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EE361 Fall 2018 HW#4

NAME: SOLUT#ON

Q1

PartA

```
Vtm=440; %V
Eff= 86.72/100; % 0-1;
RaM=0.377; % ohm
Nm=1000; %rpm
RotLoss=2263; % W
```

i)

```
Pmech= 29000; % W
```

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

Mechanical Power : 29.000000 kW

ii)

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

Mechanical Torque : 298.539659 N.m

iii)

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

Electirical Power : 33.440959 kW

iv)

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

Armeture Loss : 2.177959 kW

v

```
Iam=sqrt(ArmLoss/RaM); %% amper
fprintf('Armeture Current : %f A \n', Iam);
K1=Tmech/Iam; % Motor Constant
```

Armeture Current : 76.007109 A

vi)

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

Induced EMF : 411.345320 V

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)

```
EmfG= Iam*(RaM+RaG) + EmfM; % Volts
fprintf('Induced Emf : %f V \n', EmfG );
```

```
Induced Emf : 465.538389 V
```

ii)

w_noload at quadratic solution

```
a=K1;
b=-EmfG;
c=( RaG+RaM)*RotLoss/(K1);
w_noLoad= max(roots([ a b c ]));

N_noLoad=( w_noLoad*60)/(2*pi);

fprintf('Speed of the Motor : %f rpm \n', N_noLoad );
```

```
Speed of the Motor : 1123.334343 rpm
```

iii)

```
wm_reduct= (1025/60)*2*pi;

x=K1*(wm_reduct^2);
y=-EmfG*wm_reduct;
z=((RaM+RaG)*RotLoss)/(K1);

k=max(roots([x y z]))-1;

fprintf('Increasing in the field current : %f % \n ',k*100 );
```

```
Increasing in the field current : 9.593594
```

iv)

```
wm_750=(750/60)*2*pi; % rad/sec
P_750= Tmech*wm_750; % N.m
```

```
p=1;
r=-EmfG;
t=P_750*(RaM+RaG);

Emf_750= max((roots([p r t])));

fprintf(' Induced Emf for 750 rpm : %f V \n ', Emf_750);
```

```
 Induced Emf for 750 rpm : 426.324377 V
```

v)

```
Reduct_750 = Emf_750/(K1*wm_750)-1;

fprintf('#ncreasing in the field current : %f percentage \n ',
 Reduct_750*100);
```

```
#ncreasing in the field current : 38.198226 percentage
```

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)

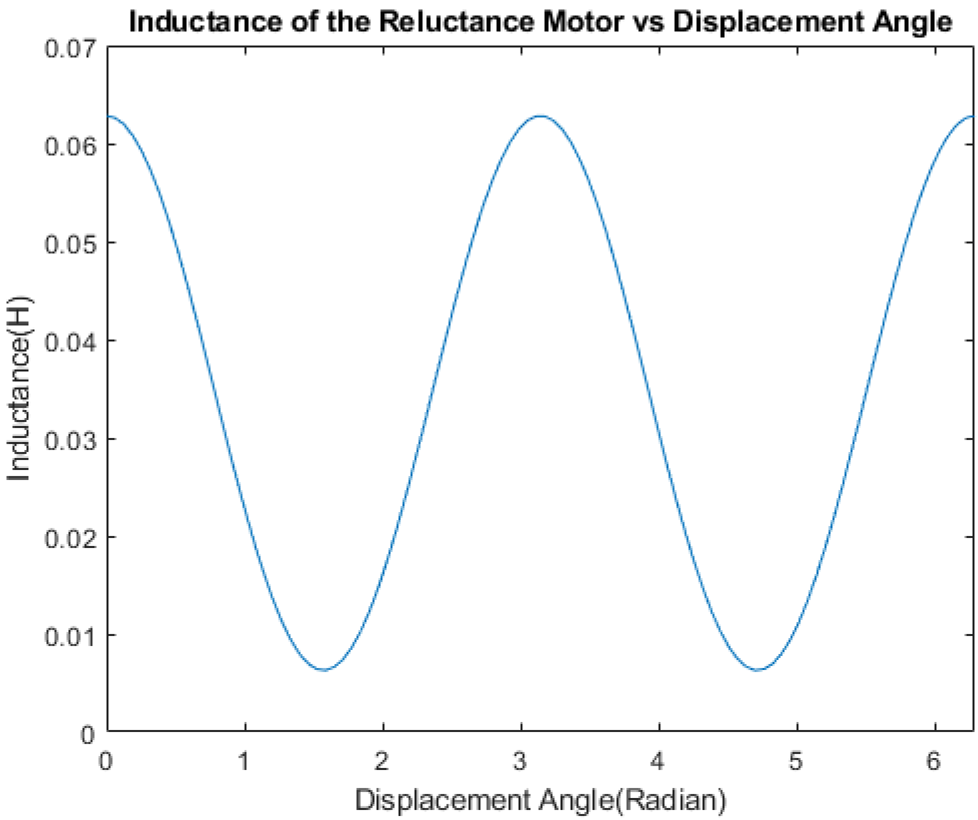
```
    g90= 1e-2; %m
    R90= (2*g90)/(A*u0); % H^-1
    Lq= n^2/R90; %H;

 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)

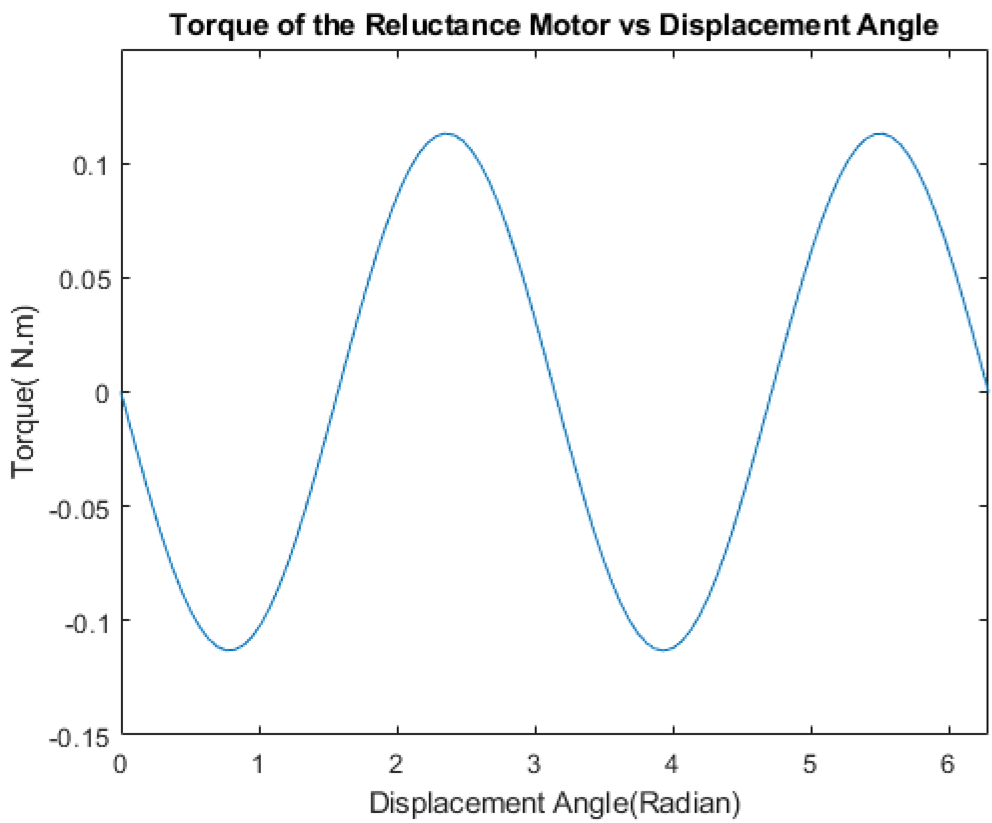
```
Theta= linspace( 0,2*pi,100); % Radian

