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## **MANIPAL INSTITUTE OF TECHNOLOGY**

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**MANIPAL**

# **Drives, Controls and Modelling Laboratory Manual (MTE 3161)**

Fifth Semester B.Tech (Mechatronics Engineering)

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**ROLL NO: 37**

## Experiment V:

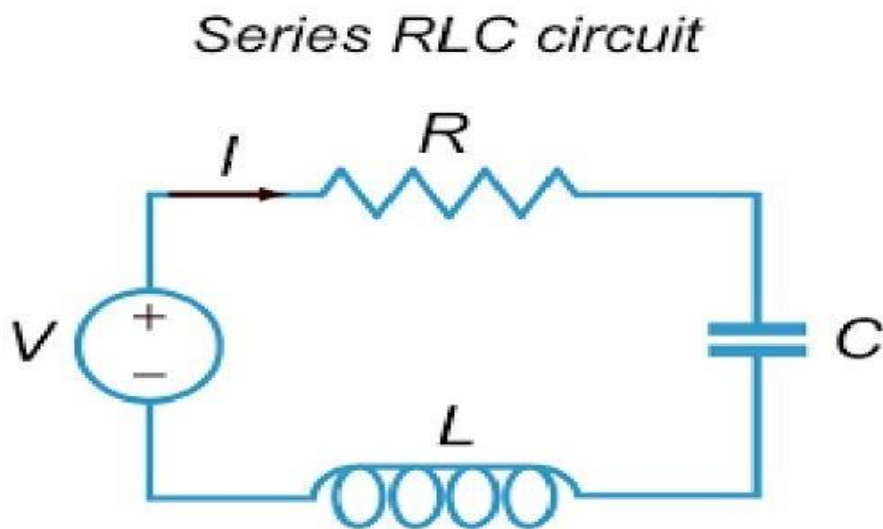
### Control of DC Motor using Buck Converter

Date: 21/09/2023

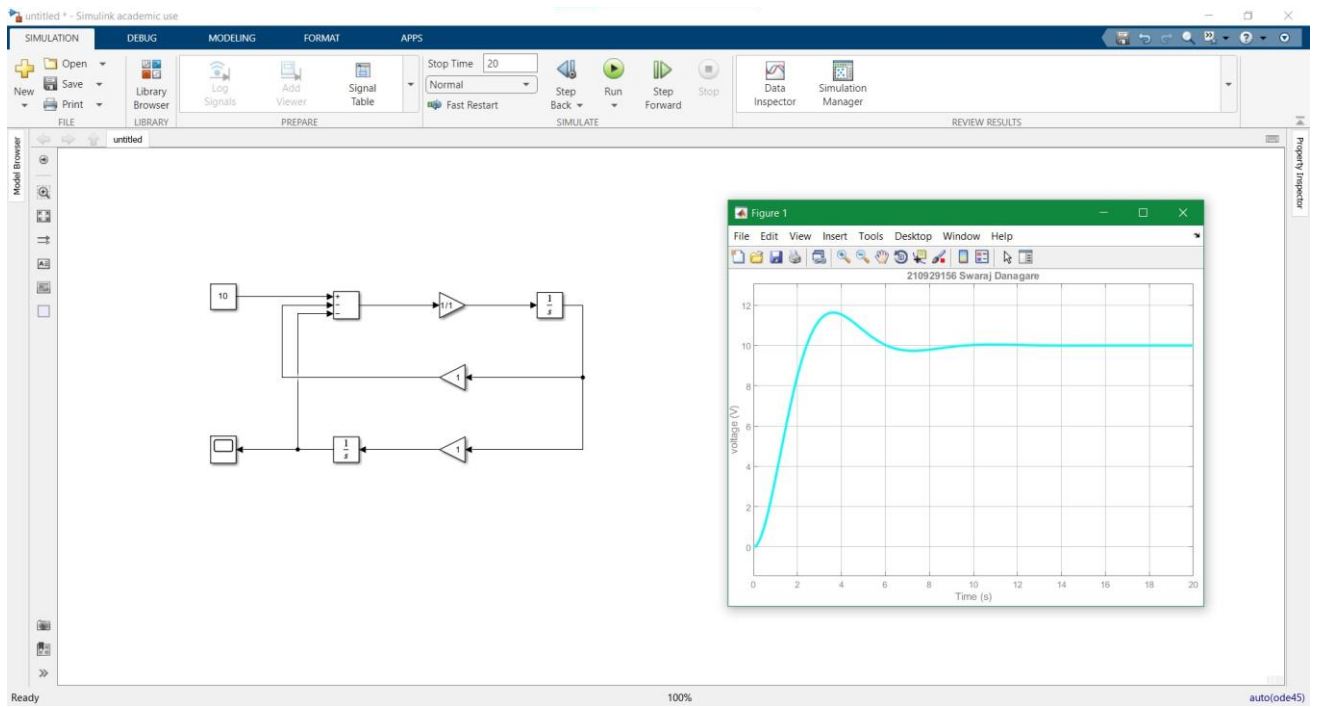
#### Aim:

