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EE361 Fall 2018 HW#4

NAME: *TEMPLATE*

STUDENT NUMBER: 123456

Q1

PartA

```
Vtm=440; %V
hp=745.699872; % Watt
Eff= 86.72/100; % 0-1;
RaM=0.377; % ohm
Nm=1000; %rpm
```

i)

```
Pelec= 39*hp; %% Watt
fprintf('Electirical Power : %f kW \n', Pelec/1000);
```

```
Electirical Power : 29.082295 kW
```

ii)

```
Iam=Pelec/Vtm; %% amper
fprintf('Armeture Current : %f A \n', Iam);
```

```
Armeture Current : 66.096125 A
```

iii)

```
EmfM= Vtm-( Iam*RaM);
fprintf('Induced EMF : %f V \n', EmfM);
```

```
Induced EMF : 415.081761 V
```

iv)

```
Pmech= Pelec*Eff;
fprintf('Mechanical Power : %f kW \n', Pmech/1000);
```

```
Mechanical Power : 25.220166 kW
```

v)

```
wm=(Nm/60)*2*pi;
Tmech= Pmech/wm;
fprintf('Mechanical Torque : %f N.m \n', Tmech)
```

```
Mechanical Torque : 240.834847 N.m
```

vi)

```
RotLoss= EmfM*Iam-Pmech;
ArmLoss= Pelec- EmfM*Iam;
fprintf('Rotational Loss : %f kW \n', RotLoss/1000);
fprintf('Armeture Loss : %f kW \n', ArmLoss/1000);
```

```
Rotational Loss : 2.215130 kW
Armeture Loss : 1.646999 kW
```

vii

```
fprintf('Field control is not suitable for this motor\n');
```

```
fprintf('beacuse the motor is permanent magnet motor.\n');
fprintf('Armeture voltage control can be made to control the speed of
 the motor.\n');
```

```
Field control is not suitable for this motor
beacuse the motor is permanent magnet motor.
Armeture voltage control can be made to control the speed of the
 motor.
```

Part B

```
RaG=0.336 ; %ohm
```

i)

```
Vtg= 440; % V
PelecG=39*hp; % Watt
Iag= Pelec/Vtg; % Amper
EmfG= Vtg+ (Iag*RaG);
fprintf('Induced Emf : %f V \n', EmfG )
```

```
Induced Emf : 462.208298 V
```

ii)

```
EmfMN = EmfG; % no-load, armeture current is zero.
nNoload= Nm*(EmfMN/EmfM); % no load speed
fprintf('Speed of the Motor : %f rpm \n', nNoload )
```

```
Speed of the Motor : 1113.535553 rpm
```

iii)

```
Nreduct=1025; % rpm
Reduction= (1-Nreduct/nNoload)*100; % percentage
fprintf('Reduction in the field current : %f % \n', Reduction)
```

```
Reduction in the field current : 7.950851
```

iv)

```
EmfM750= EmfM*(750/1000);
IagN= Iam; %% due to torque is the same

EmfG750= EmfM750+ IagN*(RaG+RaM);

fprintf(' Induced Emf for 750 rpm : %f V \n', EmfG750);
```

```
 Induced Emf for 750 rpm : 358.437858 V
```

v)

```
Reduction750= (1-EmfG750/EmfG)*100; %percentage

fprintf('Reduction in the field current : %f percentage \n ',
 Reduction750)
```

Reduction in the field current : 22.451012 percentage

vi)

```
EmfM750=EmfG750; % no load, armeture current is zero
N750= Nm*(EmfM750/EmfM); % rpm

fprintf('Speed of the motor under no load : %f rpm \n', N750);
```

Speed of the motor under no load : 863.535553 rpm

Q2)

```
n=100; % turn
i=2; % amper
u0= 4*pi*10e-7; %H/m;
A= 1e-3; % m^2
```

i)

```
    g0= 1e-3; %m
    R0= (2*g0)/(A*u0); % H^-1
    Ld= n^2/R0; %H;

 fprintf('Reluctance of d-axis is %f H^-1 \n',R0);
 fprintf('Inductance of d-axis is %f H \n' ,Ld);
```

