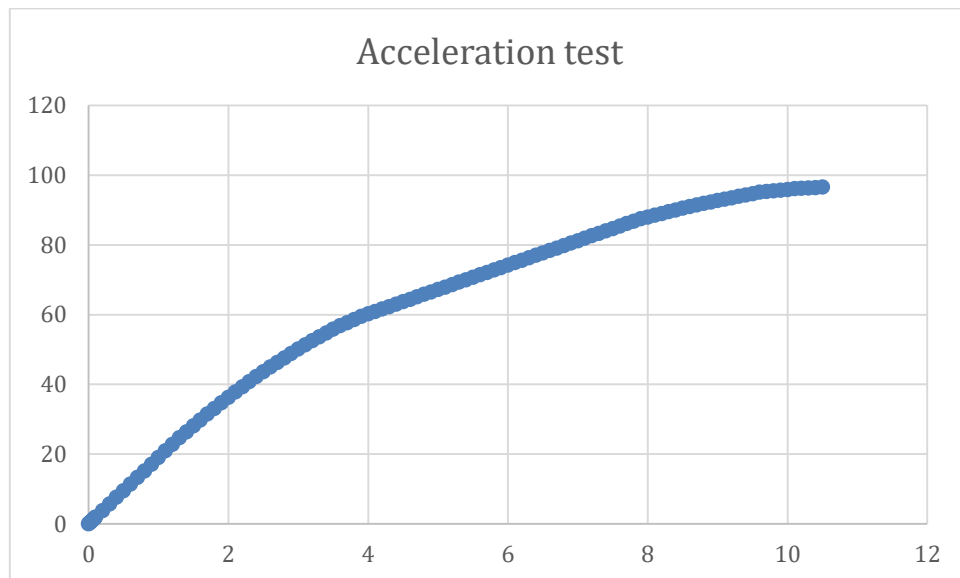| Course name	Numerical Modeling & Simulation in MATLAB-Simulink
Lesson name	**Numerical Modelling of Nissan Leaf using Acceleration Test data in** MATLAB-Simulink
Lesson objective	**Practice blocks & acquaint to use GUI of MATLAB-Simulink**
Created by	VIVEK RATHOD

Problem statement: Model Nissan Leaf for Acceleration Test in MATLAB Simulink to plot the Wheel Torque, Wheel Speed, Motor Torque, Motor Speed and Battery Current in Matlab Simulink.

Artemis Urban Drive Cycle Graph:

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Model Inputs:

Sl No	Parameter		Value	Units
1.	**Chassis**			
2.	I.	Coefficient of rolling resistance	0.015	
3.	II.	Mass of Vehicle	1630.665	Kg
4.	III.	Mass of Driver	80	Kg
5.	IV.	Gravity constant	9.81	m/s
6.	V.	Grade Angle	0	degree
7.	VI.	Velocity	From The Acceleration Test	Kmph
8.	VII.	Area	3.8056	m^2
9.	VIII.	Air Density	1.225	Kg/m^3
10.	IX.	Drag Coefficient	0.28	
11.	X.	Radius of wheel	0.2032	m
12.	**Transmission**			
13.	I.	Gear Ratio	7.9377	
14.	II.	Transmission Efficiency	89	%
15.	**Battery**			
16.	I.	Battery Capacity	24000	Wh
17.	II.	Battery Voltage	364.8	V
18.	III.	Artemis Rural drive cycle distance	0.185	Km
19.	IV.	Battery Initial SOC	100	%
20.	V.	Drive Cycle time or Simulation time	10.5	s
21.	**Cell**			
22.	I.	Cell Voltage	3.8	V
23.	II.	Cell Capacity	33.1	Ah

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Program:

Separately imported the file using import data.

```
M=1630.665; %Mass of vehicle        (kg)
Md=80;      %Mass of driver         (kg)
GVM=M+Md;   %Gross vehicle mass     (kg)
g=9.81;     %Gravity contant        (m/s^2)
GVW=GVM*g;  %Gross vehicle weight
A=3.8065;   % frontal area          (m^2)
rho=1.2250; %Air Density            (kg/m^3)
Rw=0.2032;  %Radius of wheel        (m)
cd=0.28;    %coefficient of drag
crf=0.015;  %coefficient of rolling re__sistance
GR=7.9377;  %Gear Ratio
Teff=0.89;  %transmission efficiency
ACC_Test=NissanLeafAccelerationData;

%Motor
ME=NissanLeafMotorEfficiency; %motor efficiency
MRE=NissanLeafMotorRegenerativeefficiency; %motor regenrative efficiency

%Motoring efficiency
ME_Speed=ME(:,1);
ME_Torque=ME(:,17);
ME_Eff=ME(:,2:16);
%surface plot of the efficiency
figure('Name','Motor Motering Efficiency')
surf(ME_Speed,ME_Torque,ME_Eff)
xlabel('motor speed (rpm)')
ylabel('motor torque (Nm)')
zlabel('motor efficiency(%)')

%regenerative efficiency
MRE_Speed=MRE(:,1);
MRE_Torque=MRE(:,17);
MRE_Eff=MRE(:,2:16);
%surface plot of the Regenerative efficiency
figure('Name','Motor Regenerative Efficiency')
surf(MRE_Speed,MRE_Torque,MRE_Eff)
xlabel('motor speed (rpm)')
ylabel('motor torque (Nm)')
zlabel('motor efficiency(%)')

%Motor Controller Efficiency
MCE=NissanLeafMotorControllerEfficiency;

%Motoring efficiency
MCE_Speed=MCE(:,1);
MCE_Torque=MCE(:,17);
MCE_Eff=MCE(:,2:16);
%surface plot of the efficiency
figure('Name','Motor Controller Efficiency')
```