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 0.07])
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)');
```

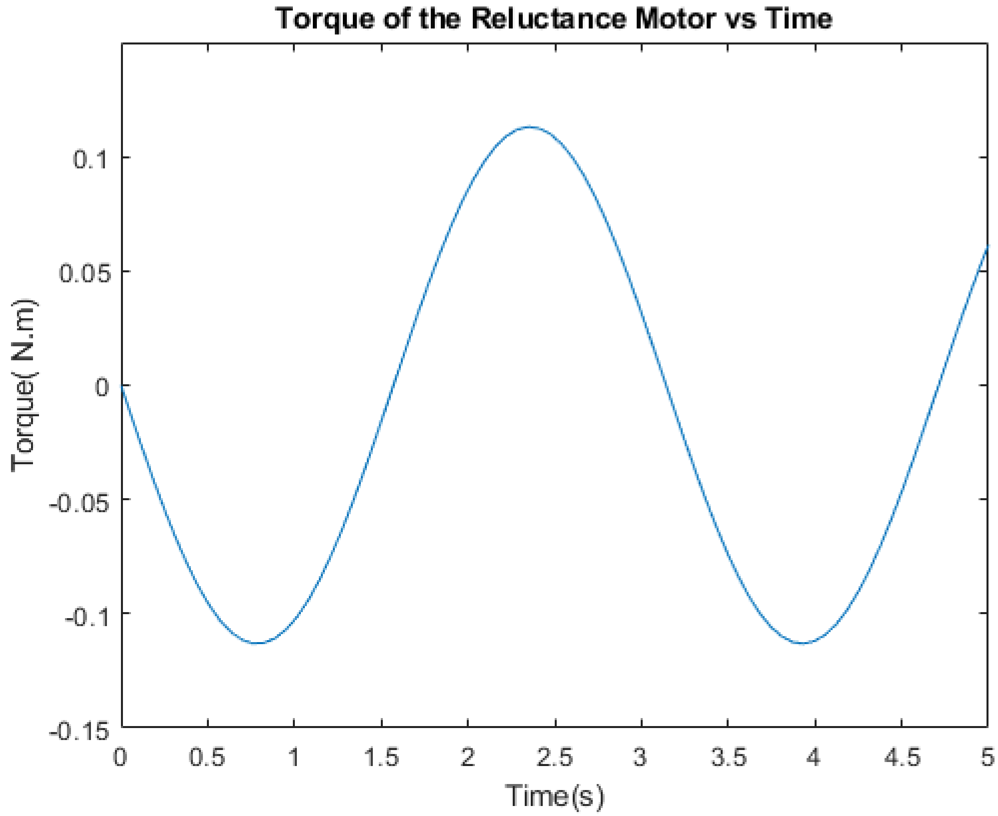
```
title('Torque of the Reluctance Motor vs Displacement Angle');
```



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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