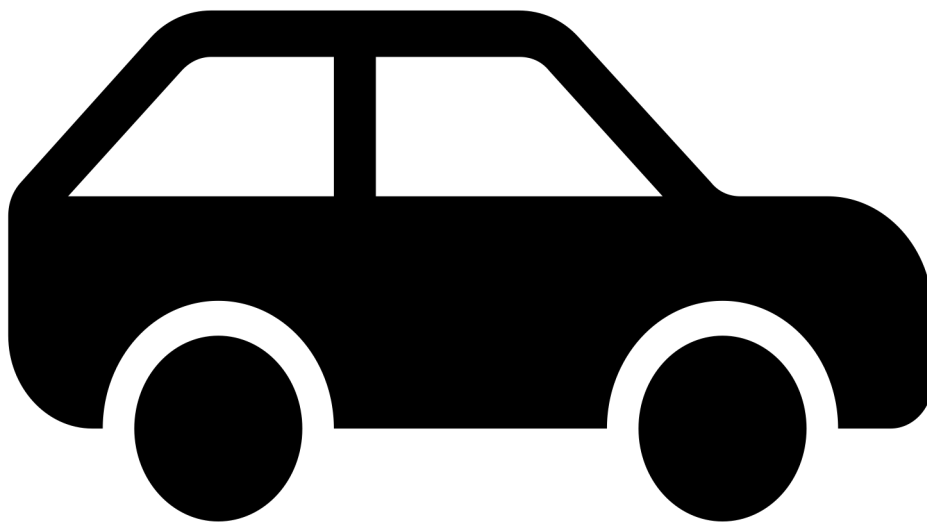


Electric Car Powertrain Project Report

Elite Techno Groups



Project- 3
Electric Vehicle Powertrain Sizing

Submitted By: Nishantkumar Vasantbhai Patel
Education: B.E. Mechanical

Problem Statement:

Questions:

Question-1:

Model Screenshot (system & sub-system level)

Question-2:

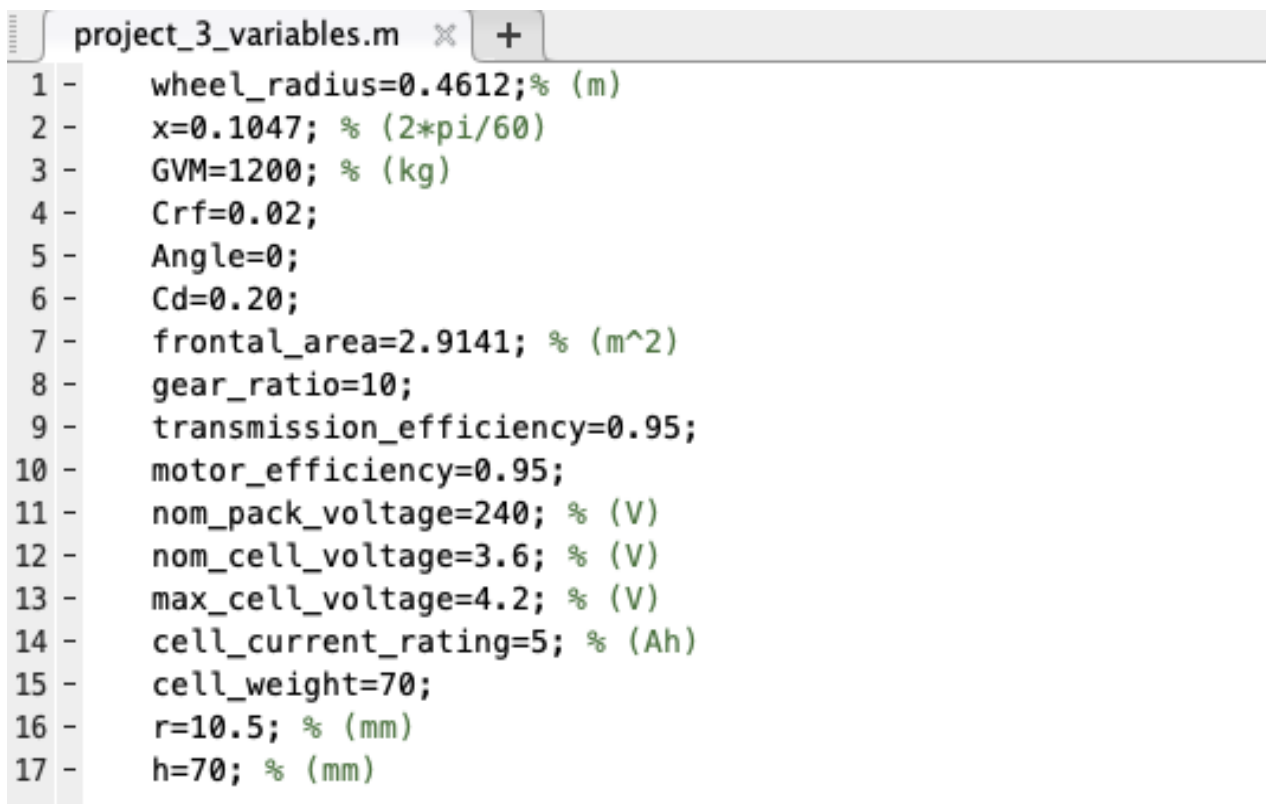
Plots for different parameters with description (FTP Highway)

Question-3:

Battery Block additional sub questions (Range= 250 Km)

- a) Total no. of cells
- b) Cell volume
- c) Battery pack volume
- d) Maximum voltage of pack
- e) Weight of battery pack

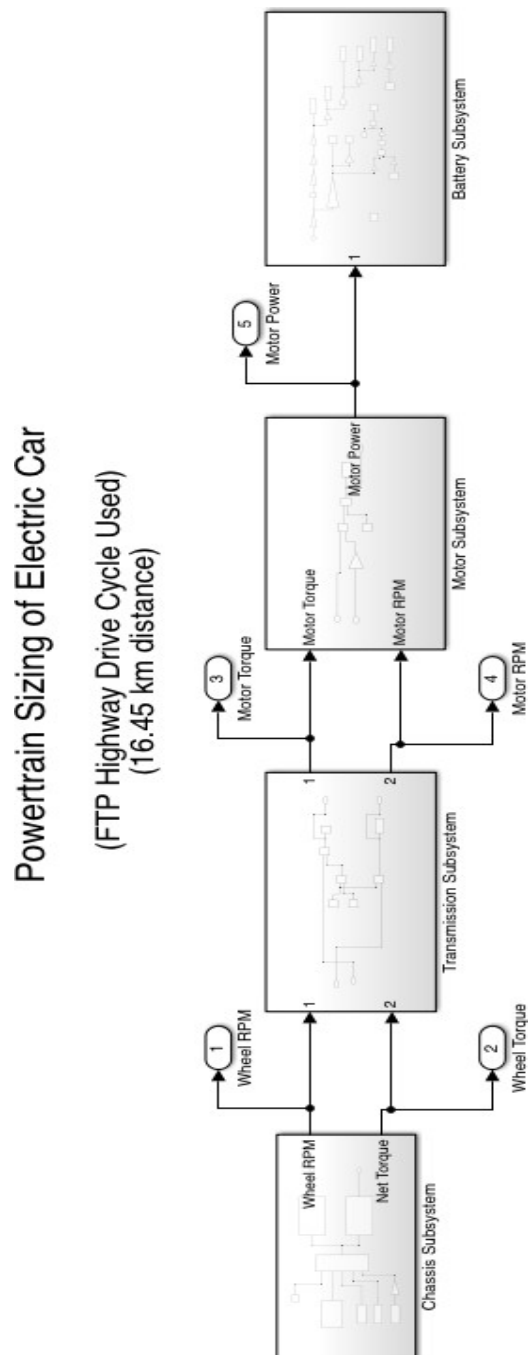
Given Parameters:



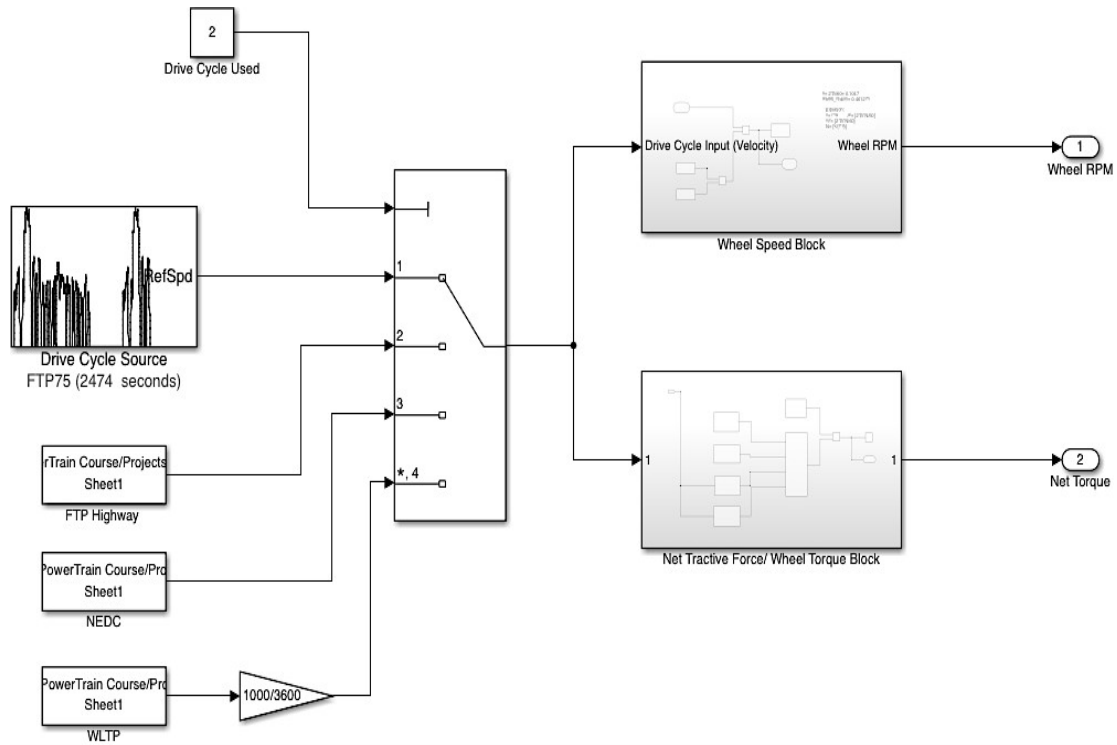
```
project_3_variables.m  x  +
1 - wheel_radius=0.4612;% (m)
2 - x=0.1047; % (2*pi/60)
3 - GVM=1200; % (kg)
4 - Crf=0.02;
5 - Angle=0;
6 - Cd=0.20;
7 - frontal_area=2.9141; % (m^2)
8 - gear_ratio=10;
9 - transmission_efficiency=0.95;
10 - motor_efficiency=0.95;
11 - nom_pack_voltage=240; % (V)
12 - nom_cell_voltage=3.6; % (V)
13 - max_cell_voltage=4.2; % (V)
14 - cell_current_rating=5; % (Ah)
15 - cell_weight=70;
16 - r=10.5; % (mm)
17 - h=70; % (mm)
```