To model an armature-controlled DC motor from first principles of modelling. Also simulate and analyze the motor performance as per specifications in SIMULINK.

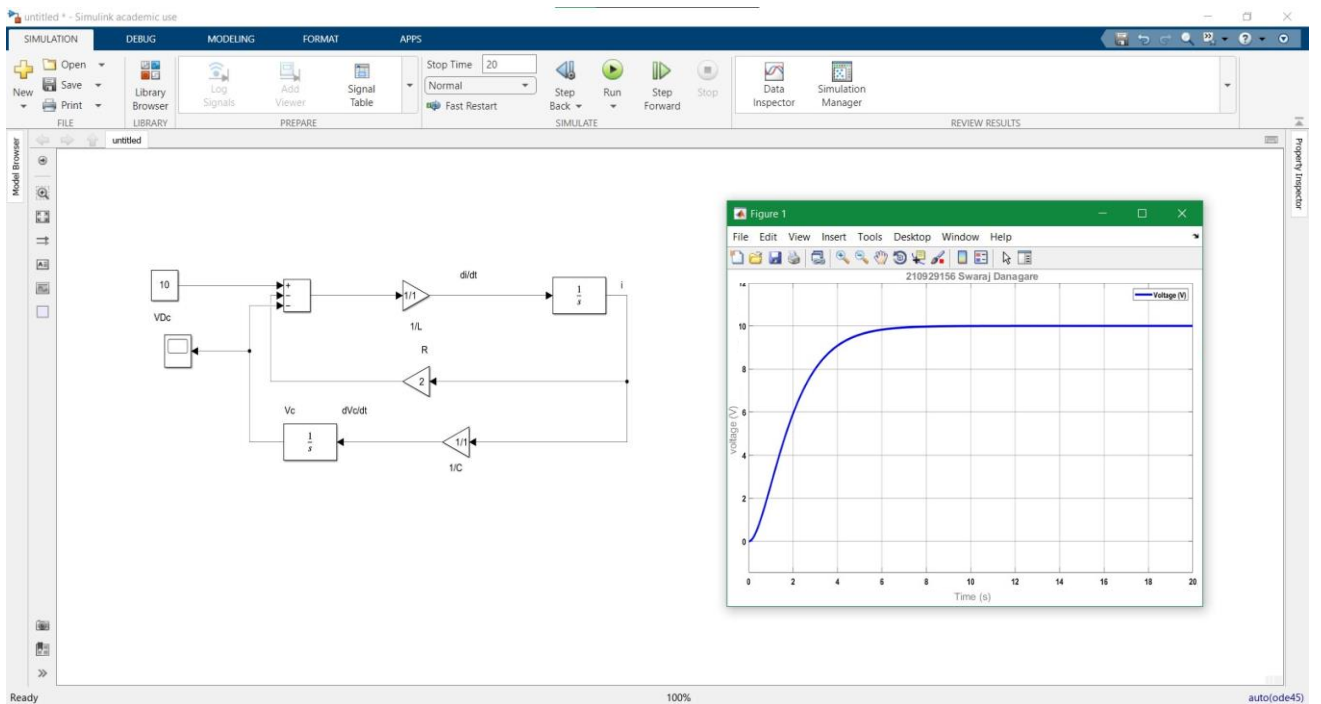
### Mathematical Modelling of RLC circuit:



## Under-Damped:



## Critically Damped:

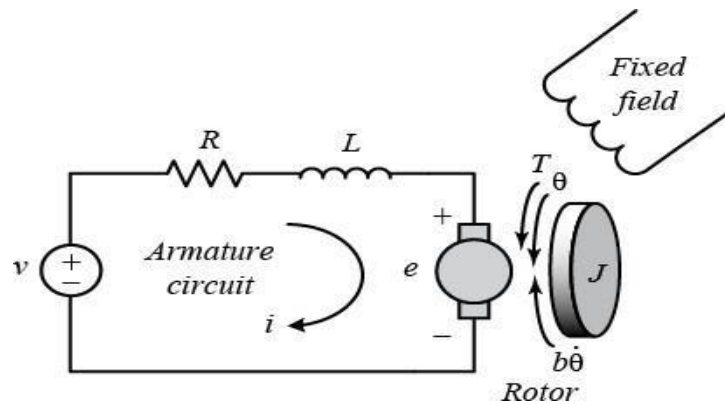


### Problem 1:

A Dc armature controlled motor with the following parameters:  $R = 2 \Omega$ ,  $L = 1.1\text{mH}$  and  $K_b = 1.26 \text{ V/rad/sec}$ ,  $K_t = 1.26 \text{ N.m/Amp}$ , with rotor parameters of  $J = 0.05\text{kg-m}^2$ ,  $\mathbf{B} = \mathbf{0} \text{ Nm/rad/sec}$  with no load is directly started from a dc supply voltage of 220V. Plot the motor starting speed response and the time taken to reach 157.07 rad/sec (1500 rpm).

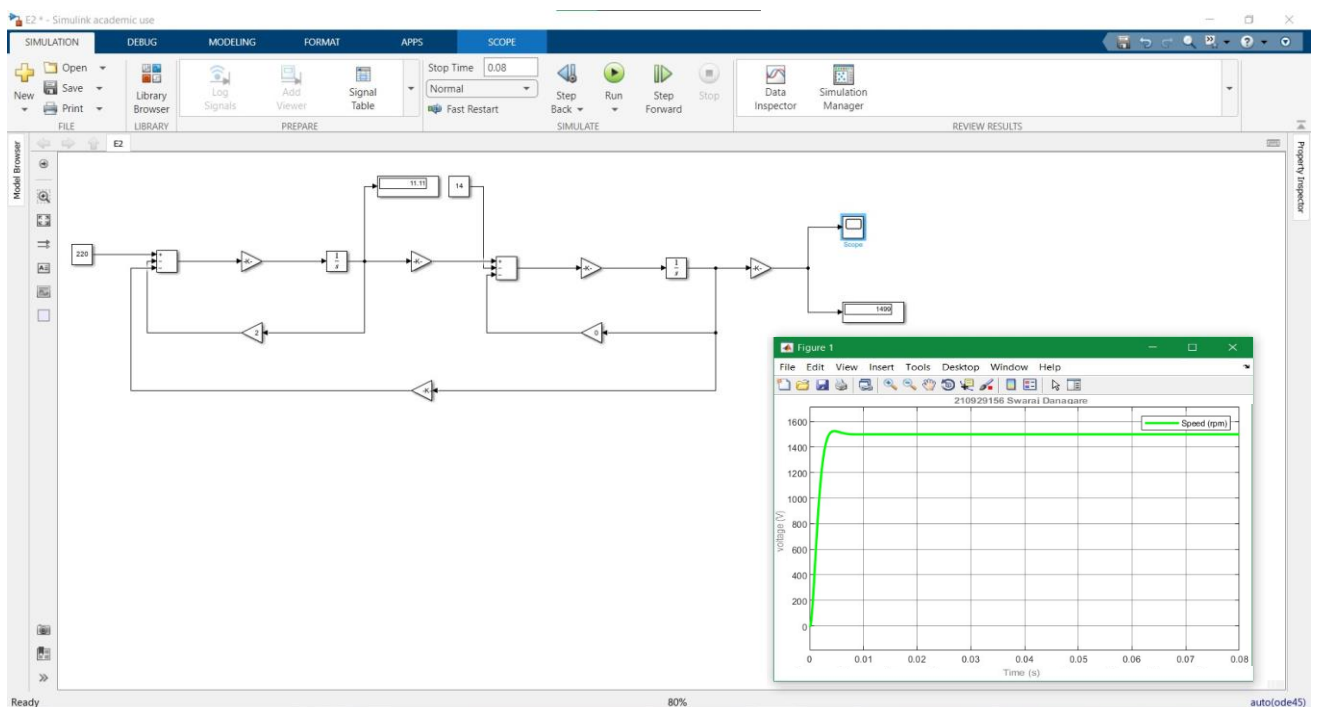
Observe the effect of friction with  $B=0.001$

