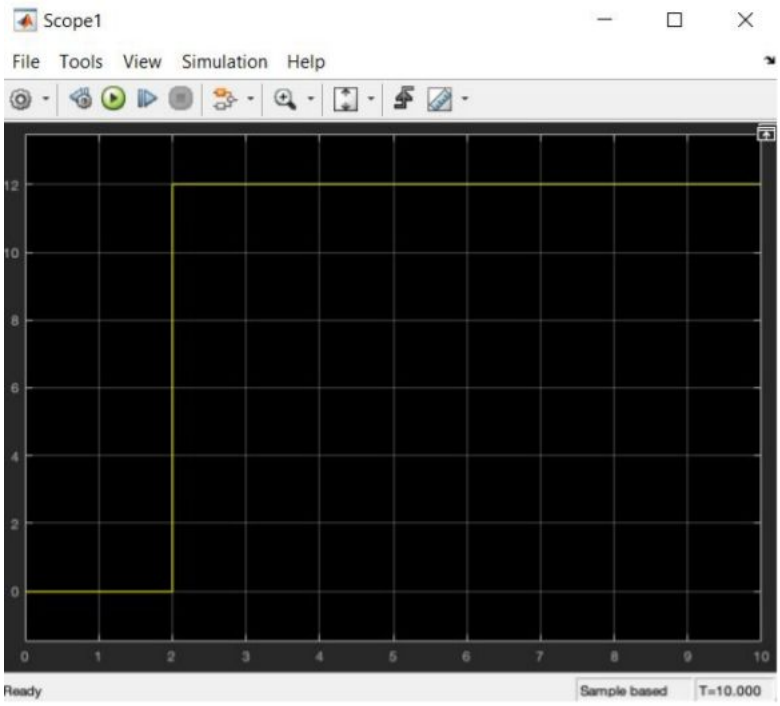
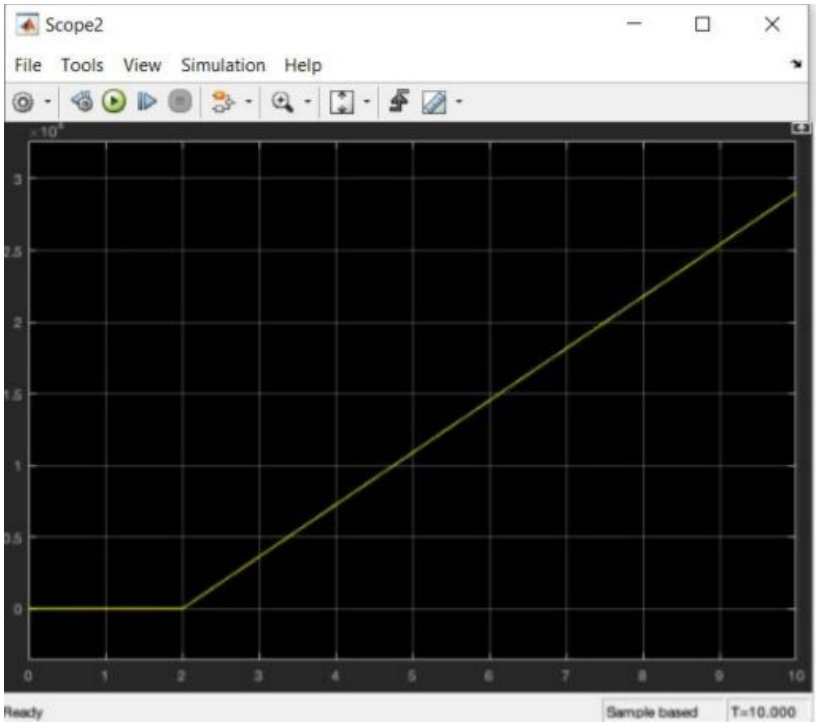
2) STEP RESPONSE