Question-1: Simulink Model Photos

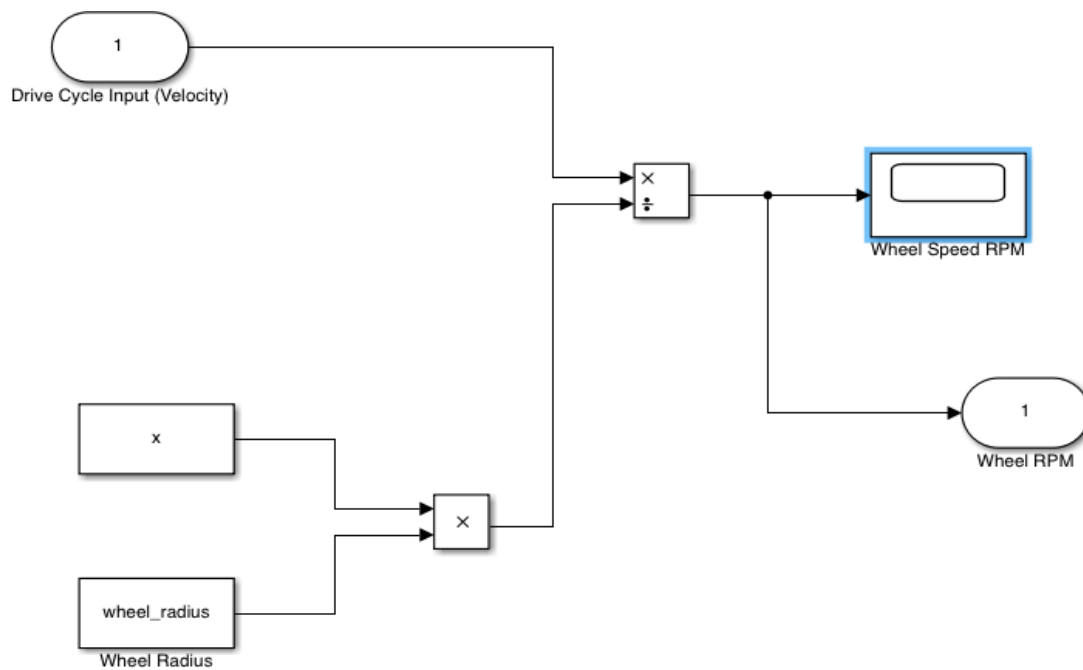
Here, we considered the **FTP Highway** drive cycle and modelled the whole system based on it.



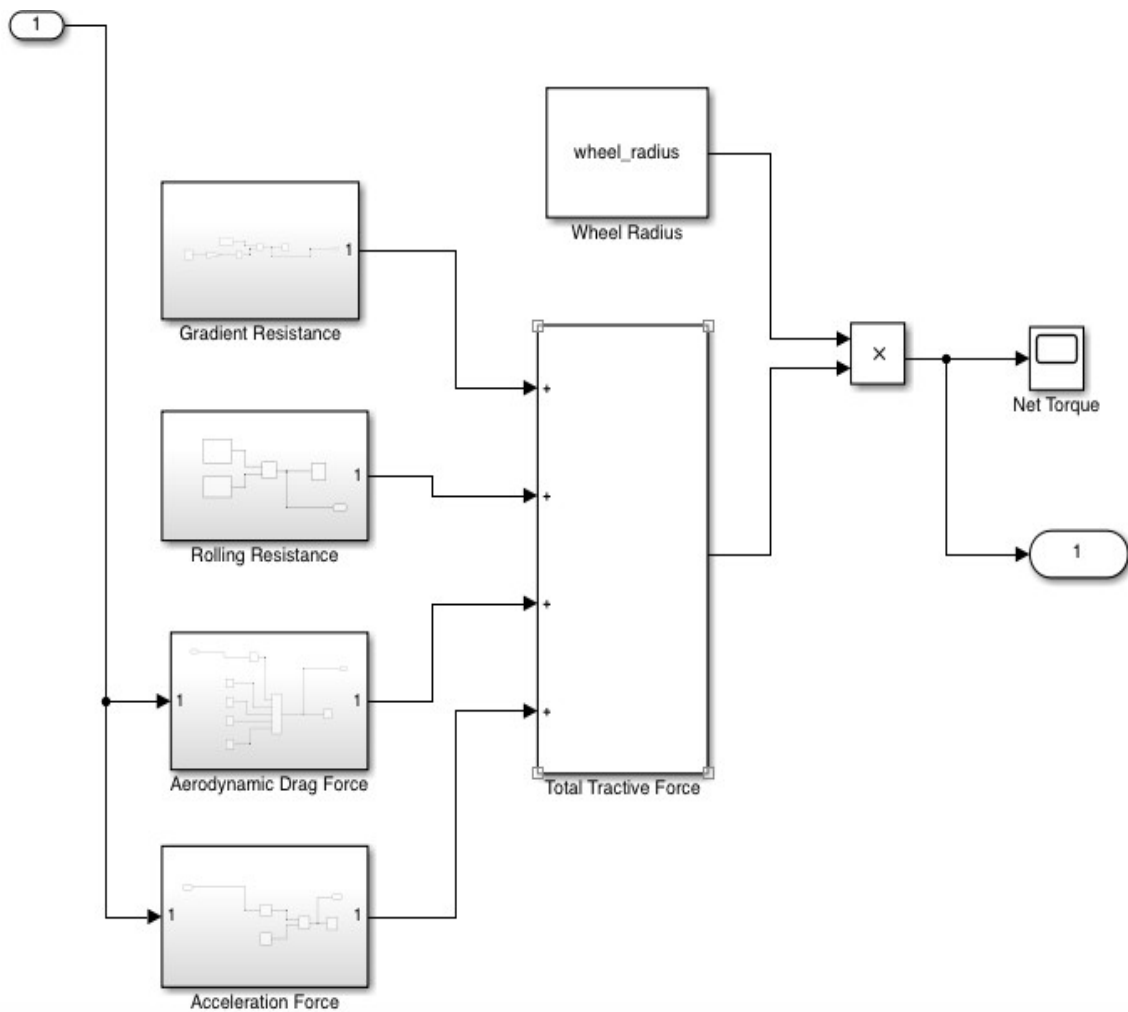
a.) Chassis Subsystem:



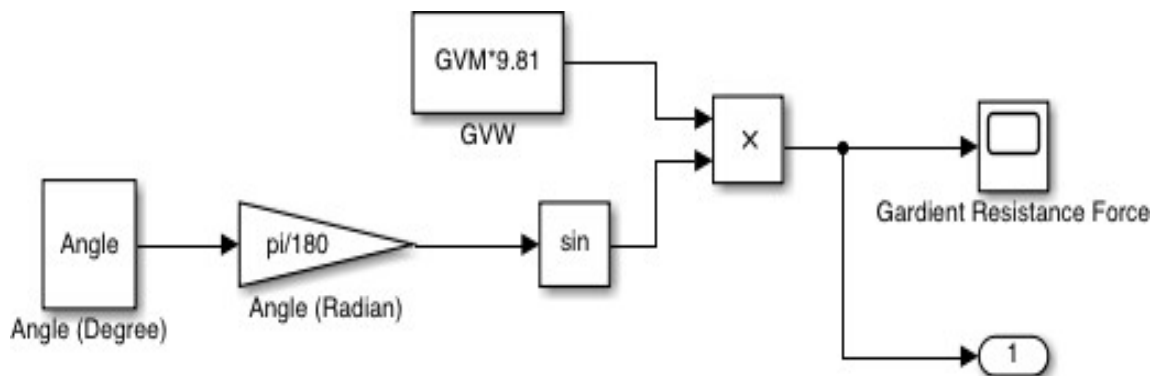
a.1) Wheel Speed Block:



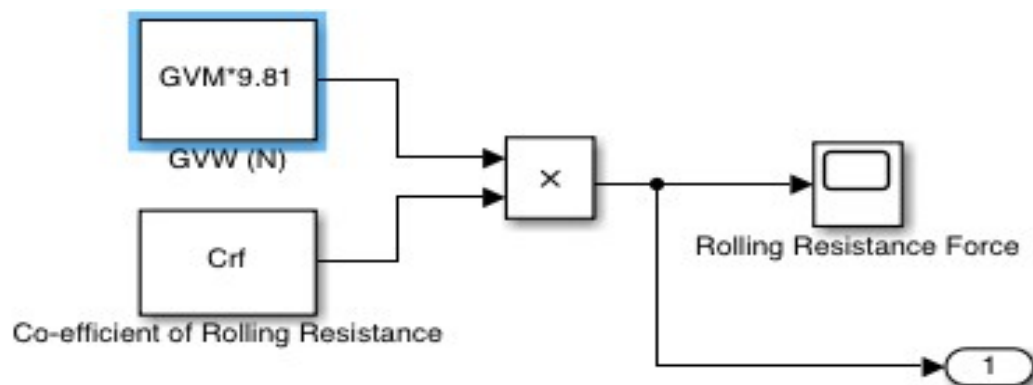
a.2) Net Torque Block:



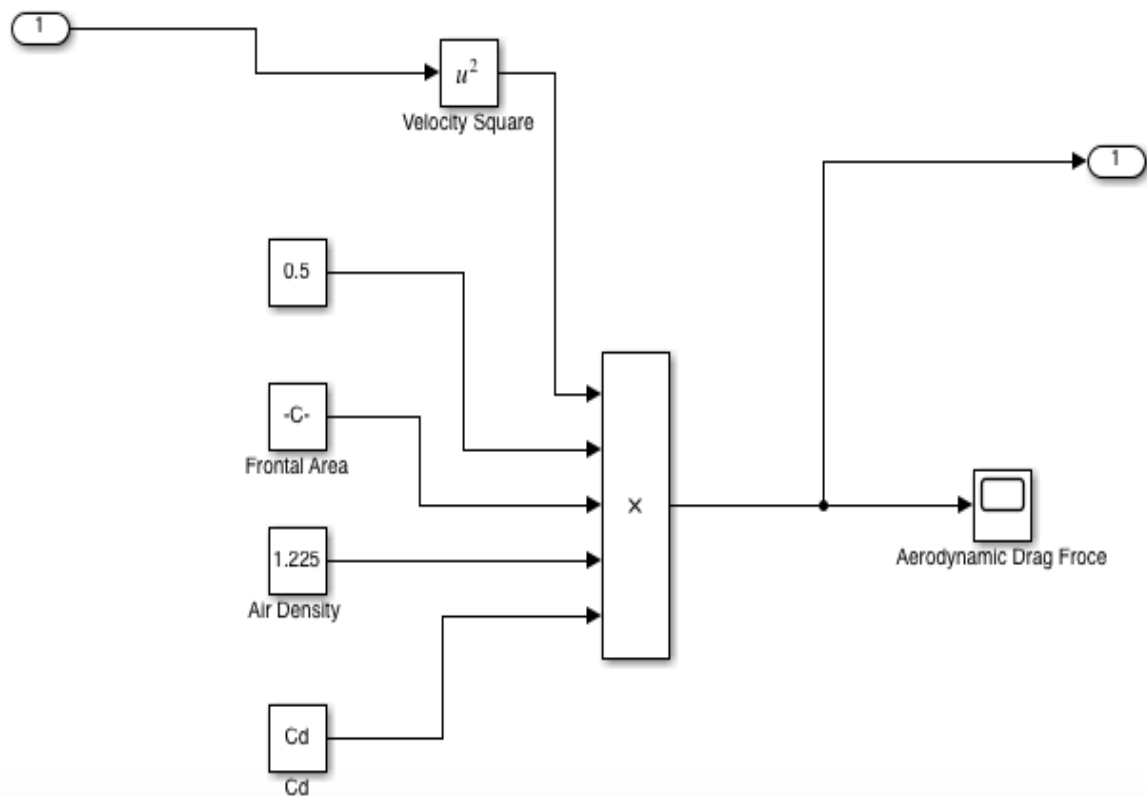
a.3) Gradient Resistance:



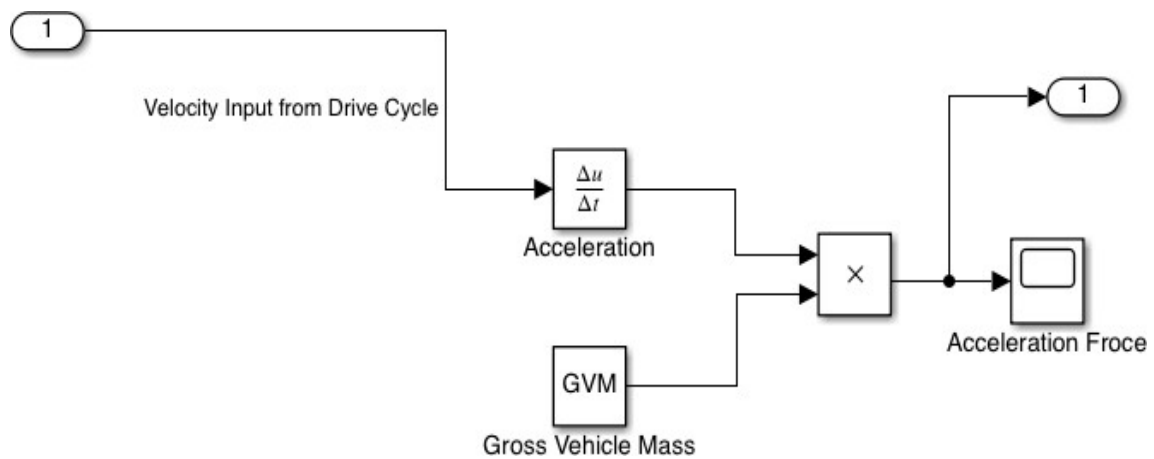
a.4) Rolling Resistance:



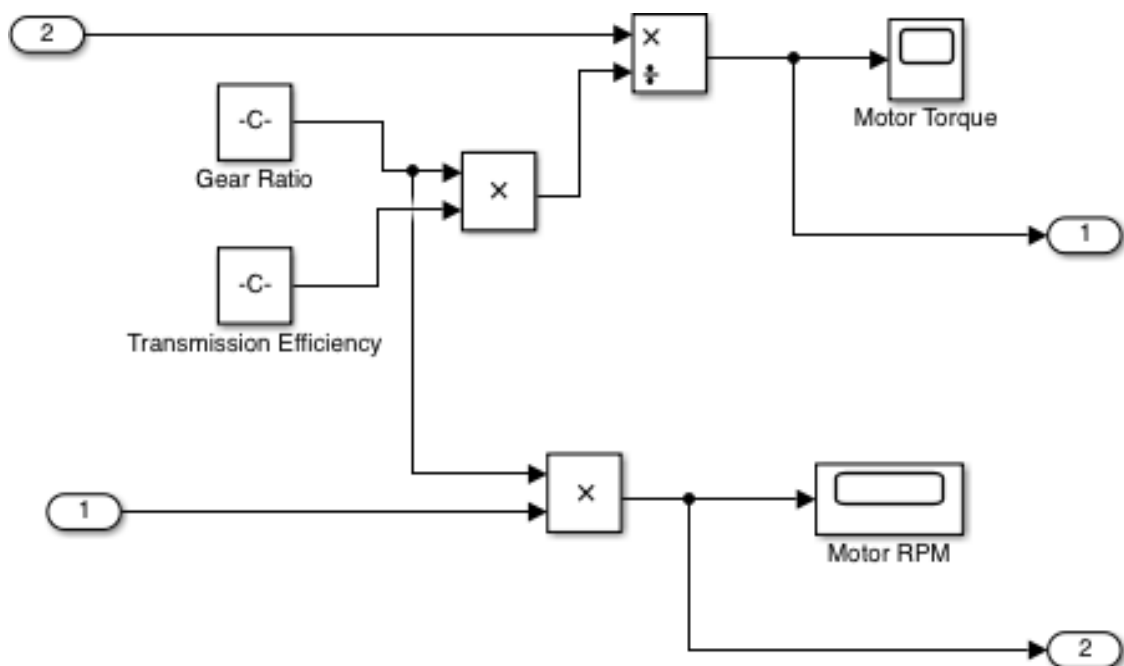
a.5) Aerodynamic Drag:



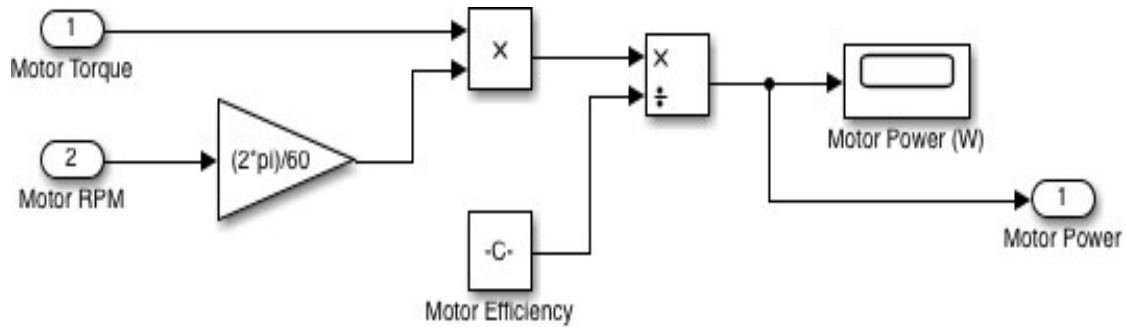
a.6) Acceleration Force:



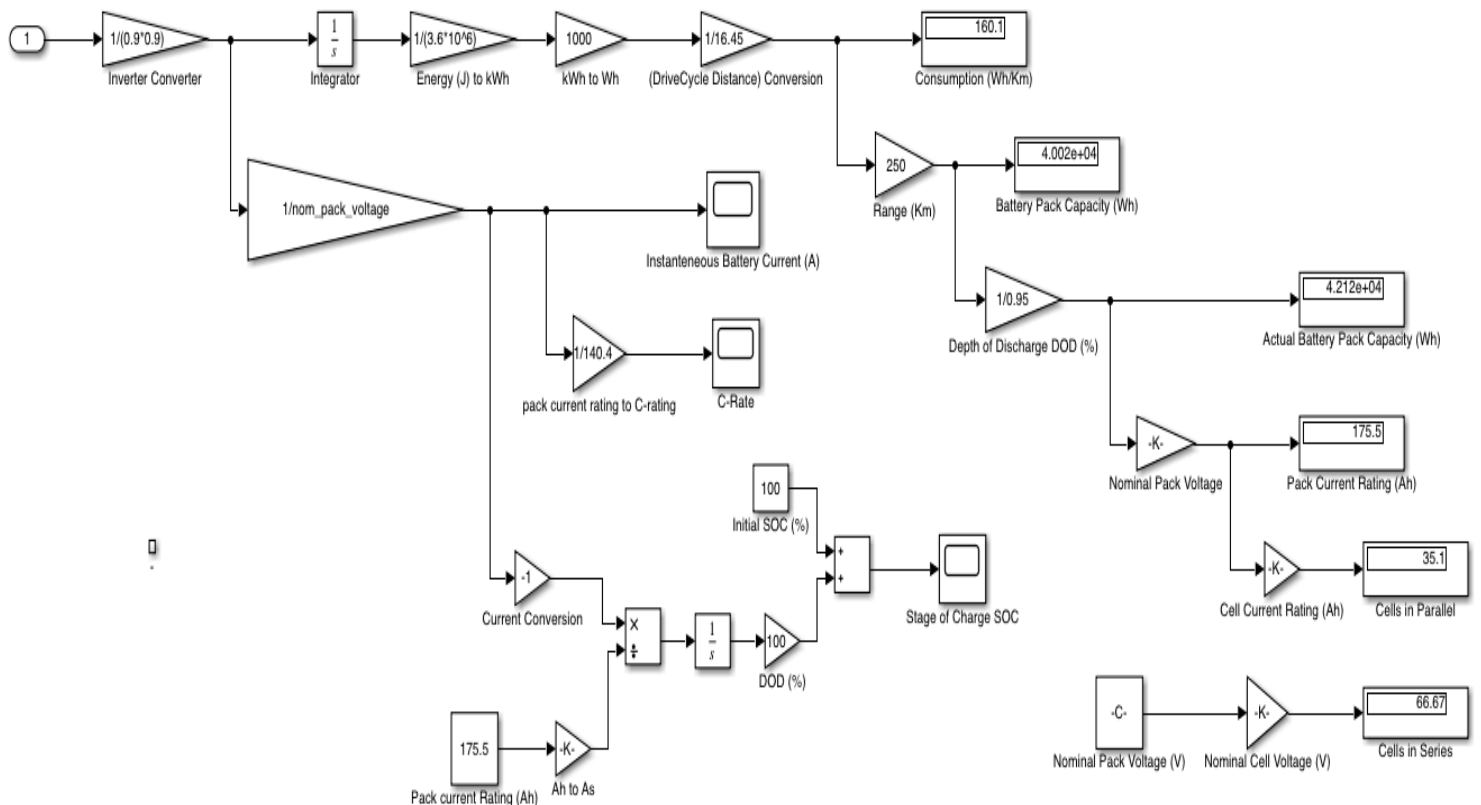
b.) Transmission Subsystem:



c.) Motor Subsystem:

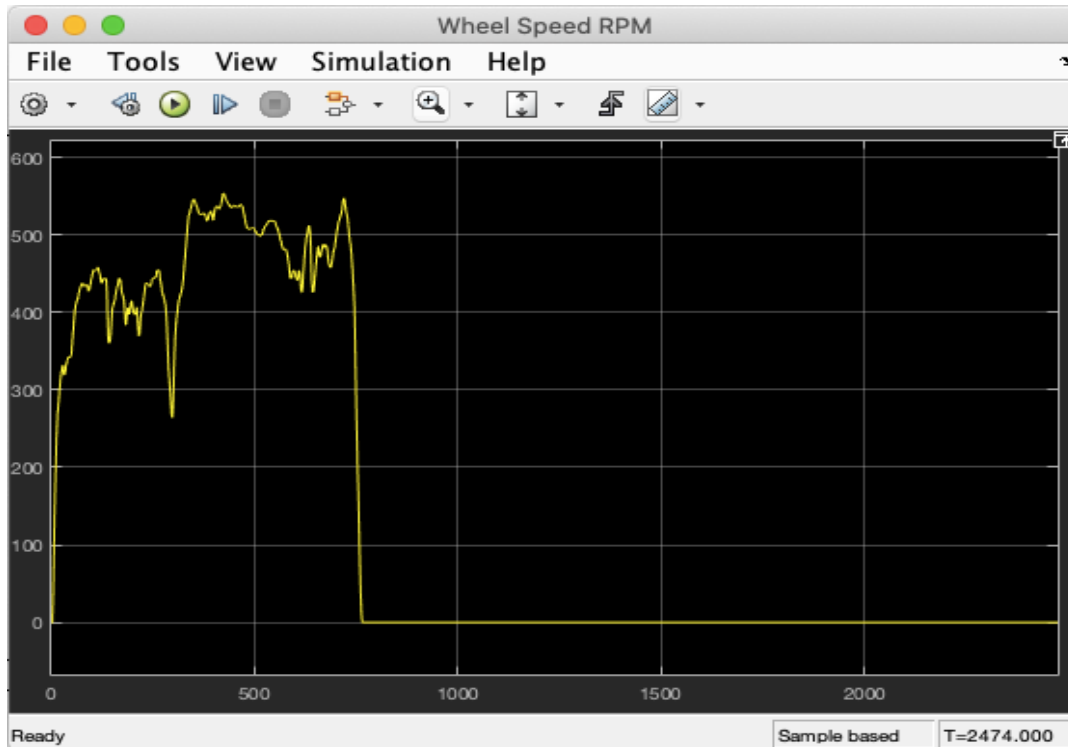


d.) Battery Subsystem:

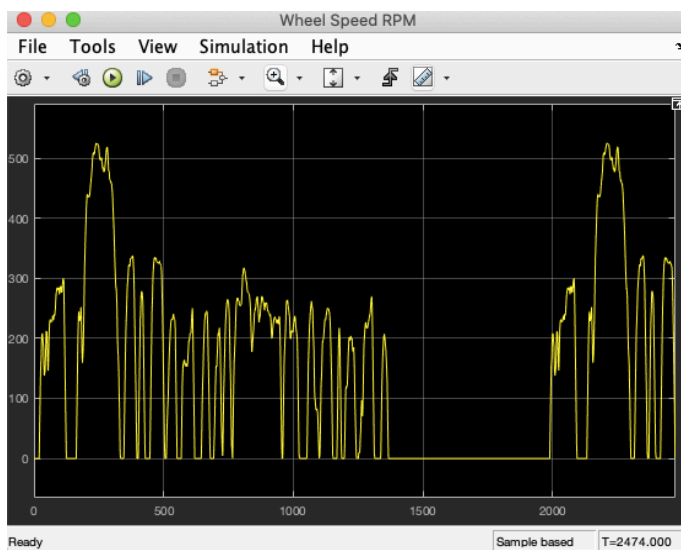


Question-2: Plots with Description:

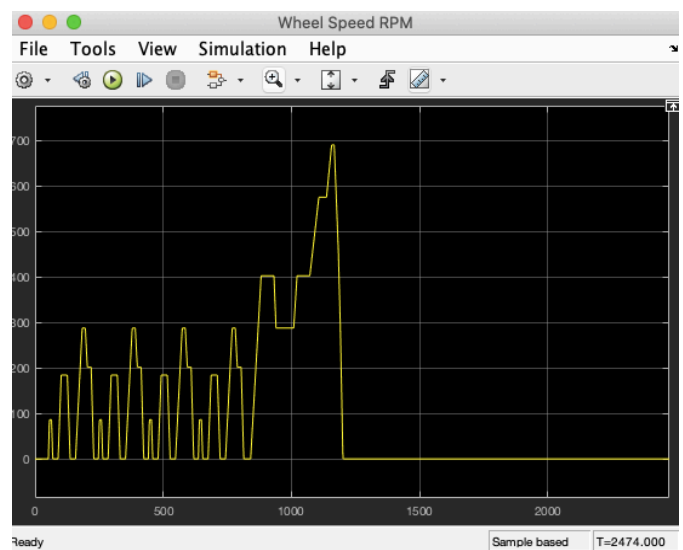
2.1) Wheel Speed(RPM):



Wheel Speed (RPM) graph indicates the maximum speed at around 550 rpm. Most of the time it is in the range of 400 to 500 rpm.

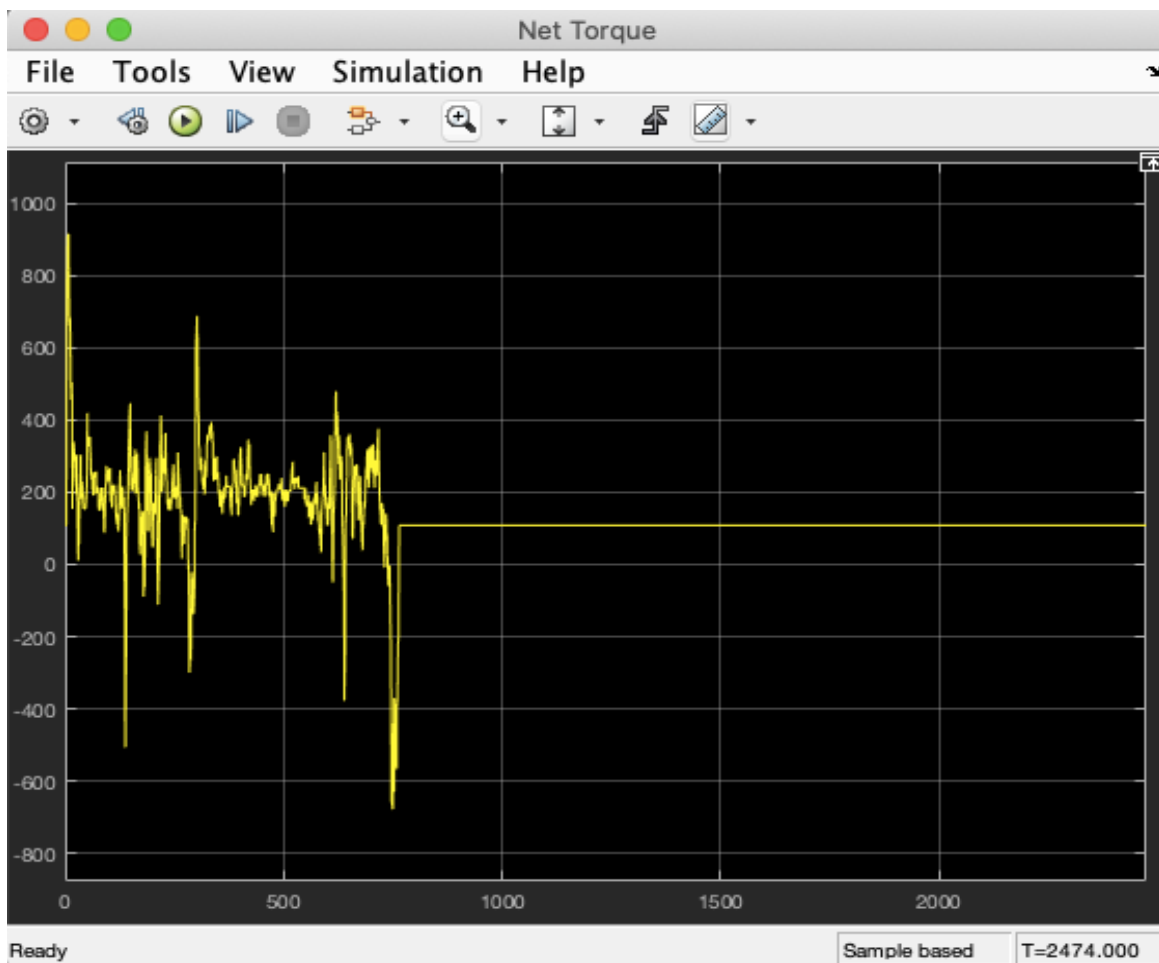


FTP 75 Drive Cycle

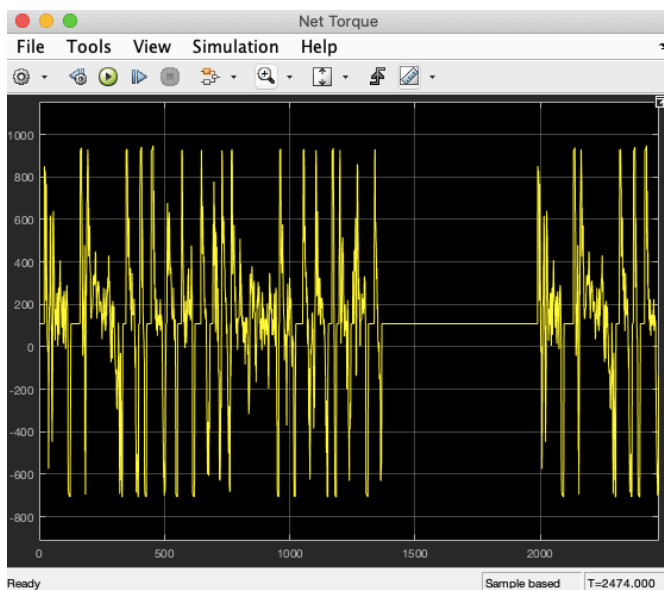


NEDC Drive Cycle

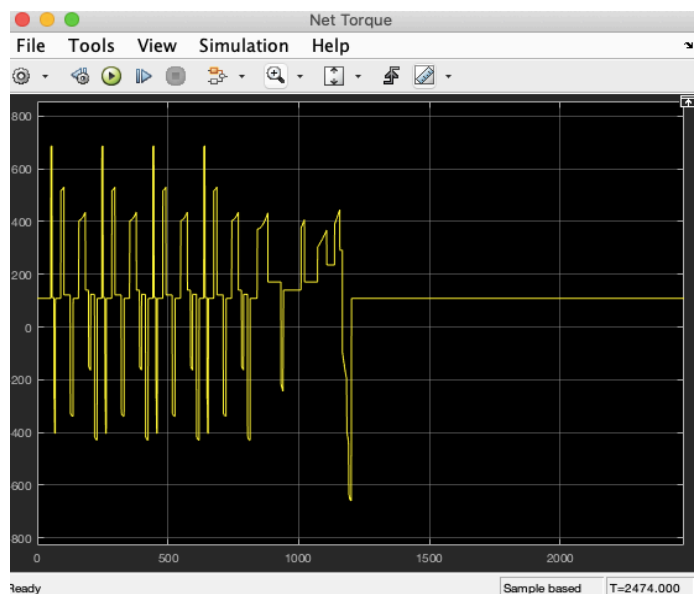
2.2) Net Torque (Nm):



Net Torque graph has maximum value of around 900 Nm, and this graph indicates that most of the time it is in the range of 200 to 400 Nm. Few times it goes below zero with maximum negative value of around 700 Nm.

