```
%EE362 Homework Template
%At same reason you want to buy 100hp (135kW) Y-connected 460V three-
phase 4-pole 50-Hz induction
%machine via Alibaba

%Link => https://bit.ly/2HBiWE2
%Of course, as a smart engineer you never blind buy anything at the
 internet
%you request some test result from the company.

%These are the test results. Find the equivalent circuit parameters.
 Draw the
%equivalent circuit using SPICE and attach the homework.
%No-load Test
P_nl=1.22*10^3; %Watts
V_nl=448; %line to line voltage
I_nl=32.1; %Ampere
%Locked Rotor Test for 50 Hz
P_lr=143*10^3;
V_lr=450;
I_lr=727;
snapnow;
Vs=460 %Rated supply voltage (line to line)
R_s=29.2*10^-3 %Per stator phase dc resistance
q = 3; % Number of phases
fe = 50; %Hz
poles = 4;
```

```
Vs =

   460


R_s =

    0.0292
```

```
%Calculate ac resistance of stator per phase for 50-Hz
R_s_ac = 1.1*R_s;
fprintf('Stator ac resistance is %d Ohm.\n', R_s_ac);
```

```
Stator ac resistance is 3.212000e-02 Ohm.
```

```
%Windage and friction losses are 82W. Find the core loss.
P_fw=82;
P_core=P_nl-P_fw-q*I_nl^2*R_s_ac;
fprintf('Core loss is %d Watts.\n', P_core);
%Find R_core and X_m,  clearly indicate your assumption
R_c = (q*V_nl^2)/P_core;
G = I_nl/V_nl
```

```
Y_c=1/R_c;
B_sq =G^2+Y_c^2;
Xm=1/sqrt(B_sq)
fprintf('Core resistance is %d ohm and core reactance is %d.\n',
 R_c,Xm);
%%State your assumption here
%I assume that impedance of stator winding is much less than core
 impedence
```

Core loss is 1.038710e+03 Watts.

G =

0.0717

Xm =

13.9523

Core resistance is 5.796730e+02 ohm and core reactance is 1.395234e+01.

```
%Find winding paramaters X_1, X_2 and R_2. Assume X_1 = X=2
P_phase = P_lr/q
R_2=P_phase/I_lr^2-R_s_ac
Z=V_lr/I_lr
X_2sq = Z^2-R_2^2;
X_2 = sqrt(X_2sq);
X_1=X_2;
fprintf('X_1 = ,%d X_2 = %d, R_2 = %d\n', X_1,X_2,R_2);
```

P_phase =

4.7667e+04

R_2 =

0.0581

Z =

0.6190

X_1 = ,6.162524e-01 X_2 = 6.162524e-01, R_2 = 5.806742e-02

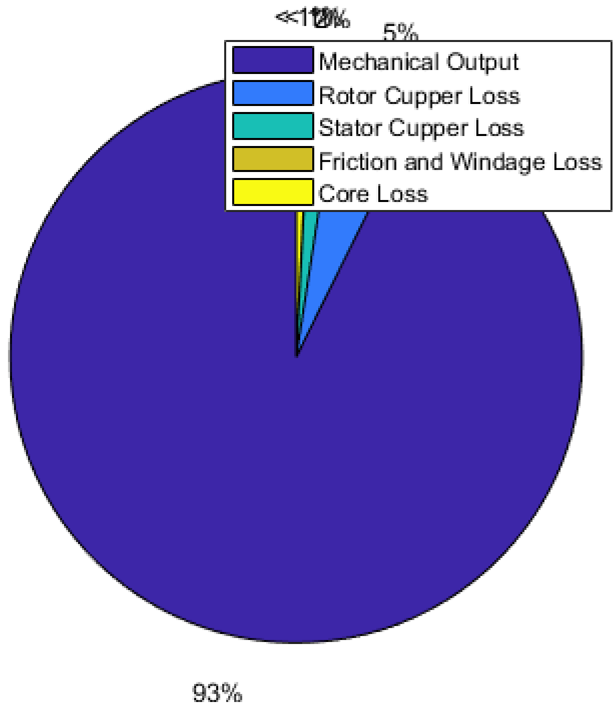
```
%Calculate ns both rpm and rad/sec
omegas= 4*pi*fe/poles;
ns = 120*fe/poles;
fprintf('ns is %d rpm and $$\omega_s$$ is %d rad/sec.\n', ns, omegas);
%Find the thevenin equivalent parameters
```

```
Z1eq = j*Xm*(R_s_ac+j*X_1)/(R_s_ac+j*(X_1+Xm));
R1eq = real(Z1eq);
X1eq = imag(Z1eq);
V1eq = abs(Vs*j*Xm/(R_s_ac+j*(X_1+Xm)));
```

