MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent Unit of Manipal Academy of Higher Education)

MANIPAL

Drives, Controls and Modelling Laboratory Manual (MTE 3161)

Fifth Semester B.Tech (Mechatronics Engineering)

NAME: Swaraj Dangare

REG NO: 210929156

ROLL NO: 37

Closed loop Speed Control of DC Motor using buck converter

Aim:
To model armature voltage speed control of DC motor using buck converter.
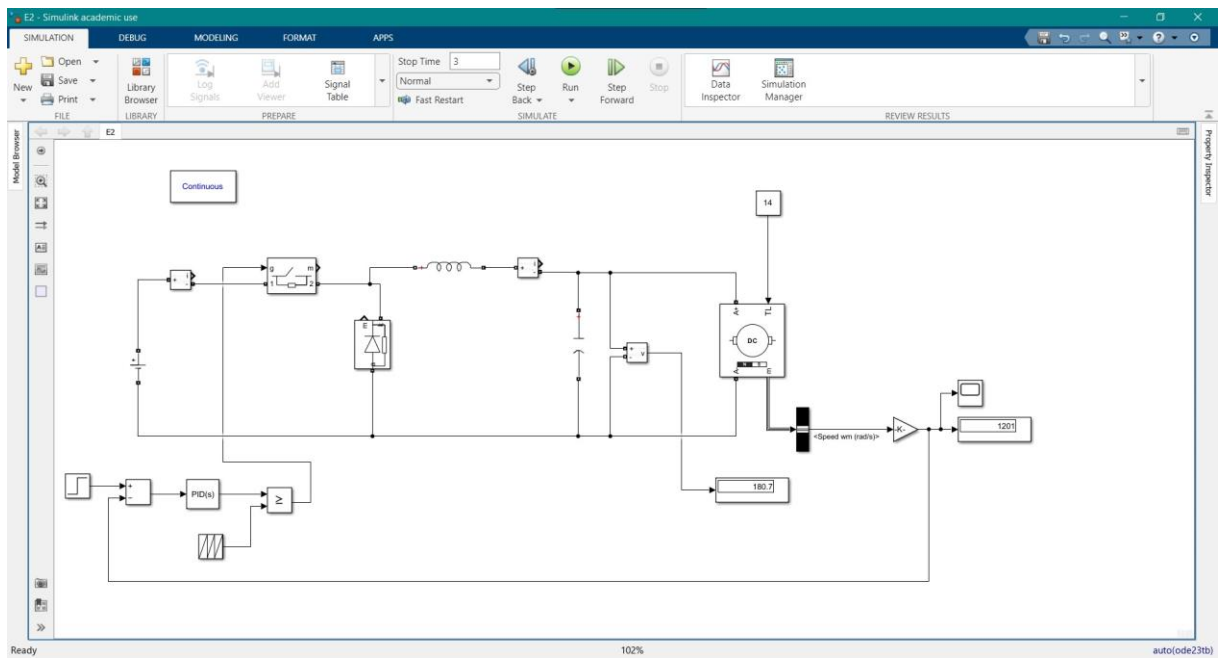
Problem 1:
A Dc armature controlled motor with the following parameters: R = 2 Ω, L =1.1mH and K_b = 1.26 V/rad/sec, K_t = 1.26 N.m/Amp, with rotor parameters of J = 0.05kg-m^2 , **B = 0 Nm/rad/sec** with no