### Circuit Description:



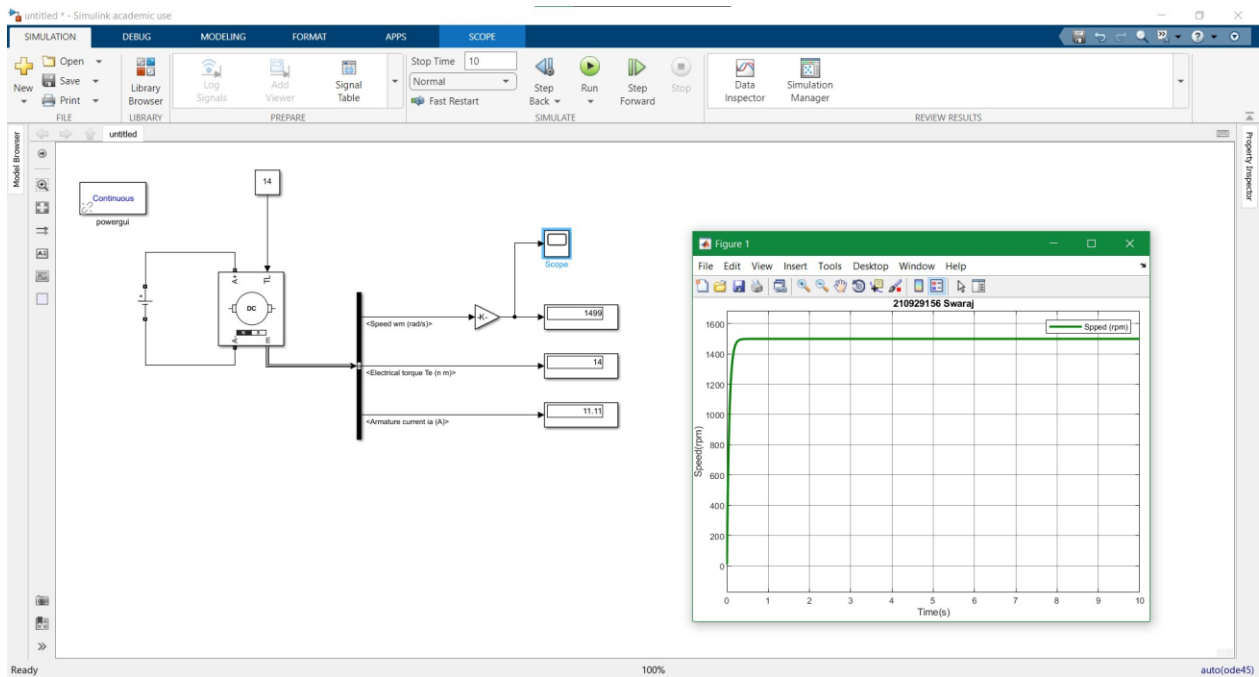
### Solution

### SIMULINK Diagram:



## Problem 2:

A Dc armature controlled motor with the following parameters:  $R = 2 \Omega$ ,  $L = 1.1\text{mH}$  and  $K_b = 1.26 \text{ V/rad/sec}$ ,  $K_t = 1.26 \text{ N.m/Amp}$ , with rotor parameters of  $J = 0.05\text{kg}\cdot\text{m}^2$ ,  $B = 0 \text{ Nm/rad/sec}$  with no load is directly started from a dc supply voltage of 220V and is given rated field current. Plot the motor starting speed response and the time taken to reach 157.07 rad/sec (1500 rpm) using Simscape. Observe the effect of friction with  $B=0.001$



Block Parameters: DC Machine

Armature resistance and inductance [Ra (ohms) La (H)] [ 2 0.011 ] [2,0.011]

Specify: Torque constant (N.m/A)