Reluctance of d-axis is 159154.943092 H^-1
Inductance of d-axis is 0.062832 H

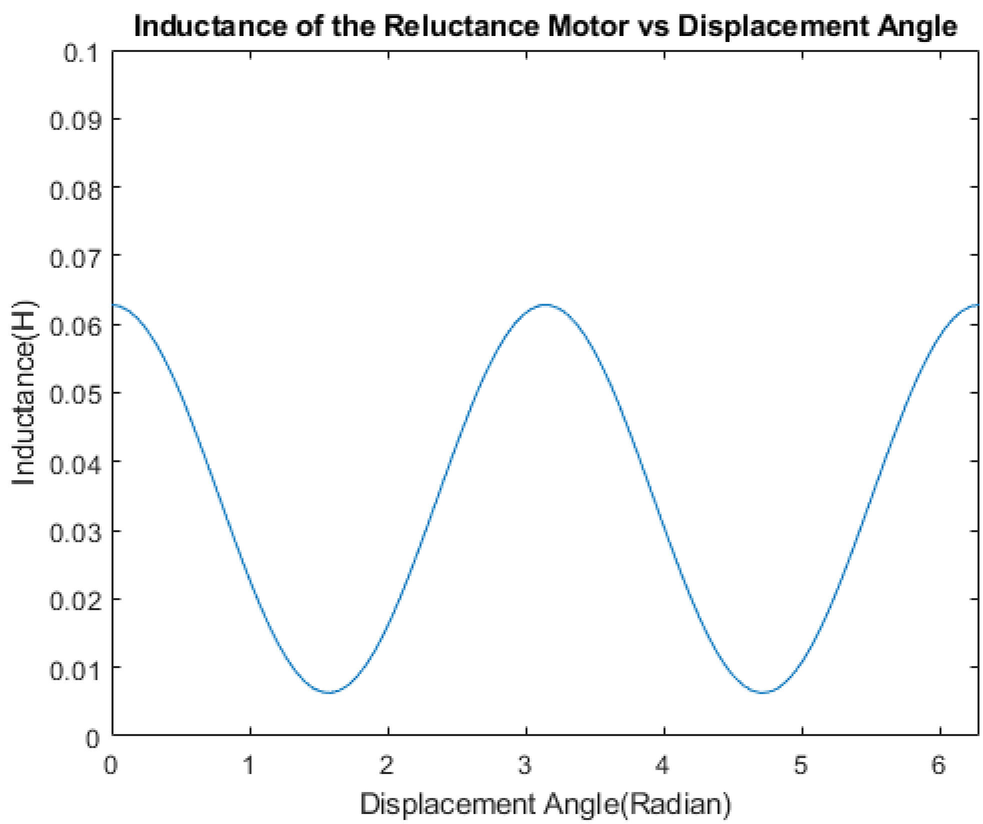
ii)

```
    g90= 1e-2; %m
    R90= (2*g90)/(A*u0); % H^-1
    Lq= n^2/R90; %H;

 fprintf('Reluctance of q-axis is %f H^-1 \n',R90);
 fprintf('Inductance of q-axis is %f H \n' ,Lq);
```

Reluctance of q-axis is 1591549.430919 H^-1
Inductance of q-axis is 0.006283 H

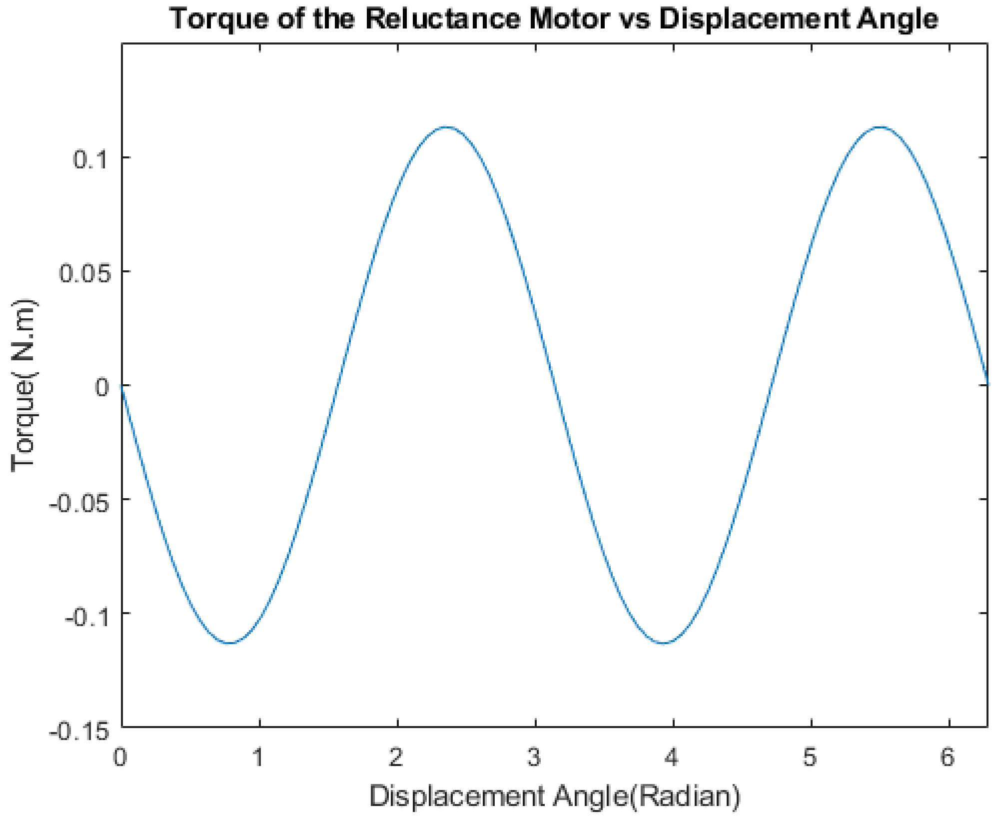
iii)

```
Theta= linspace( 0,2*pi,100); % Radian

L= 0.5*(Ld+Lq) + 0.5*(Ld-Lq)*cos(2*Theta); % H

figure(1)
plot(Theta,L);
xlabel('Displacement Angle(Radian)');
xlim( [0 2*pi])
ylim([0 0.1])
ylabel('Inductance(H)');
title('Inductance of the Reluctance Motor vs Displacement Angle');
```