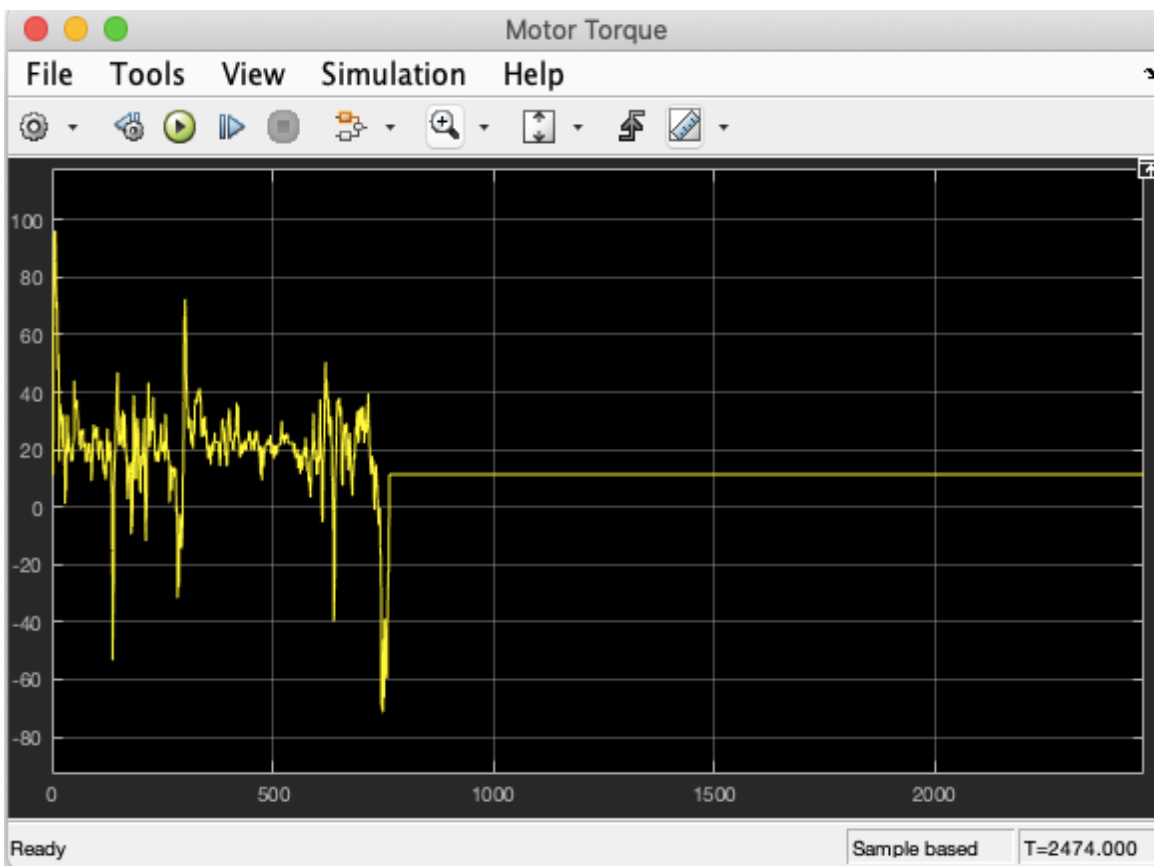


FTP 75 Drive Cycle

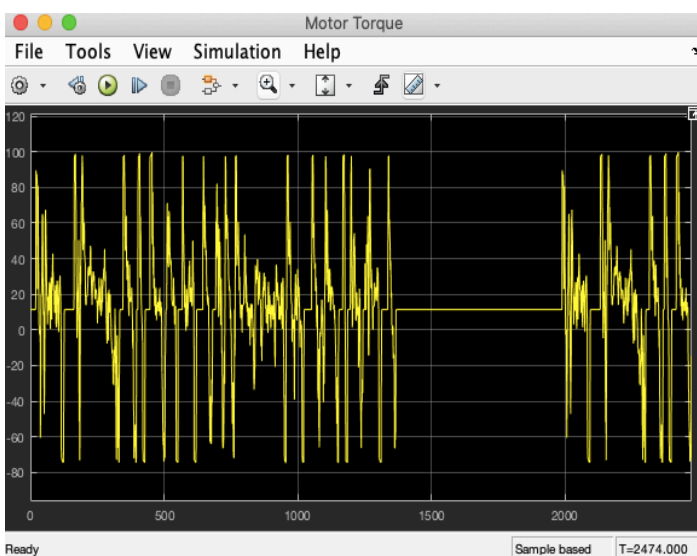


NEDC Drive Cycle

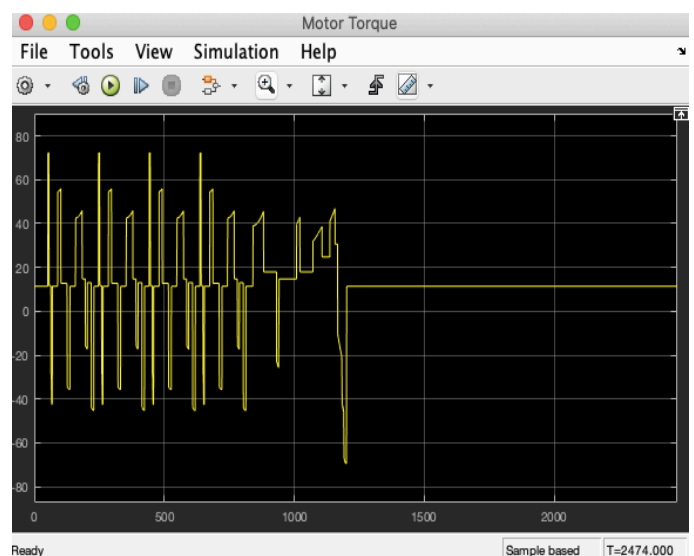
2.3) Motor Torque (Nm):



Motor Torque graph has maximum value of around 100 Nm, and this graph indicates that most of the time it is in the range of 0 to 40 Nm. Few times it goes below zero with maximum negative value of around 65 Nm. At the initial stage it touches maximum torque.