Torque constant (N.m/A) 1.26

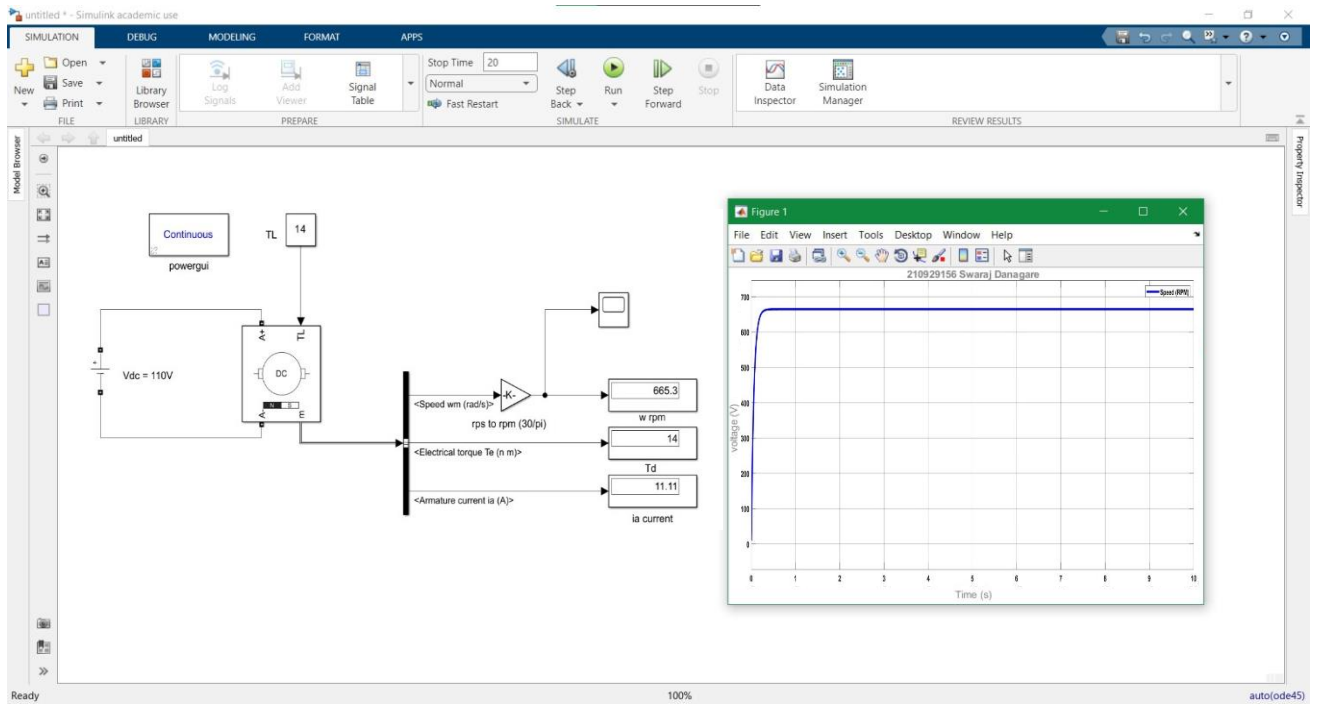
Total inertia J (kg.m<sup>2</sup>) 0.05

Viscous friction coefficient Bm (N.m.s) 0

Coulomb friction torque Tf (N.m) 0

Initial speed (rad/s) : 1

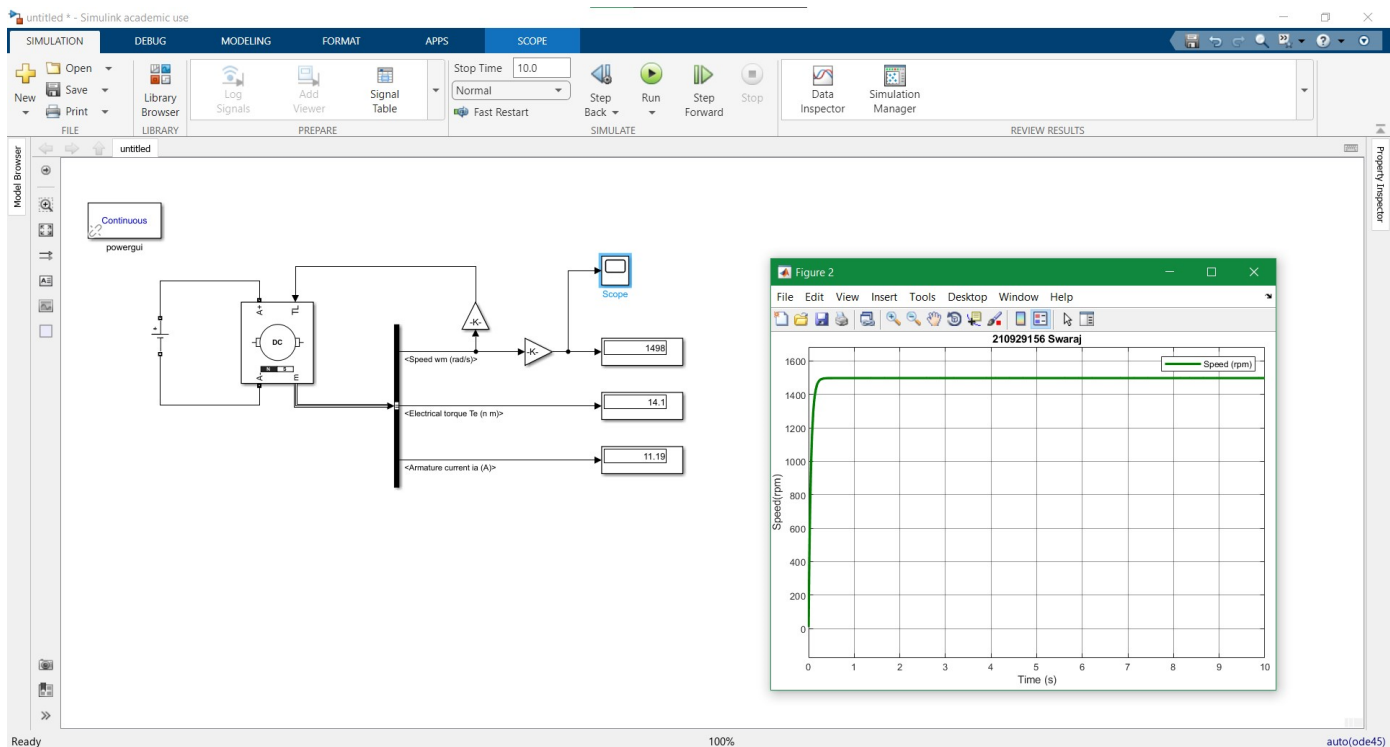
OK Cancel Help Apply



Armature voltage = 110V, speed response = 665.3 rpm

### Problem 3:

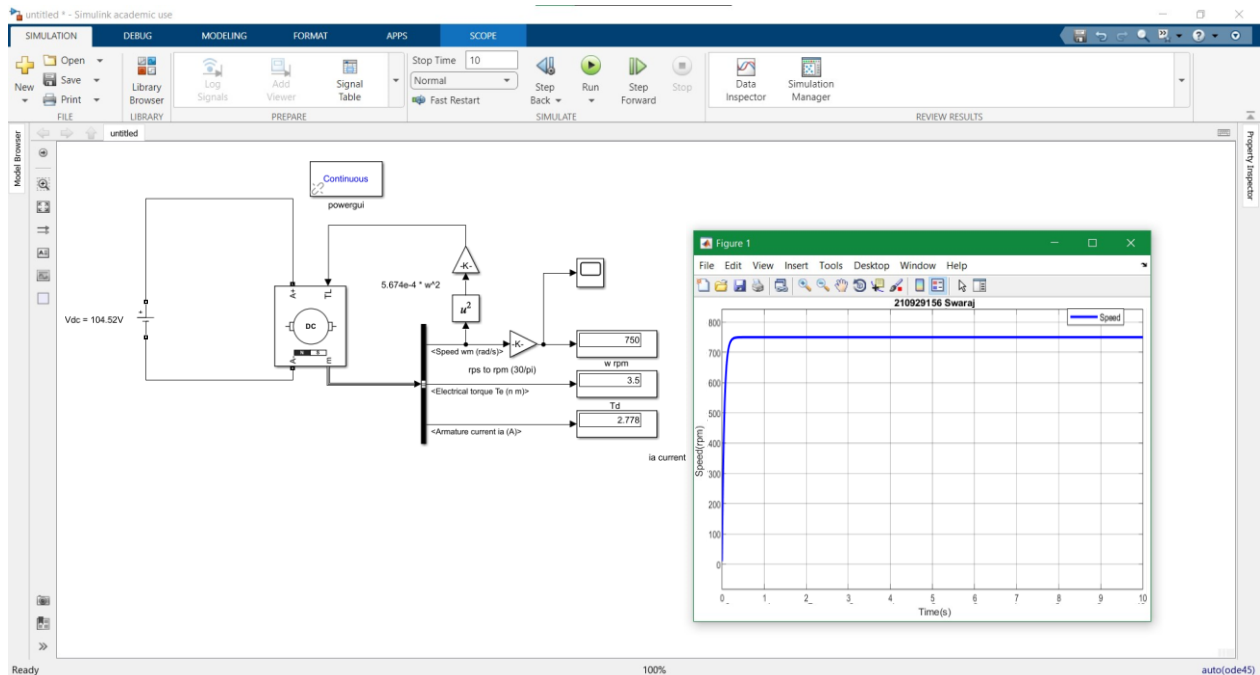
A Dc armature controlled motor with the following parameters:  $R = 2\Omega$ ,  $L = 0.011H$  and  $K_b = K_t$  1.26V/rad/sec, with rotor parameters of  $J = 0.0167 \text{ kg-m}^2$ ,  $B = 0 \text{ Nm/rad/sec}$  with a load torque is proportional to the speed of rotation,  $T_L = 0.08 \omega$ . Its armature is connected to a dc supply voltage of 220V and is given rated field current. Find speed of motor.



## Open-Ended Lab Exercises - 5:

1. A DC armature controlled motor with the following parameters:  $R = 2\Omega$ ,  $L = 0.011\text{H}$  and  $K_b = K_t$   $1.26\text{V/rad/sec}$ , with rotor parameters of  $J = 0.05\text{ kg-m}^2$ ,  $B = 0\text{ Nm/rad/sec}$  with a FAN load with coefficient  $5.67\text{e-}4$ . Calculate the Torque at 750rpm and simulate the same by vary voltage to get 750rpm output.

**Torque at 750rpm = 3.5 N.m Vin = 104.52 V**



2. For the same above system, if the input voltage is 100V, what is the speed and torque of the output FAN load. **Speed  $\omega_m = 719.2\text{ rpm}$**   
**Torque = 3.218 N.m**