iv

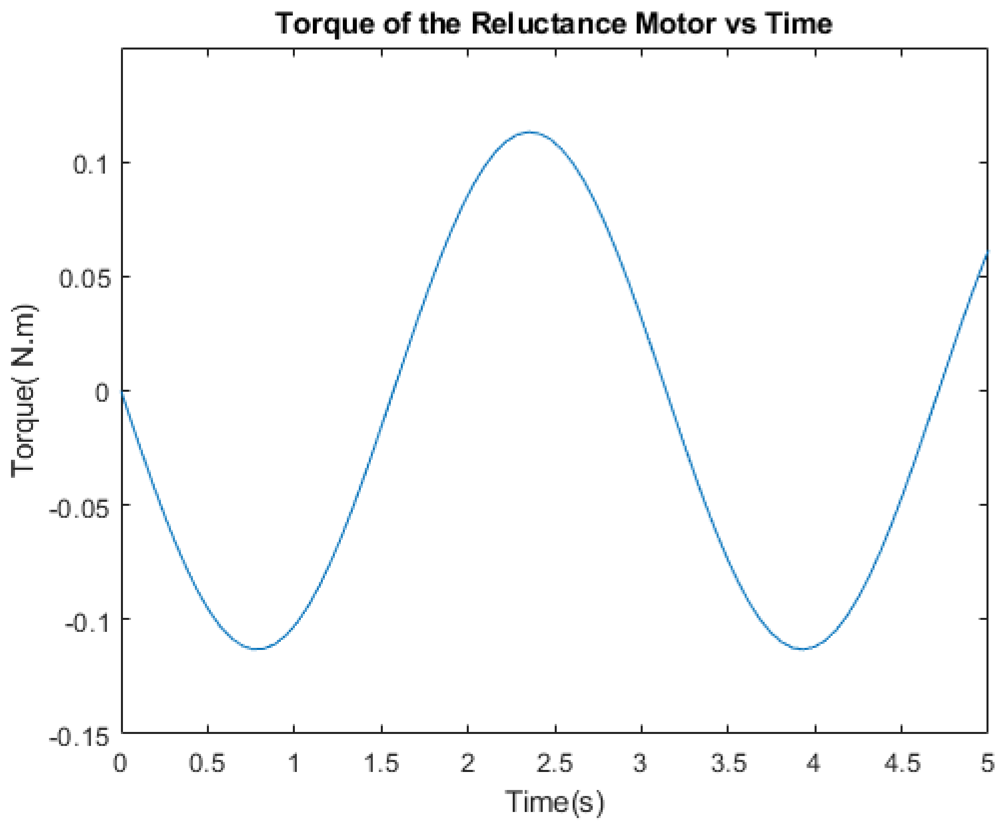
```
T= -0.5*(Ld-Lq)* i^2*sin(2*Theta);
figure(2)
plot(Theta,T);
xlabel('Displacement Angle(Radian)');
xlim( [0 2*pi])
ylim([-0.15 0.15])
ylabel('Torque( N.m)');
title('Torque of the Reluctance Motor vs Displacement Angle');
```



V

```
Sigma=pi/6;
t=linspace(0,5,100);
wm=377;
Te=-0.5*(Ld-Lq)* i^2*sin(wm*t+ Sigma);
figure(3)
plot(Theta,T)
xlabel('Time(s)');
xlim( [0 5])
ylim([-0.15 0.15])
ylabel('Torque( N.m)');
title('Torque of the Reluctance Motor vs Time');

fprintf(' Average torque is zero' );
```

Average torque is zero



vi

```
fprintf('The average torque of the releuctance motor is not zero only
 if mechanical\n ')
fprintf('speed is is equal to electrical angular frequency and initial
 poisition is not fold of pi.\n')
```

```
The average torque of the releuctance motor is not zero only if
 mechanical
 speed is is equal to electrical angular frequency and initial
 poisition is not fold of pi.
```

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