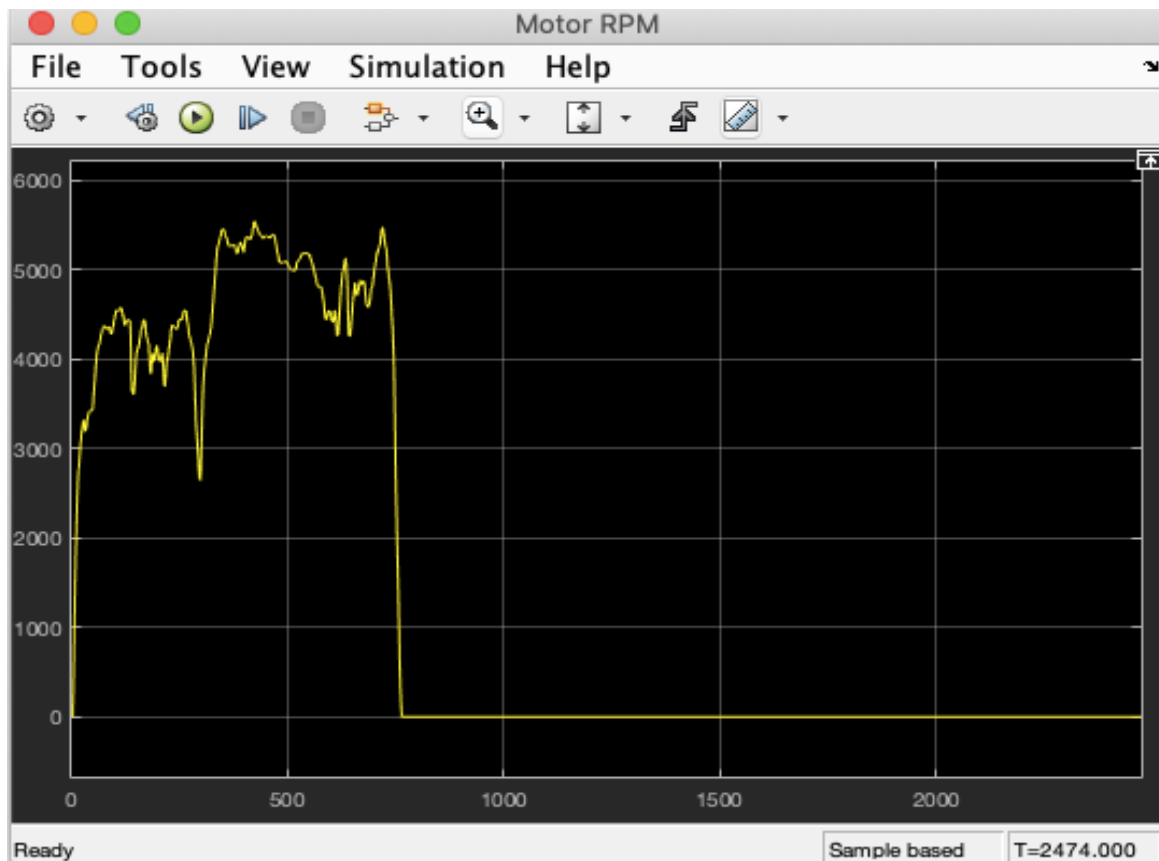


FTP 75 Drive Cycle

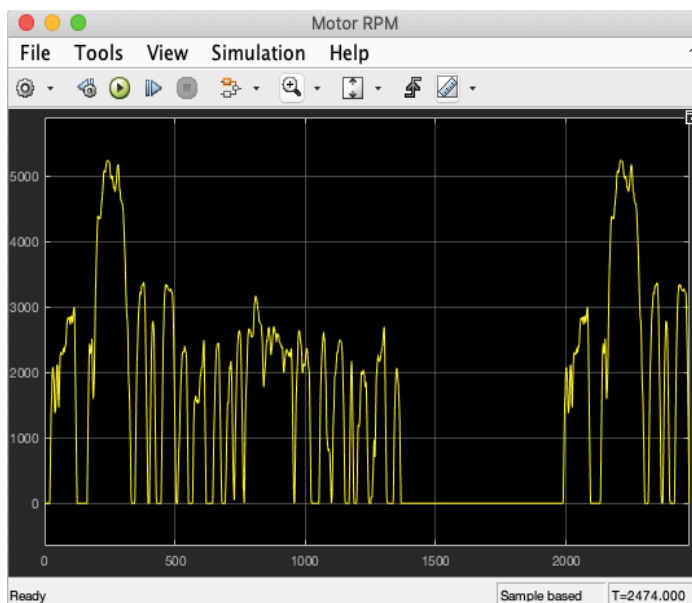


NEDC Drive Cycle

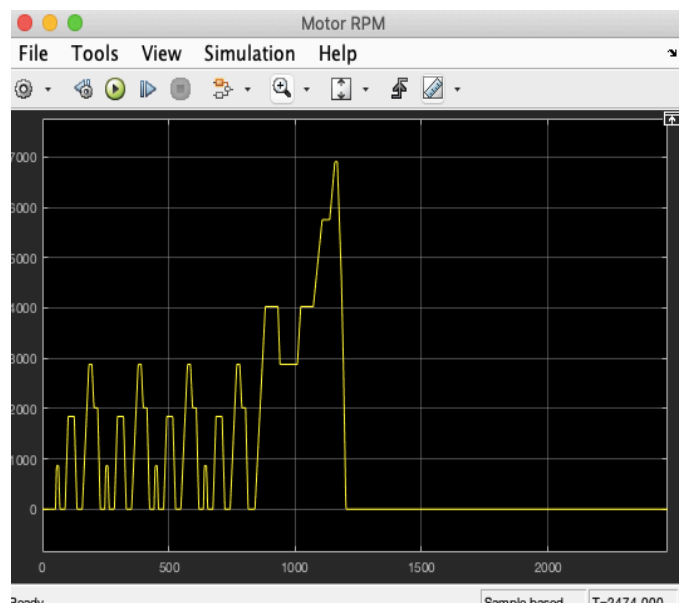
2.4) Motor Speed(RPM):



Motor RPM graph has maximum value of around 5500 rpm, and this graph indicates that most of the time it lies in the range of 3000 to 5000 rpm. RPM never going to be zero or negative value.

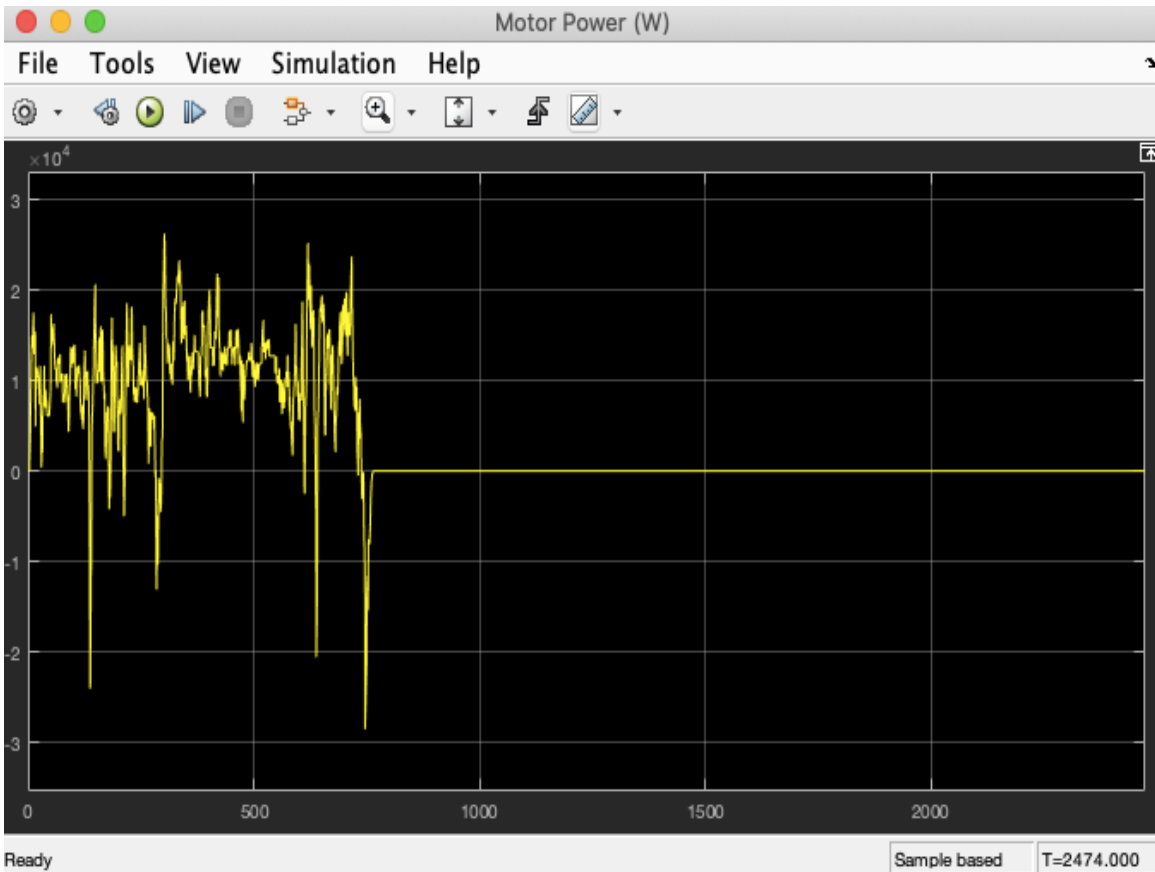


FTP 75 Drive Cycle

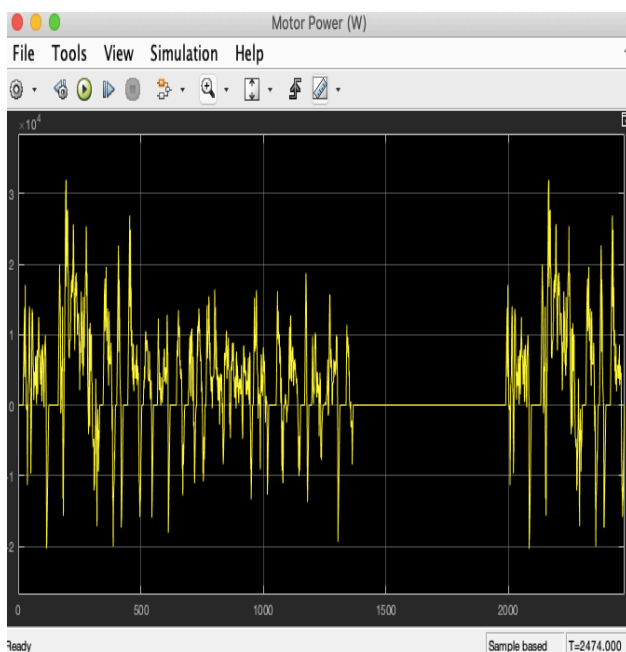


NEDC Drive Cycle

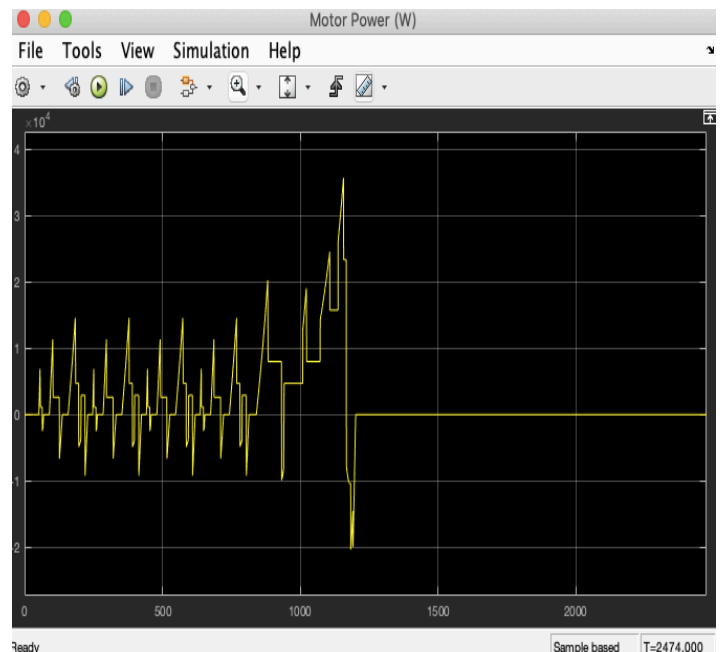
2.5) Motor Power (Watt):



Motor Power chart has maximum value of around 25 kW, and this graph indicates that most of the time it is in the range of 0 to 20 kW. Few times it goes below zero with maximum negative value of around 30kW.