load is directly started from a dc supply voltage of 220V. Plot the motor starting speed response and the time taken to reach 157.07 rad/sec (1500 rpm).
Control the speed of DC motor using armature voltage control through buck converter.
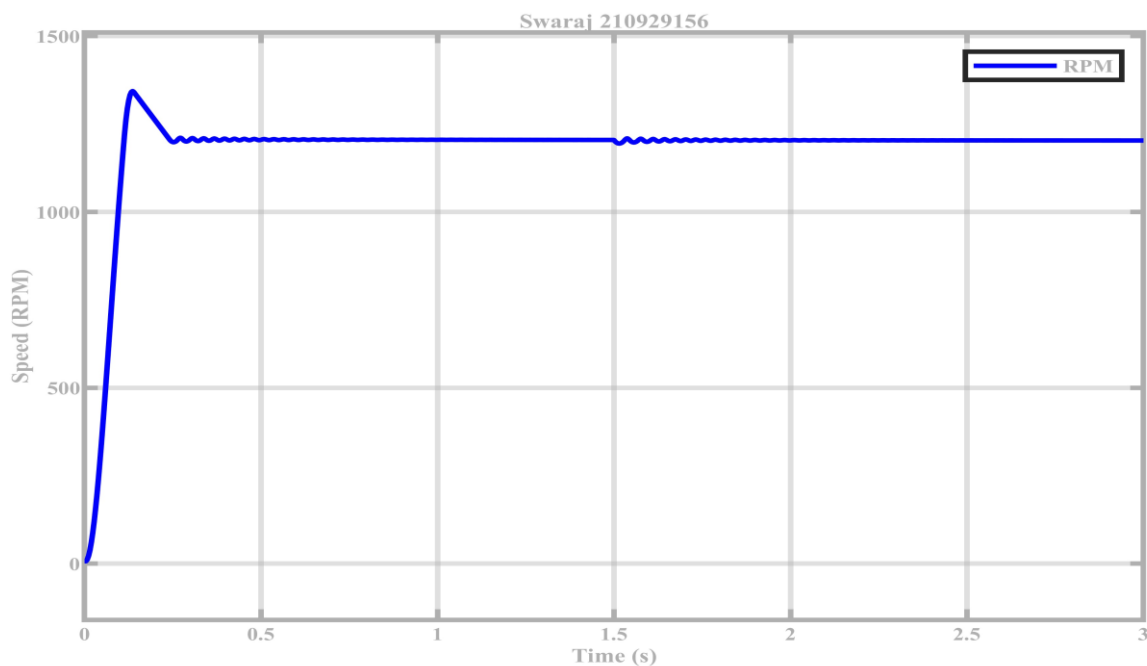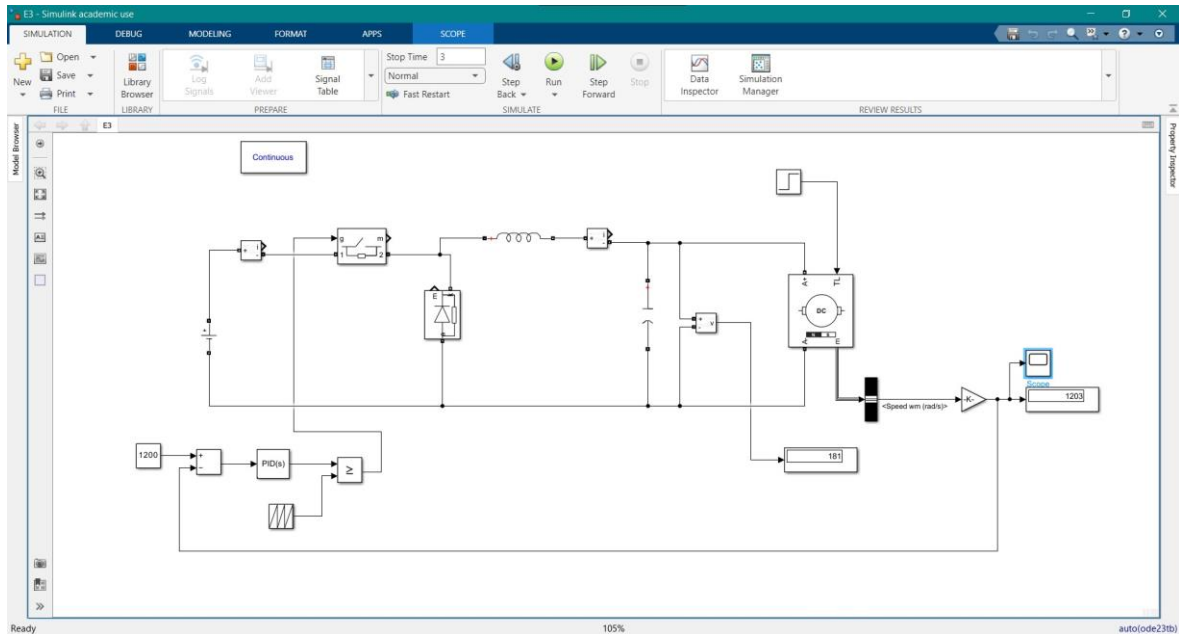
Circuit Description:
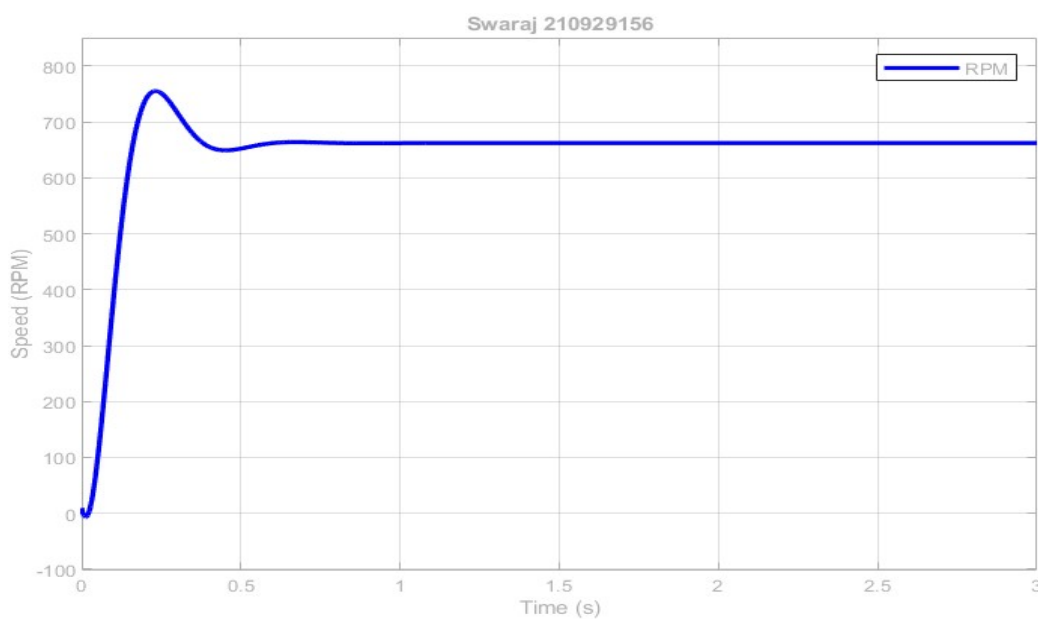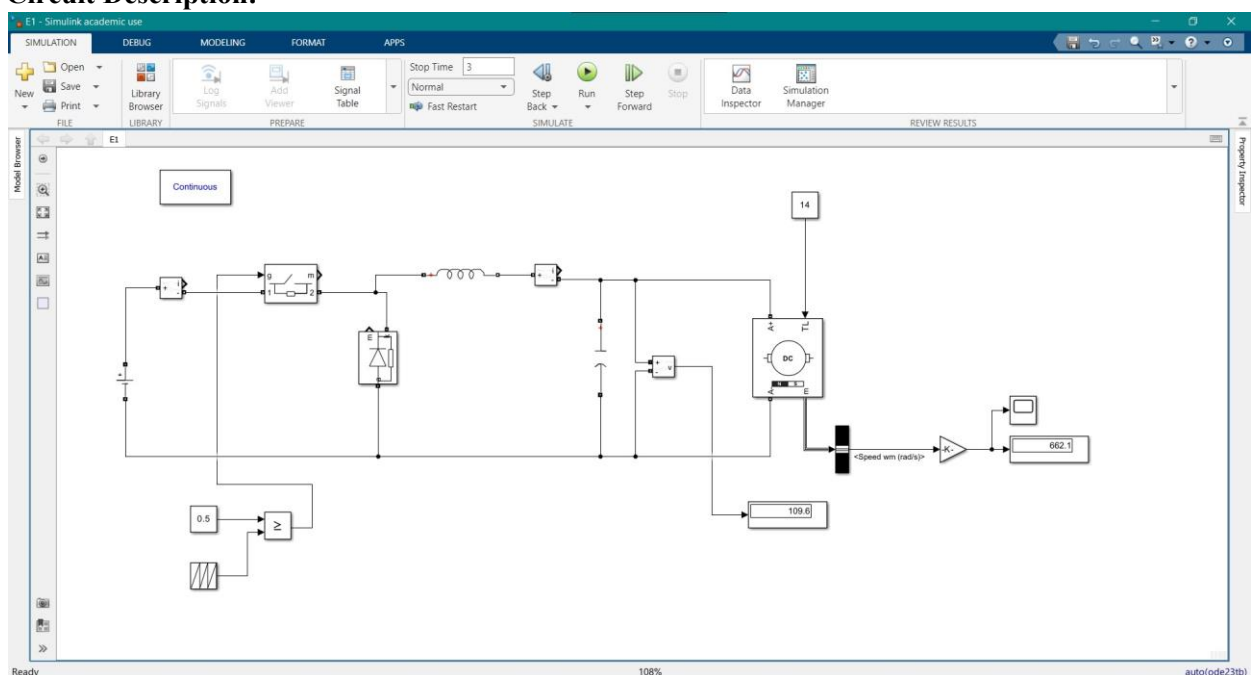
Closed loop speed control: kp=0.1 ki=0.02, step change in input reference 600 rpm to 1200 rpm
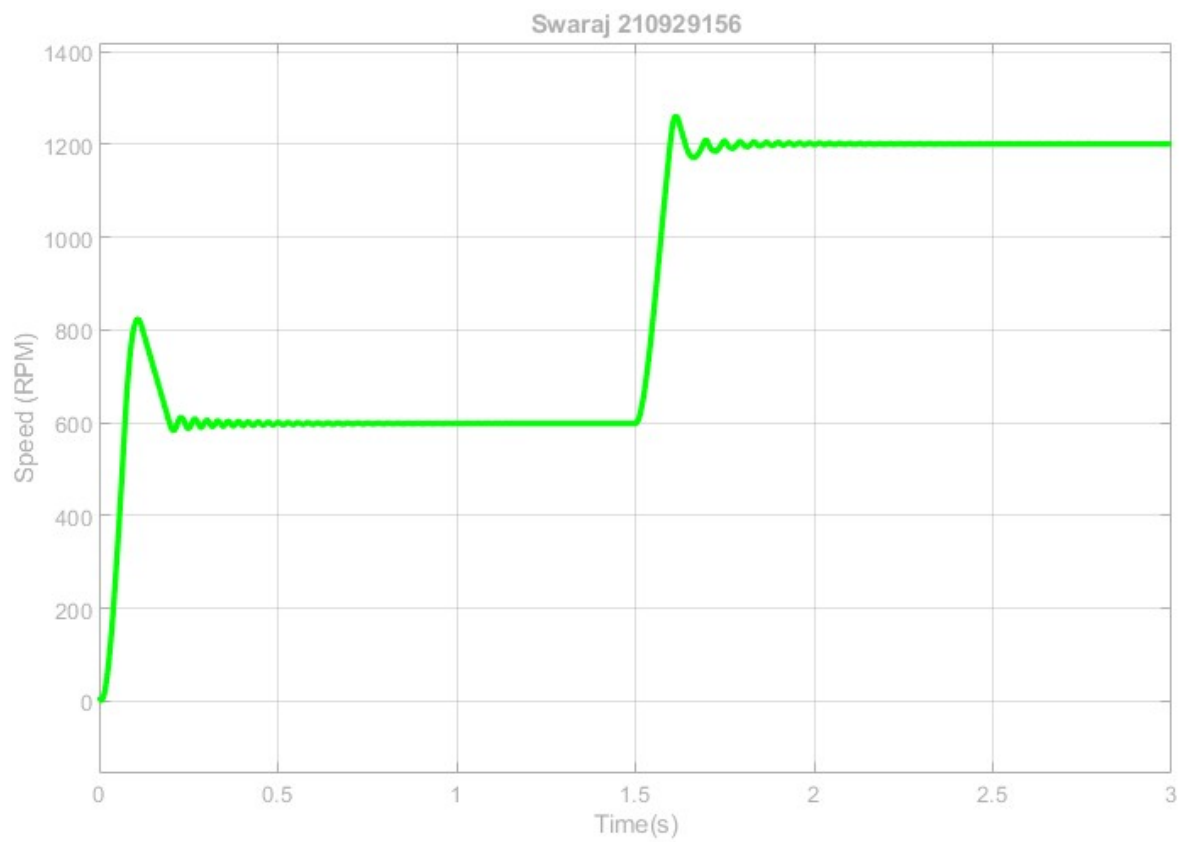
Closed loop speed control: kp=0.1 ki=0.02, step change in load from 7Nm to 14Nm for constant speed of 1200 rpm.