Warning: Escaped character '\o' is not valid. See 'doc sprintf' for supported special characters.
ns is 1500 rpm and $$ns is 1.570796e+02 rpm and $$

```
%Now you know every circuit parameter of the induction
 machine.Calculate
%all the losses and build an pie-diagram when s = 0.05 at rated
 voltage and power.
%Assume current on magnetizing branch is negligible small.
s=0.05;
%Stator cupper loss
I2=abs(V1eq./(Z1eq+j*X_2+R_2./s));
P_cu1=I2^2*R_s_ac
%Air-gap power
P_rated = 135*10^3;
P_gap = P_rated-P_cu1-P_core-P_fw
%Rotor cupper loss
P_cu2=s*P_gap;
%Mechanical power
P_mech = (1-s)*P_gap;
Data=[P_mech,P_cu2,P_cu1,P_fw,P_core];
figure;
pie(Data)
legend('Mechanical Output','Rotor Cupper Loss','Stator Cupper
 Loss','Friction and Windage Loss','Core Loss')
%Calculate the efficency, Now change the slip to 0.1 (%10). Comment on
%change. Comment relationship between slip and efficiency
```

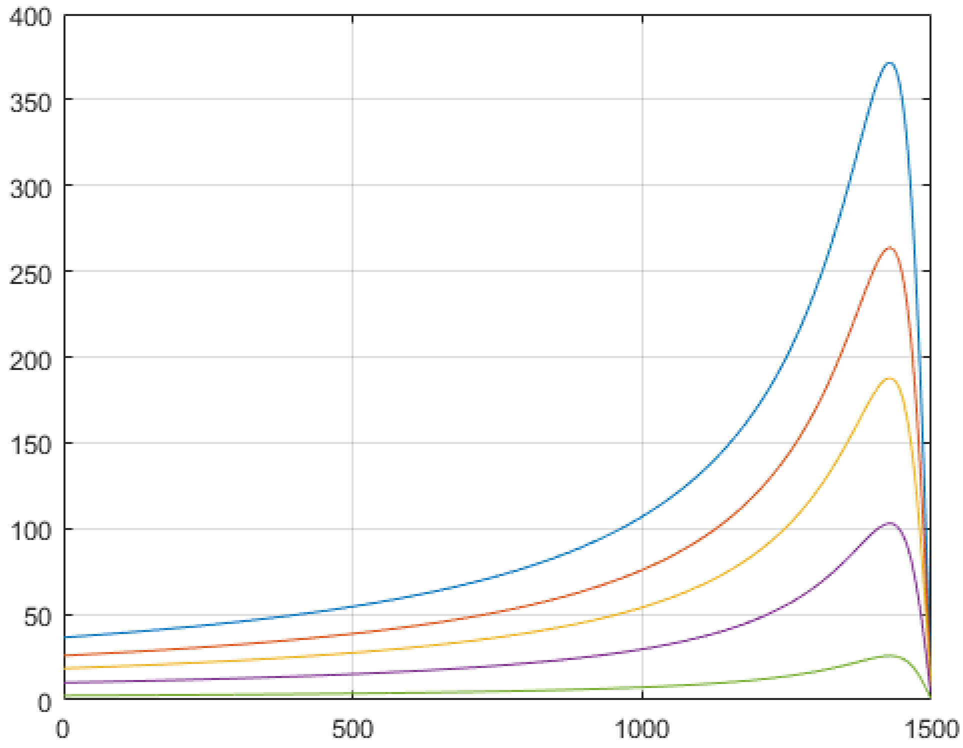
```
P_cu1 =

   2.1693e+03


P_gap =

   1.3171e+05
```




```
%Plot torque vs speed graph with different supply voltages.
figure;
for m = 1:5
    if m == 1;
        V1eq=380/sqrt(3)
    end
    if m == 2;
        V1eq=320/sqrt(3)
    end
    if m == 3;
        V1eq=270/sqrt(3)
    end
    if m == 4;
        V1eq=200/sqrt(3)
    end
    if m == 5;
        V1eq=100/sqrt(3)
    end
    s = .001:.001:1; %slip
    rpm = ns*(1-s);
    I2=abs(V1eq./(Z1eq+j*X_2+R_2./s));
    T = q*(I2.^2)*R_2./(s*omegas);
    plot(rpm,T)
    hold on;
    grid on;
end
```

```
hold off;
```

```
V1eq =

  219.3931

V1eq =

  184.7521

V1eq =

  155.8846

V1eq =

  115.4701

V1eq =

   57.7350
```