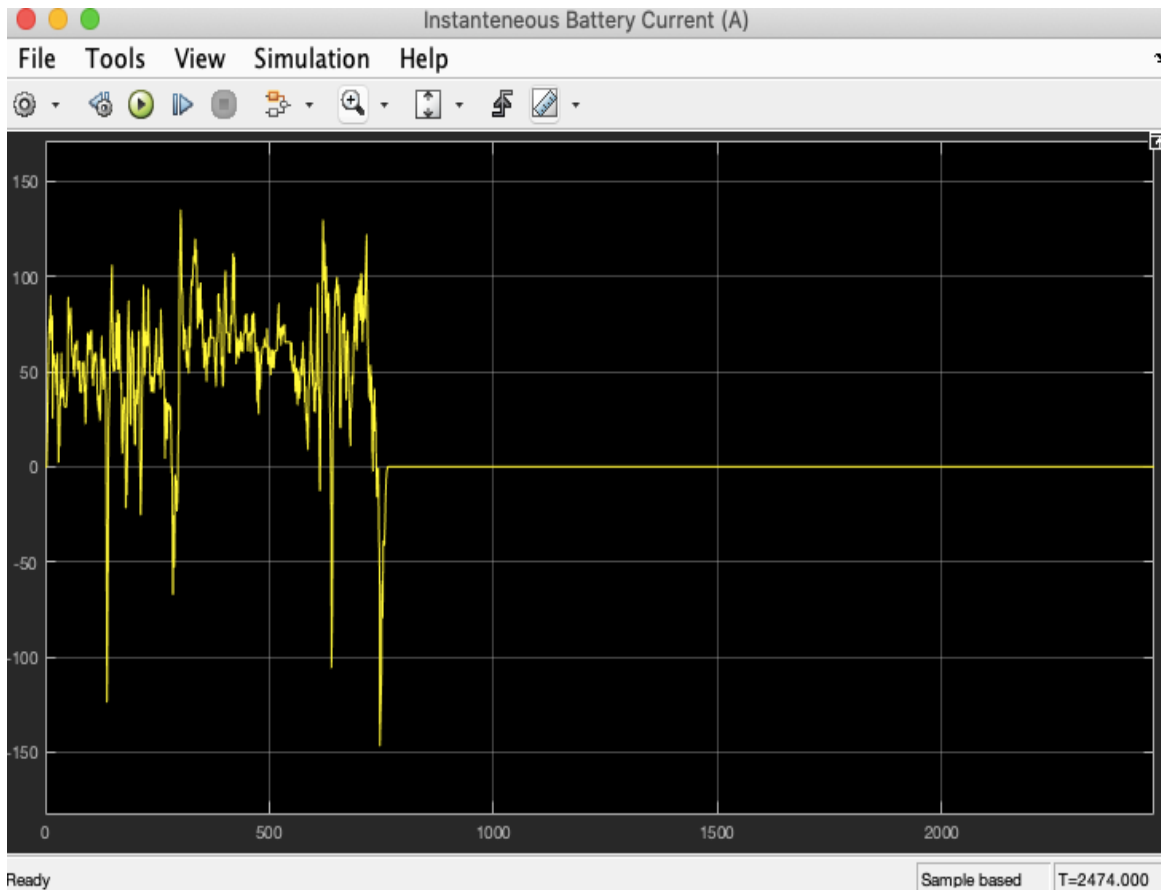


FTP 75 Drive Cycle

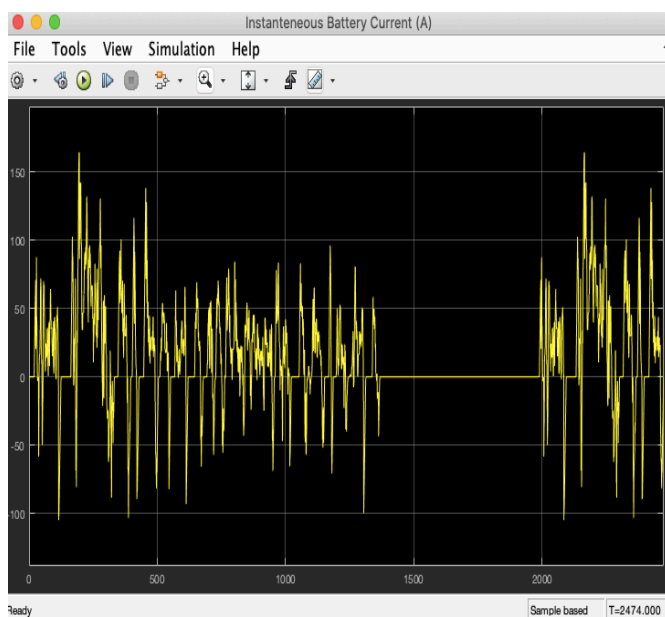


NEDC Drive Cycle

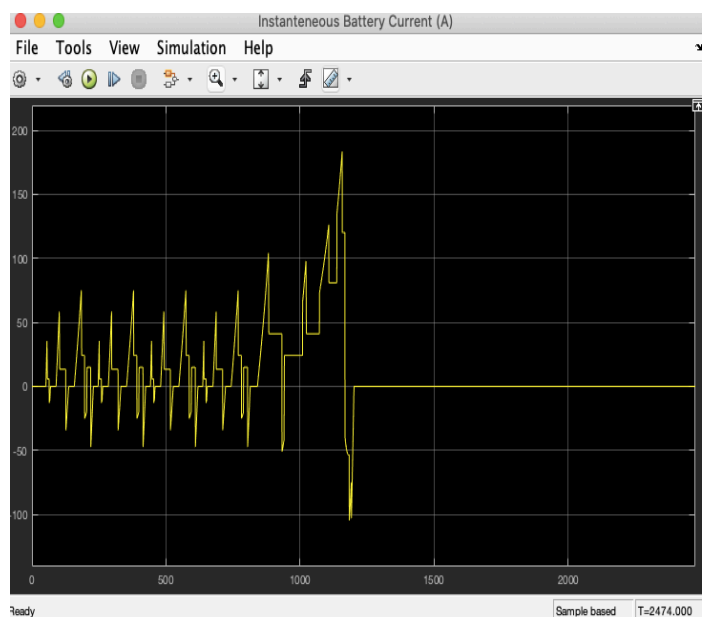
2.6) Instantaneous Battery (A):



Instantaneous Current chart has maximum positive value is of around 175 A, and negative value at about -150 A. Most of the time it lies between 0 and 100 A.

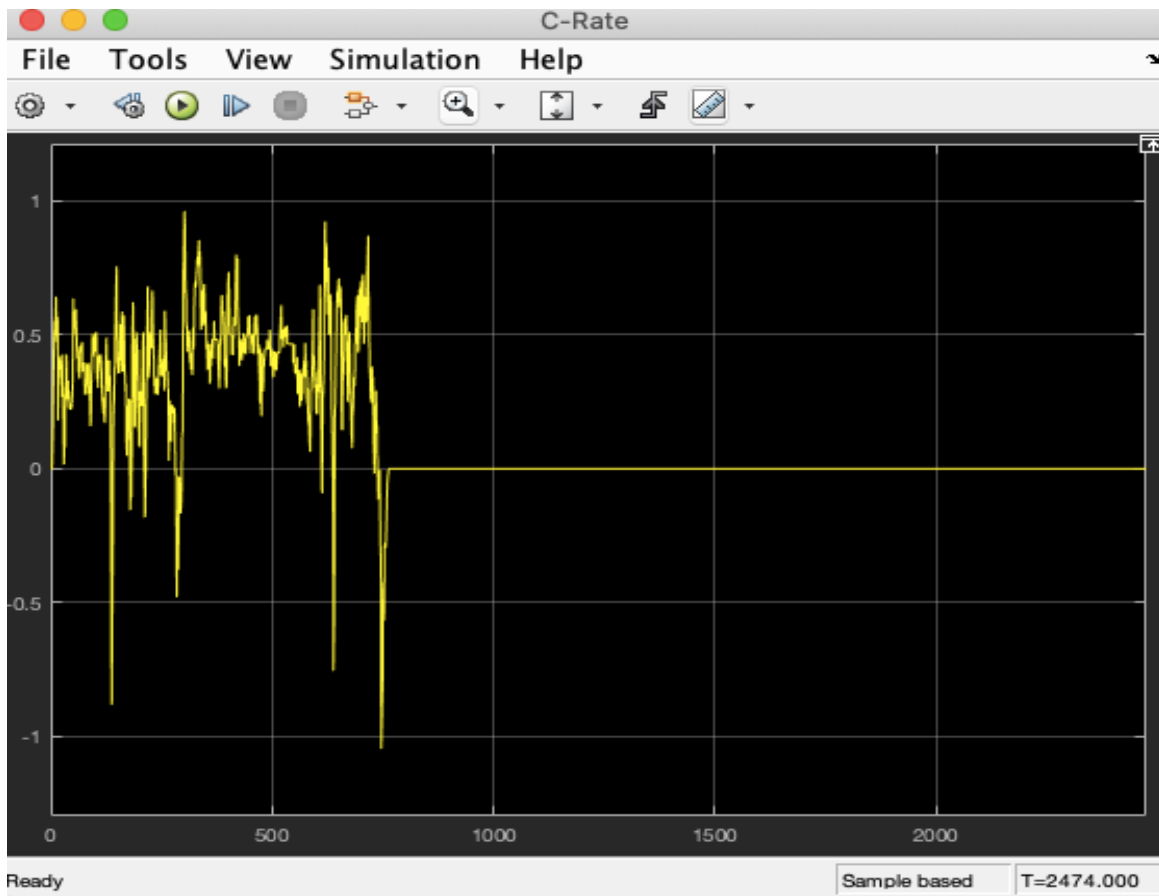


FTP 75 Drive Cycle

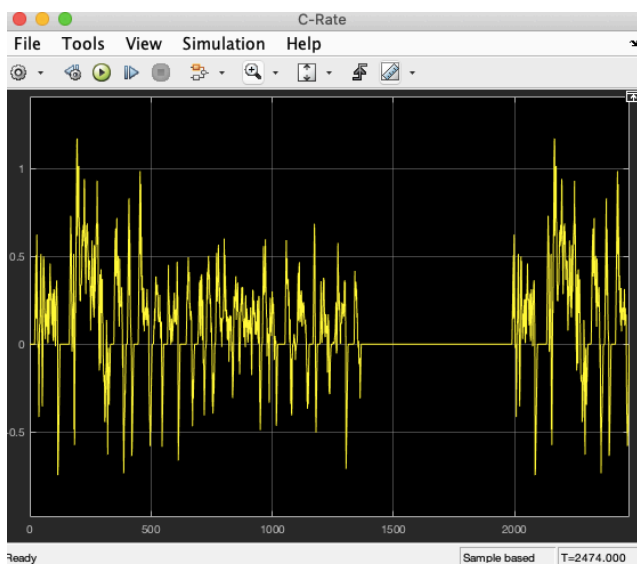


NEDC Drive Cycle

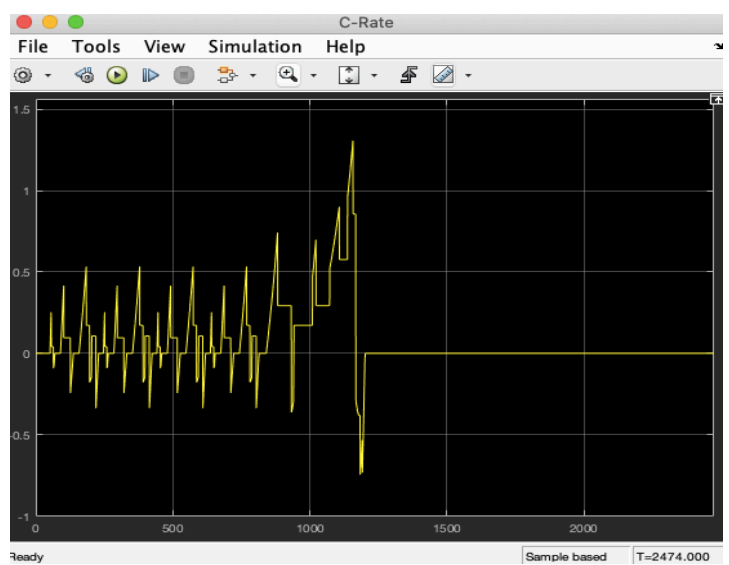
2.7) C-Rate:



C-Rate graph indicates frequent variations over the time because of instantaneous current. C-rate value mostly stay between in the range of 0 to 0.5 C.