Problem 2:

To model and simulate the DC motor with closed loop speed control with current controller using Simscape. A Dc armature controlled motor with the following parameters: R = 1.1 Ω, L =0.003H and K_b = 1.2 V/rad/sec, K_t = 1.2 N.m/Amp, with rotor parameters of J = 0.05kg-m² , B = 0.001 Nm/rad/sec. Develop the model and find the speed response with step change in speed and step change in load.

Given:

Speed controller gains: kp=0.1, ki=0.1

Current controller gains: kp=0.01, ki=0.08

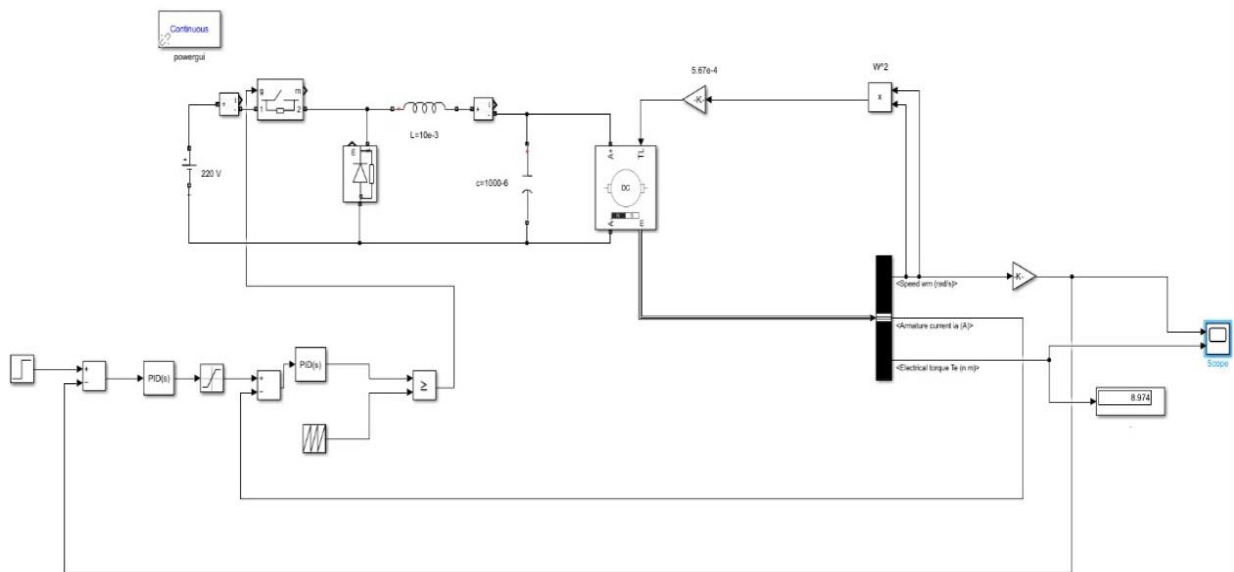Closed Loop Speed Control

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<Electrical torque Te (n m)>
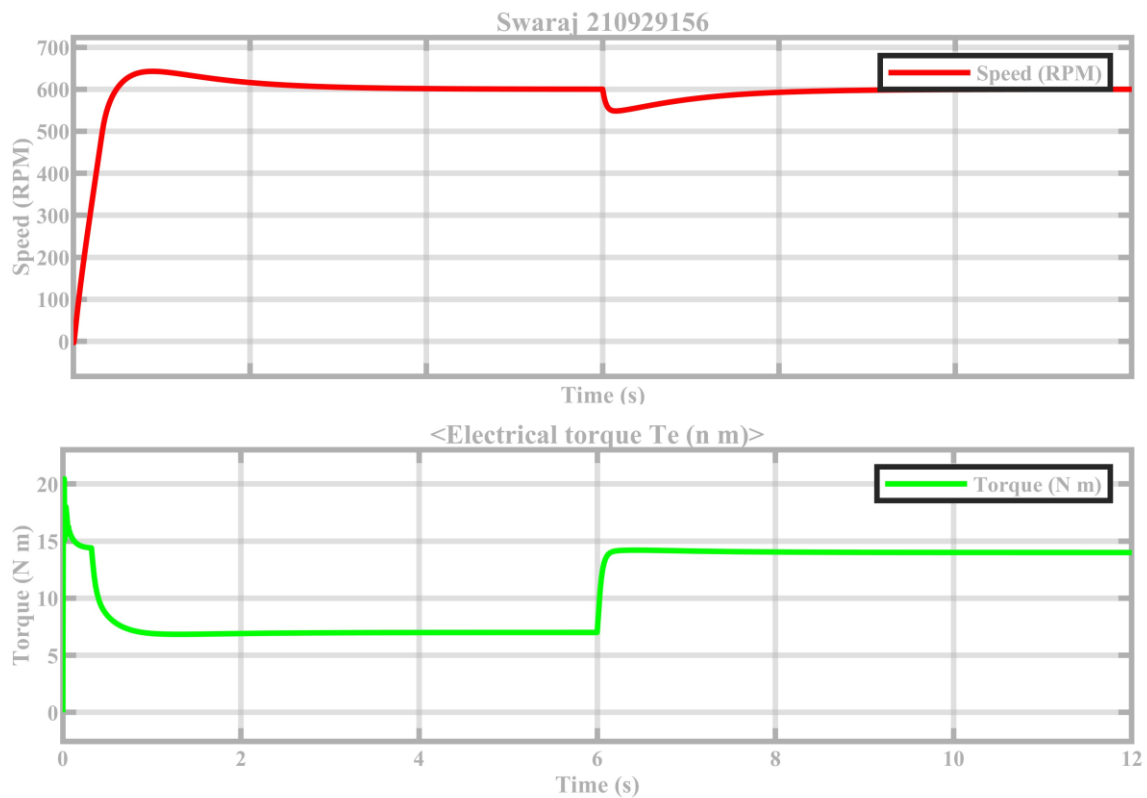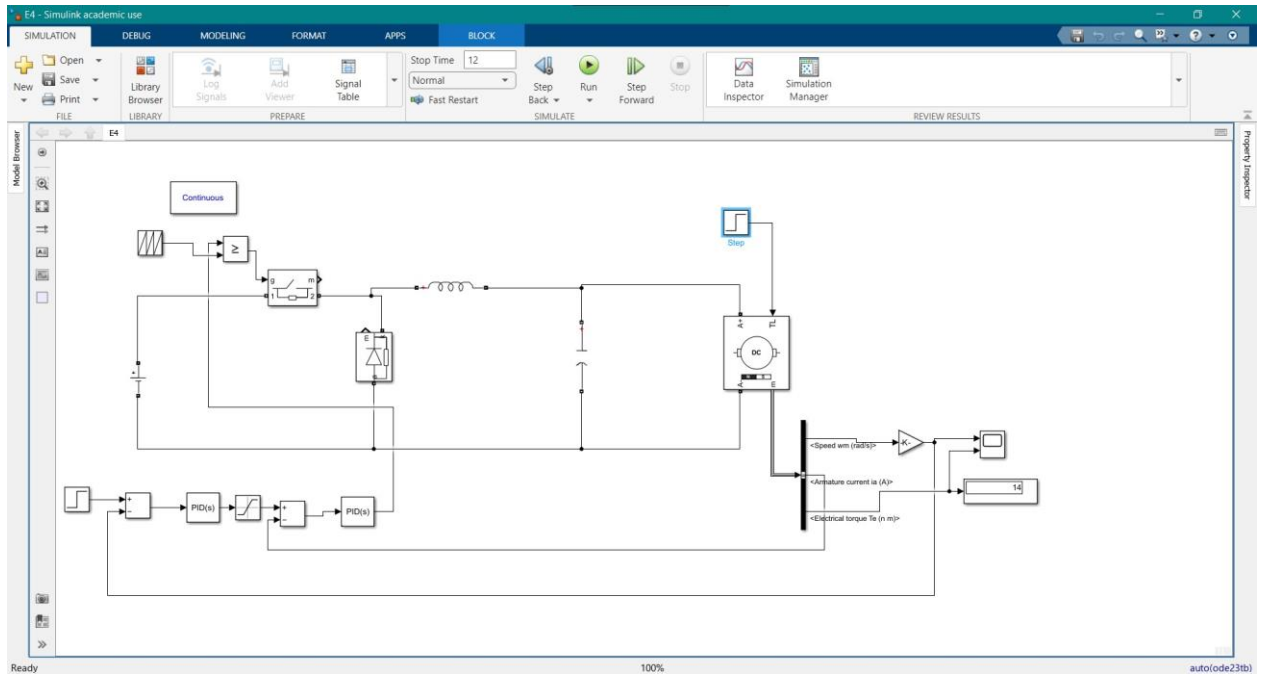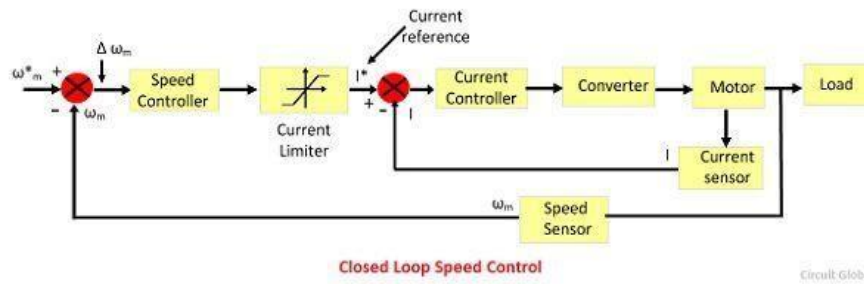
Open-Ended Lab Exercises - 5:

1. A DC armature controlled motor with the following parameters: R = 2Ω, L =0.011H and K_b = K_t
   1.26V/rad/sec, with rotor parameters of J = 0.05 kg-m^2 , B = 0 Nm/rad/sec with a FAN load
   with coefficient 5.67e-4. Calculate the Torque at 750rpm and 1200rpm and simulate the closed
   loop speed control of Motor with 750rpm for 5 secs and 1200rpm in next 5 secs.

Torque at 750 rpm = 3.5 N.m

Torque at 1200 rpm = 8.97 N.m

Swaraj 210929156