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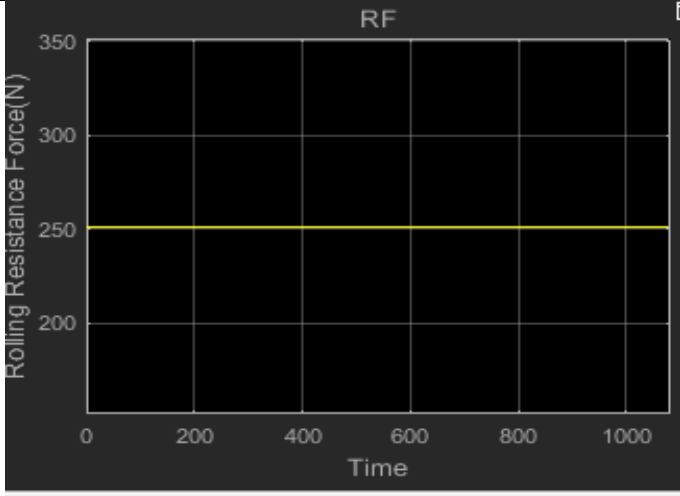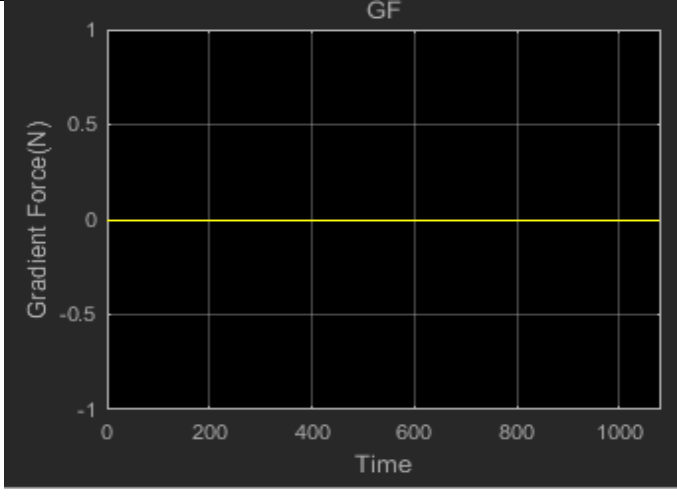Bangalore, Karnataka, 560102

```
surf(MCE_Speed,MCE_Torque,MCE_Eff)
xlabel('motor speed (rpm)')
ylabel('motor torque (Nm)')
zlabel('motor efficiency(%)')

%Motor Controller Regenrative Efficiency
MCRE=Nissanleafmotorcontrollerregenerativeefficiency;

%Motoring Regenerative efficiency
MCRE_Speed=MCRE(:,1);
MCRE_Torque=MCRE(:,17);
MCRE_Eff=MCRE(:,2:16);
%surface plot of the efficiency
figure('Name','Motor Controller Regenerative Efficiency')
surf(MCRE_Speed,MCRE_Torque,MCRE_Eff)
xlabel('motor speed (rpm)')
ylabel('motor torque (Nm)')
zlabel('motor efficiency(%)')

%Intial state of charge
ISOC=1;
```
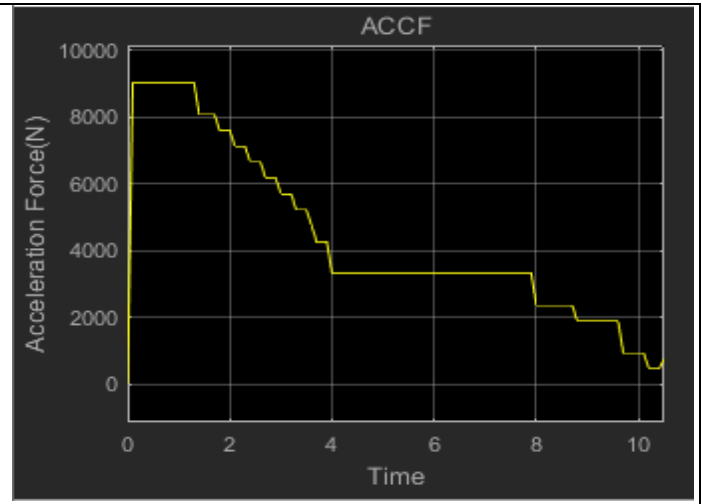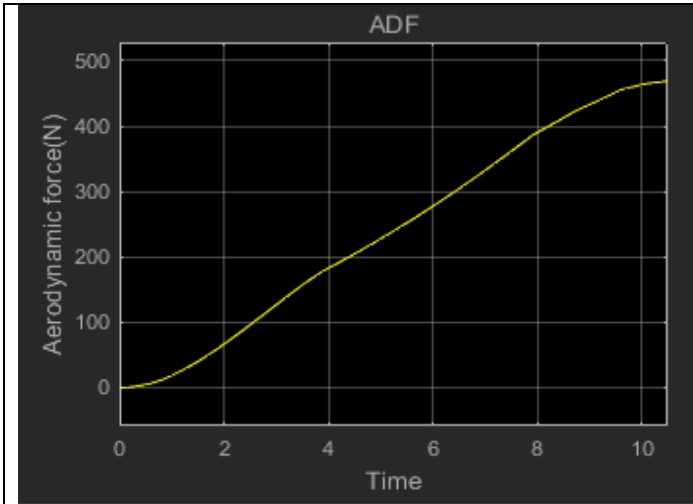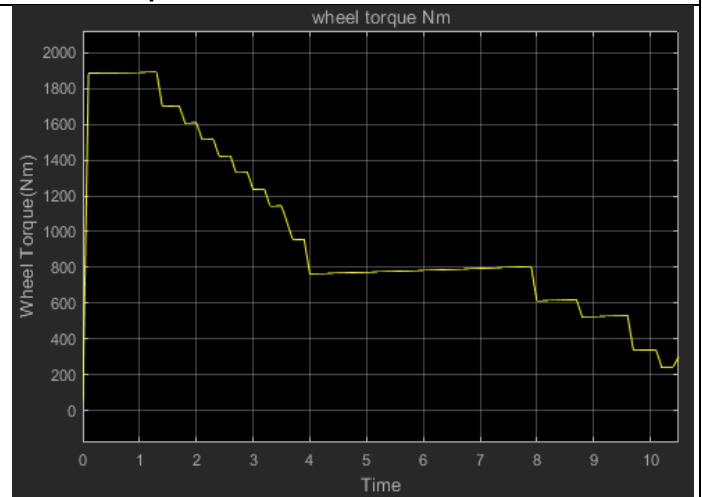
Result:

Rolling Force:	Gradeability Force:
Aerodynamic Force:	**Acceleration Force:**

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ADF

ACCF

Wheel Speed:

wheel speed rpm

Wheel Torque:

wheel torque Nm

Motor Speed:

motor speed rpm
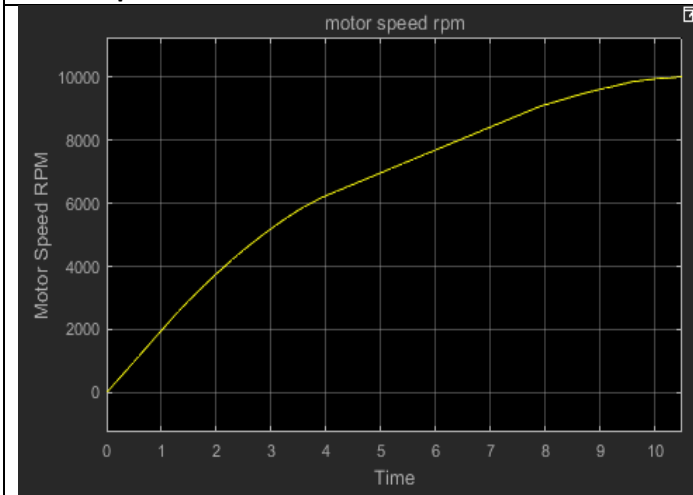
Motor Torque:

Motor torque Nm
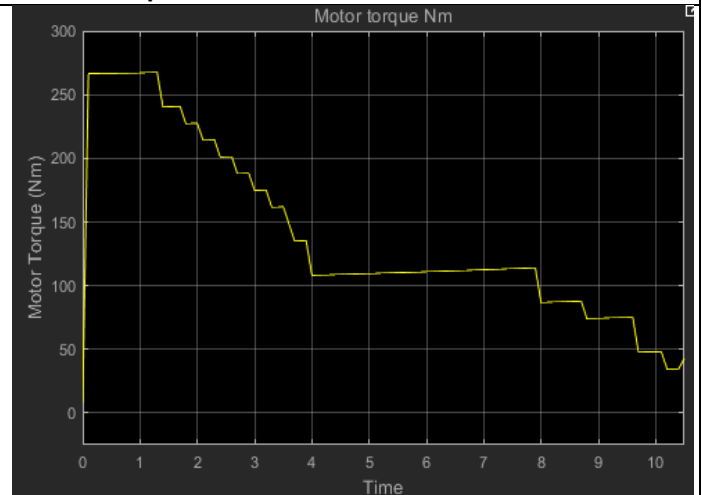
Motor Power:

Battery Power:

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motor electrical Power

Battery motoring Power (Watt)
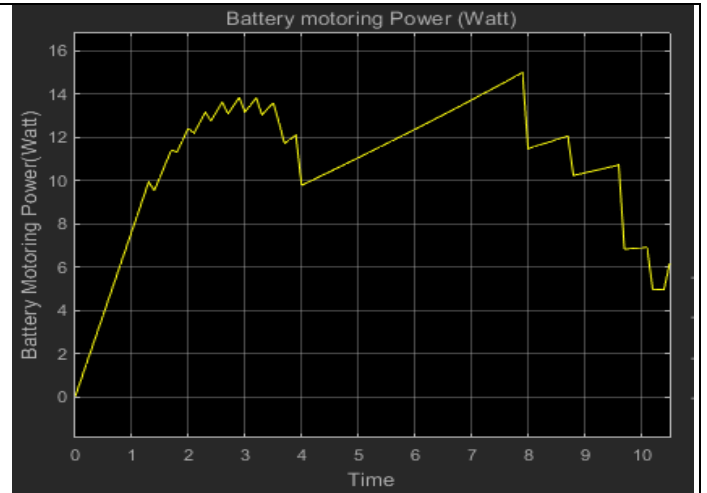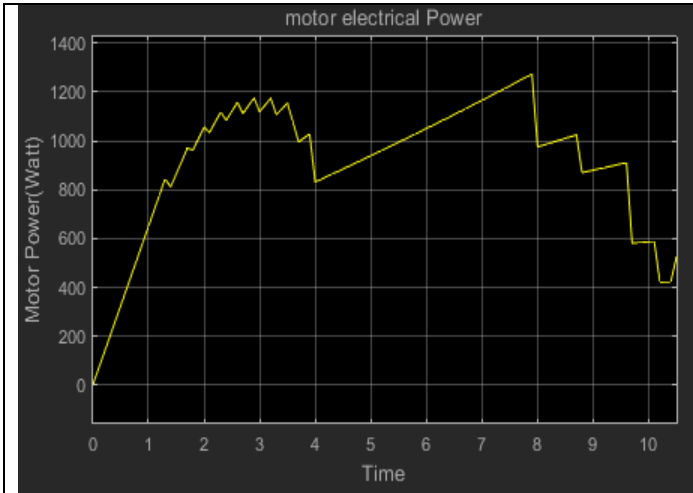
Battery Current:

Battery motoring Current (A)
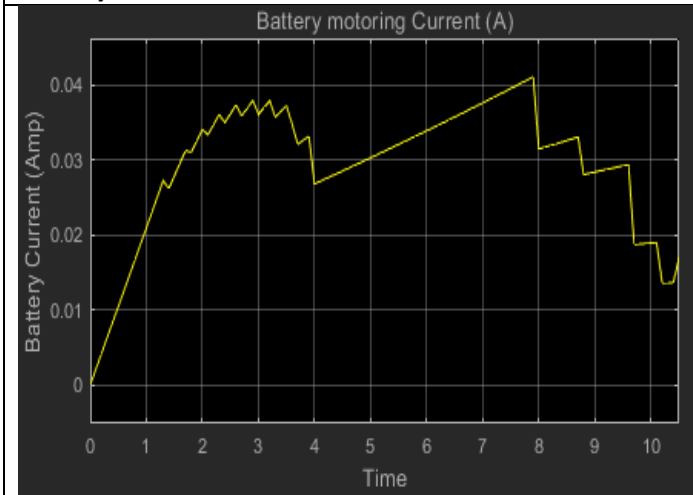
Battery SOC:

Battery C-rate:

Battery motoring Current (A)

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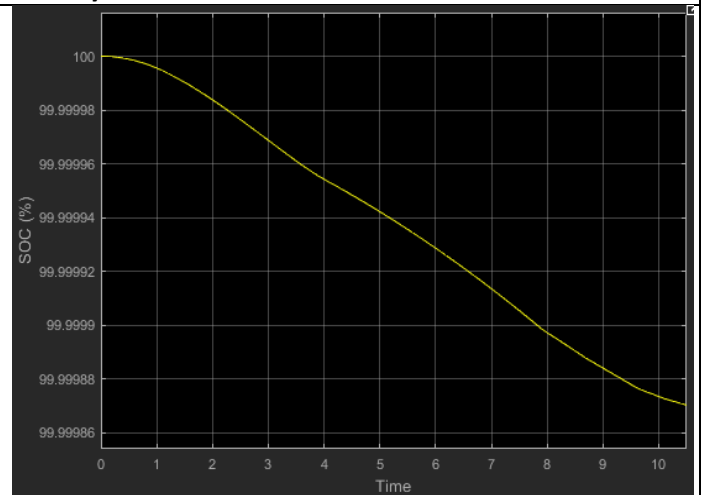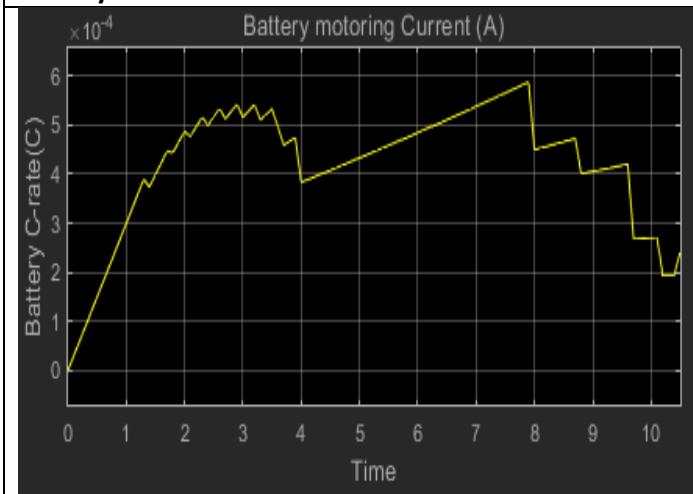
Conclusion:

Sl No	Parameters	Values	Units
1.	**Chassis**		
2.	• Rolling Force	250	N
3.	• Gradeability Force	0	N
4.	• Maximum Aerodynamic Force	469.6614	N
5.	• Maximum Acceleration Force	9028.5	N
6.	• Maximum Wheel Speed	1260.5	Rpm
7.	• Maximum Wheel Torque	1892	Nm
8.	**Motor**		
9.	• Maximum Motor Speed	1000.6	Rpm
10.	**Motor Torque**		
11.	• Nominal Motor Torque	138.6414	Nm
12.	**Motor Power**		
13.	• Nominal Motor Power	77042	W
14.	**Battery**		
15.	• Power per Km	0.1683	Wh/Km
16.	• Vehicle Range	-	Km
17.	• Battery Capacity in Ah	65.79	Ah
18.	**Cell**		
19.	• Cell Voltage	3.8	V
20.	• Cell Capacity	33.1	Ah
21.	**No of cells**	192	
22.	**Battery Power**		
23.	• Nominal Battery Power	10.6632	W
24.	**Battery Current**		
25.	• Nominal Battery Current	0.0292	A
26.	**Battery C-rate**		
27.	• Nominal Battery Discharge C-rate	0.0004164	C
28.	• State of Charge	99.99	%
29.	**Regenerative**		
30.	**Battery Power**		
31.	• Nominal Battery Power	0	W
32.	**Battery Current**		
33.	• Nominal Battery Current	0	A
34.	**Battery C-rate**		
35.	• Nominal Battery Discharge C-rate	0	C
36.	• State of Charge	0	%