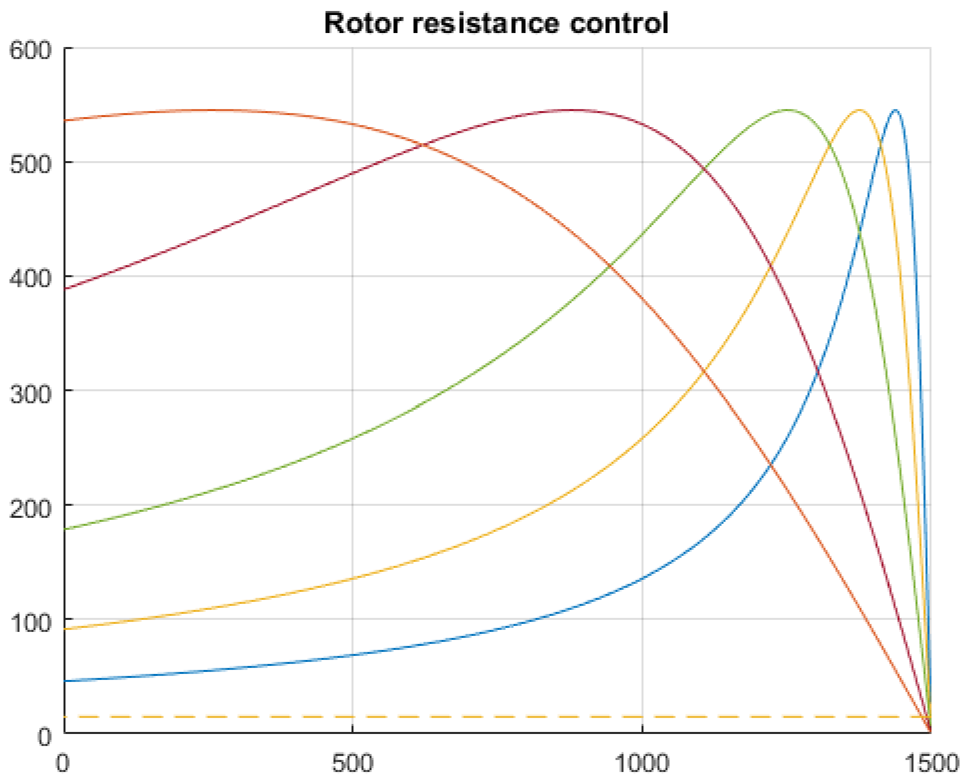



```
%Plot torque vs speed graph with differents R_2 (0.1,0.2,0.5,1,1.5)
%For loop may help you. Use 1000 data point slip vector.
figure;
Vleq=460/sqrt(3) %uncomment
for m = 1:5
    if m == 1;
        R_2=0.05;
    end
    if m == 2;
        R_2=0.1;
    end
    if m == 3;
        R_2=0.2;
    end
    if m == 4;
        R_2=0.5;
    end
    if m == 5;
        R_2=1.0;
    end
    s = .001:.001:1; %slip
    rpm = ns*(1-s);
    I2=abs(Vleq./(Z1eq+j*X_2+R_2./s));
    T = q*(I2.^2)*R_2./(s*omegas);
    load_linear(1:1000) = 15;
    hold on;
```

```
    grid on;
    plot(rpm,T,rpm,load_linear,'--');
    title('Rotor resistance control');
end
hold off;
```