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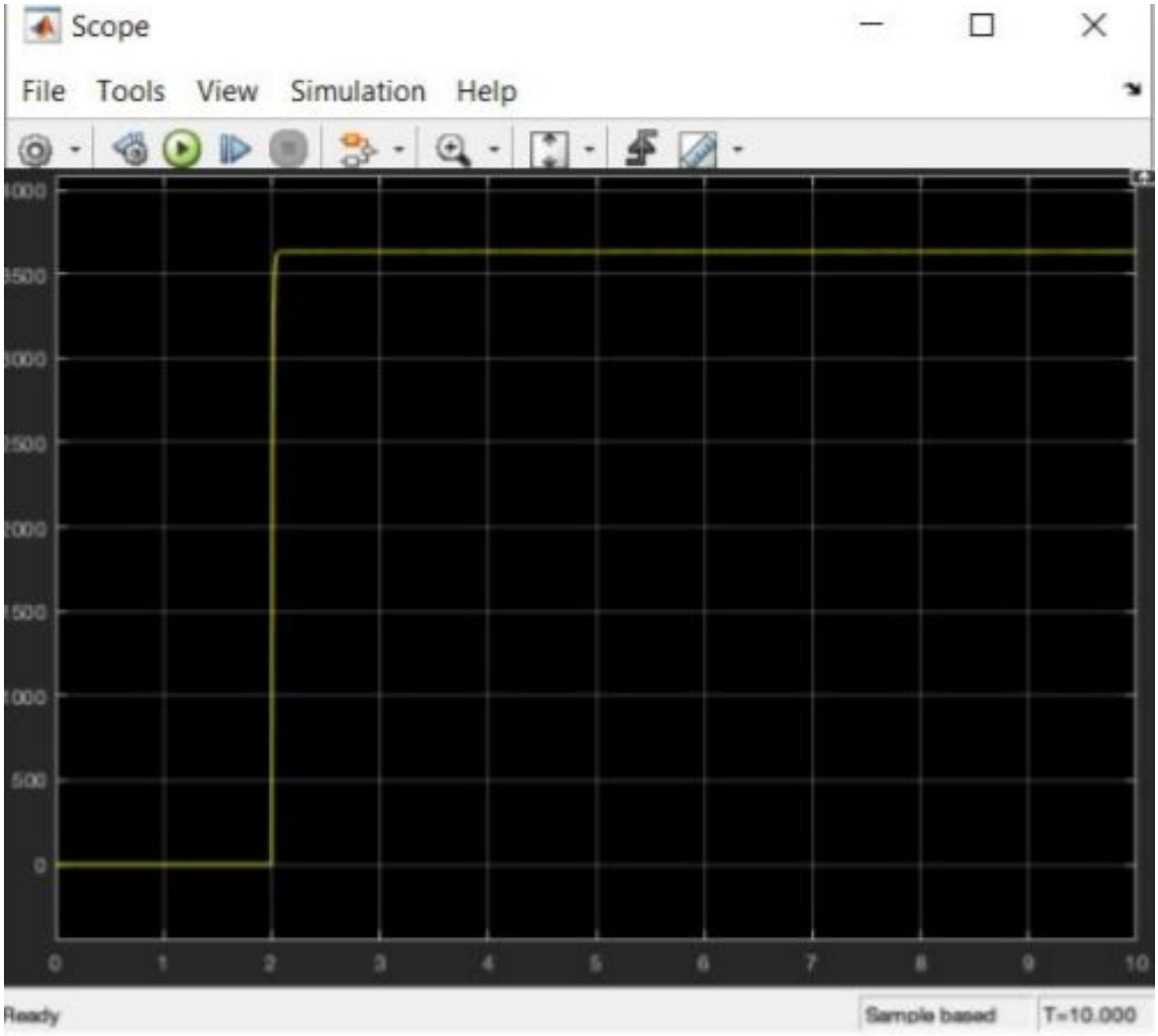

RESULT

We obtained the graphs for responses of DC motors for both impulse and step inputs.

PRECAUTIONS

Enter the input readings of impulse input carefully in the signal builder.

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