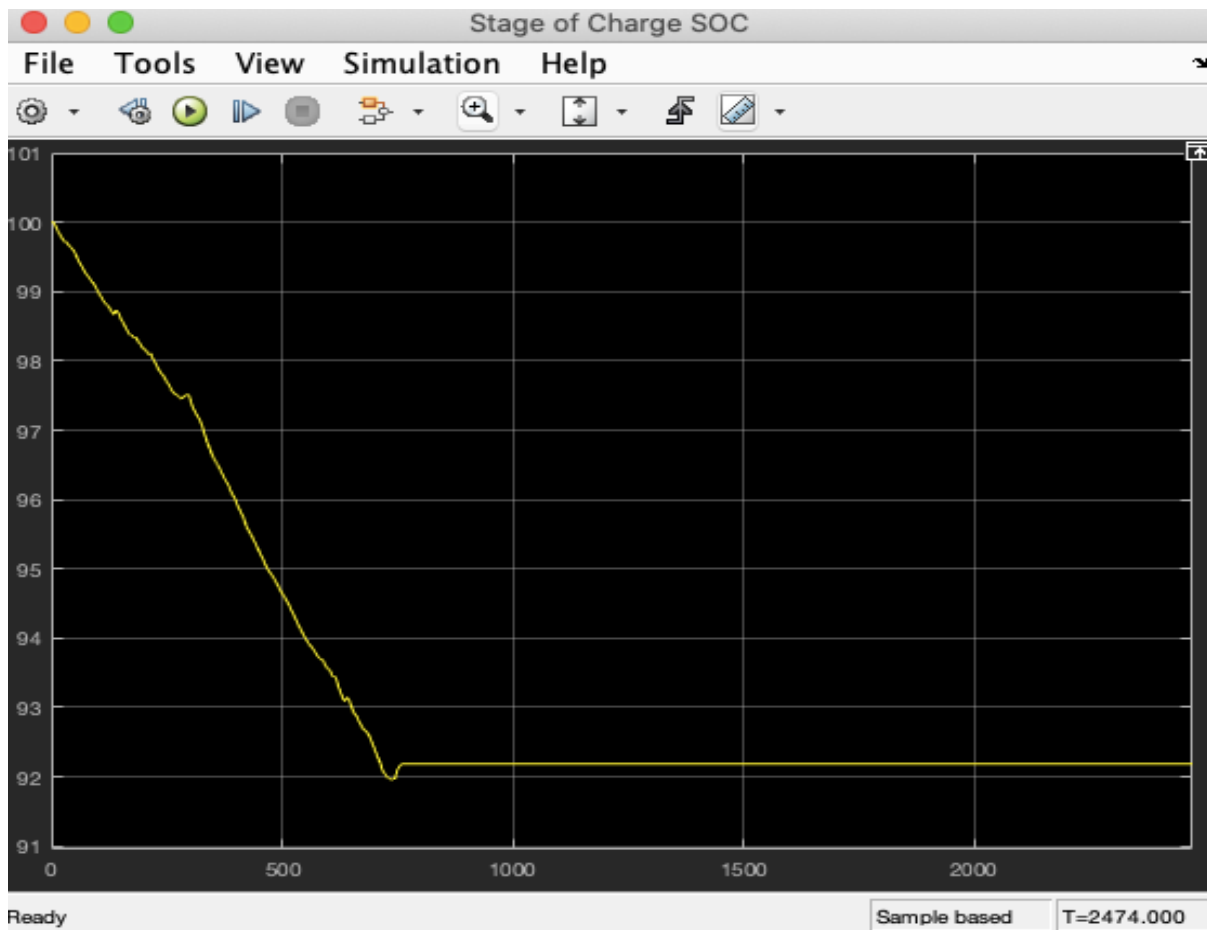


FTP 75 Drive Cycle

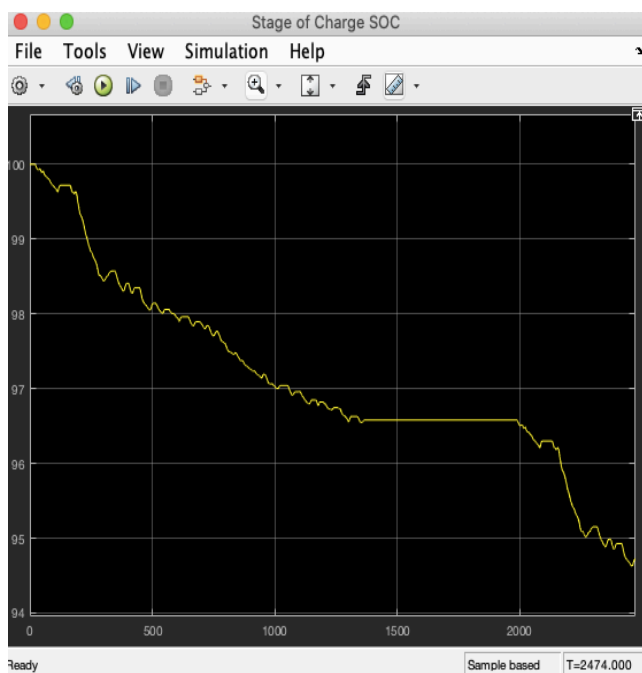


NEDC Drive Cycle

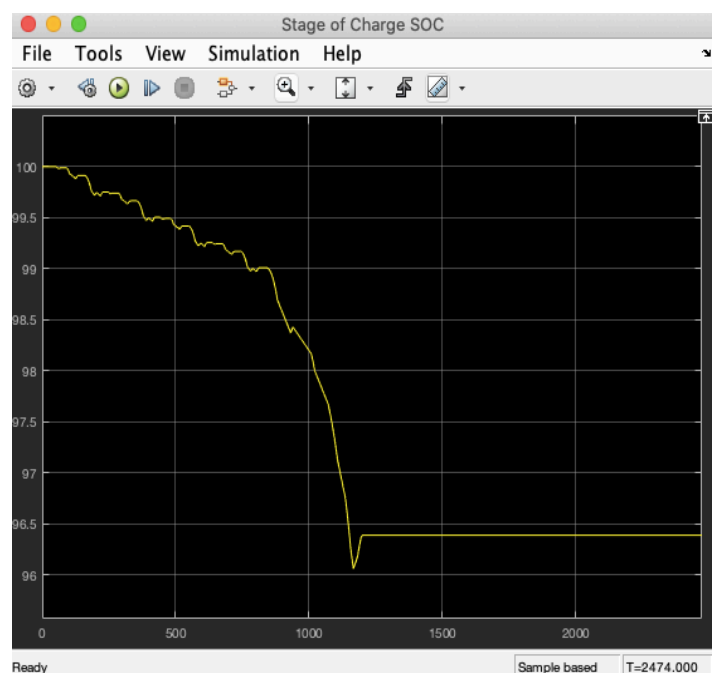
2.8) State of Charge SOC (%):



SOC chart represents the SOC percentage of battery pack. Firstly Initial SOC is 100% then gradually with the time it has fallen down to 92%.

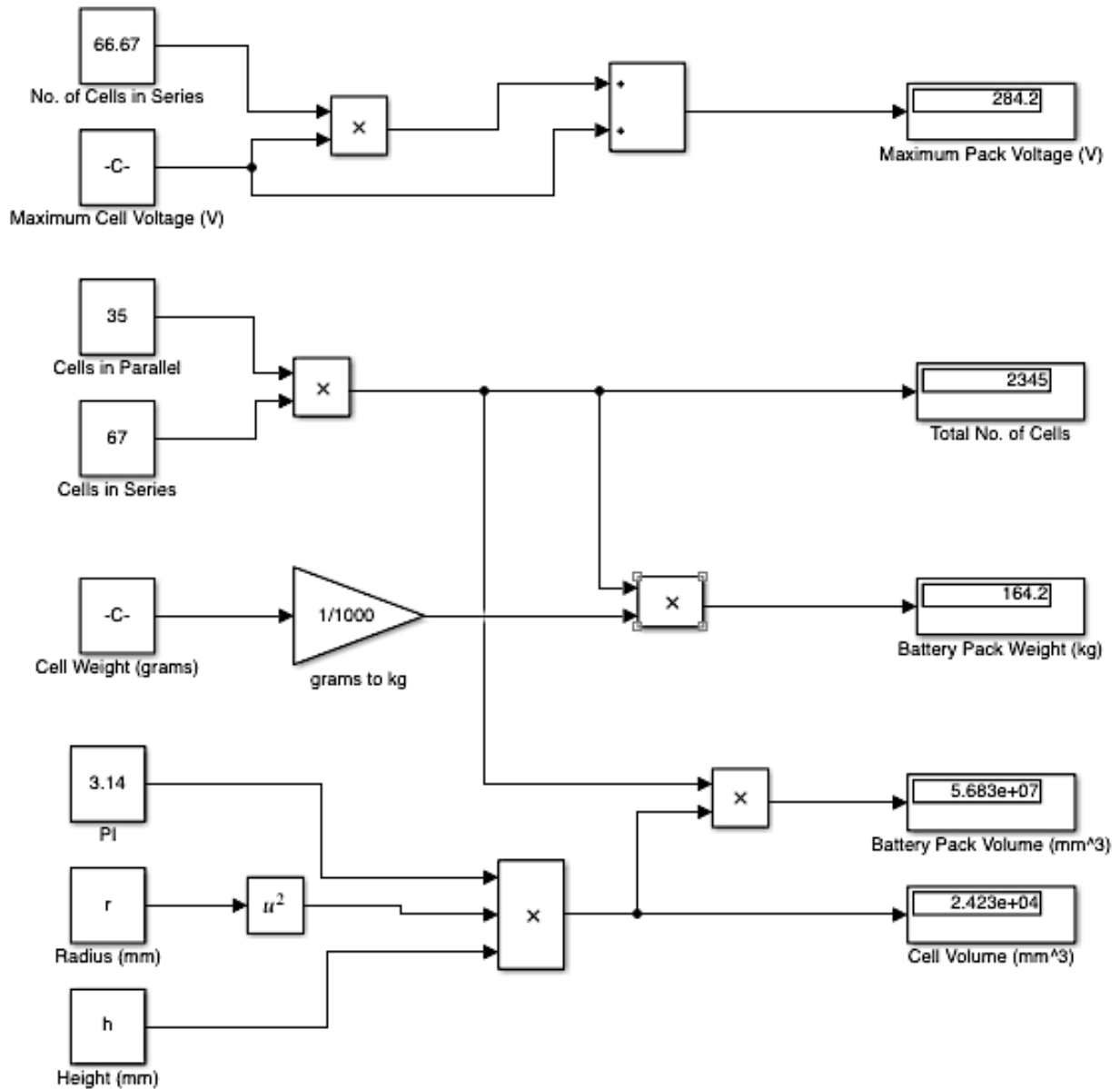


FTP 75 Drive Cycle



NEDC Drive Cycle

Question-3: Battery Pack Questions:



- a) Total No. of Cells = 2345
- b) Cell Volume = $2.423 \times 10^4 \text{ mm}^3$
- c) Battery Pack Volume = $5.68 \times 10^7 \text{ mm}^3$
- d) Maximum Voltage of Pack = 284.2 V
- e) Weight of Battery Pack = 164.2 kg