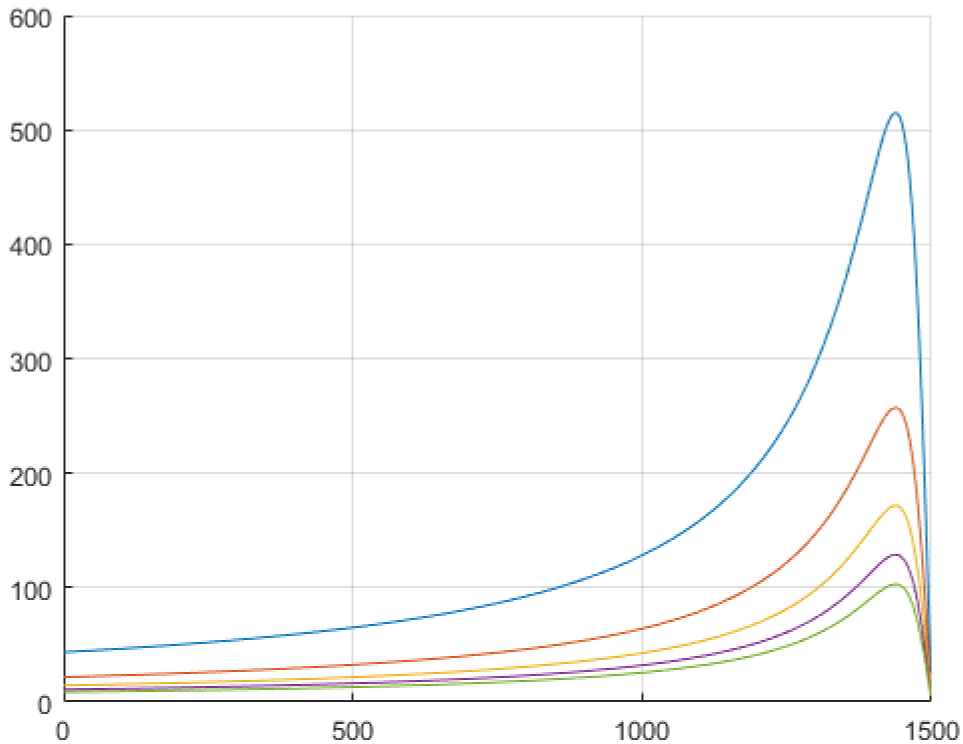
Vleq =

265.5811




```
%Plot torque vs speed graph using contant v/f topology %
R_2=0.05;
figure;
for m = 1:5
    if m == 1;
        fe=10;
        V1eq = 300/sqrt(3);
    end
    if m == 2;
        V1eq = 150/sqrt(3);
        fe=20;
    end
    if m == 3;
        V1eq = 100/sqrt(3);
        fe=30;
```

```
    end
    if m == 4;
        V1eq = 75/sqrt(3);
        fe=40;
    end
    if m == 5;
        V1eq = 60/sqrt(3);
        fe=50;
    end
    hold on;
    grid on;
    V1eq = 200/sqrt(3);
    s = .001:.001:1; %slip
    omegas= 4*pi*fe/poles;
    rpm = ns*(1-s);
    I2=abs(V1eq./(Z1eq+j*X_2+R_2./s));
    T = (q*(I2.^2)*R_2)./(s*omegas);
    plot(rpm,T)
end
```




```
%Comment on both control method? Compare them briefly?
```

Published with MATLAB® R2017a