Scilab Textbook Companion for Electric Machines - I by M. Verma And V. Ahuja[1]

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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

Contents

List of Scilab Codes

Chapter 1

Introduction To Electrical Machines

Scilab code Exa 1.9 Find the emf induced in the coil

```
//Chapter:1:Introduction to electrical Machines
//Caption:Find the emf induced in the coil
//Exa:1.9
clc;
clear;
close;
N=800;//No.of turns
Phy_1=2000*10^-6;//In Webers
Phy_2=1000*10^-6;//In Webers
t=0.1;//in seconds
e=N*(Phy_1-Phy_2)/t;
disp(e,'Emf induced in the coil (in volts)=')
```

Scilab code Exa 1.10 Find the average value of emf induced in the coil

```
//Caption:Find the average value of emf induced in
    the coil
//Exa:1.10
clc;
clear;
close;
N=1000;//No.of turns
Phy_1=2000*10^-6;//In Webers
//On reversal of current
Phy_2=2000*10^-6;//In Webers
t=0.2;//in seconds
e=N*(Phy_1-(-Phy_2))/t;
disp(e,'Average value of emf induced in the coil (in
     volts)=')
```

Scilab code Exa 1.11 Find the average emf induced in the coil and current through the coil

```
//Caption:Find the (1)average emf induced in the
    coil (2)current through the coil
//Exa:1.11
clc;
```

```
clear;
close;
N=300;//No.of turns
R=60;//resitance in ohms
Phy_1=2*10^-3;//In Webers
Phy_2=3*10^-3;//In Webers
t=0.2;//in seconds
e=N*(Phy_2-Phy_1)/t;
disp(e,'(1) Average emf induced in the coil (in volts)=');
i=e/R;
disp(i,'(2) Current through the coil (in Amperes)=')
```

Scilab code Exa 1.12 Find the average value of emf induced across the feild terminals

```
//Caption:Find the average value of emf induced across the feild terminals
//Exa:1.12
clc;
clear;
close;
P=4;//no of poles
N=4*250;//No.of turns
Phy_1=40*P*10^-3;//In Webers
Phy_2=5*P*10^-3;//In Webers
t=0.1;//in seconds
e=N*(Phy_1-Phy_2)/t;
disp(e,'average value of emf induced across the feild terminals (in volts)=')
```

Chapter 2

DC Machines

Scilab code Exa 2.1 Find current delievered by each machine and terminal voltage

```
//Caption:Find (a)current delievered by each machine
    and (b)terminal voltage
//Exa:2.1
clc;
clear;
close;
//for 50kw generator
I_1=50*1000/500;//full load current in ampere
V_1=0.06*500;//full load voltage drop in volts
V_1pi=V_1/I_1;//voltage drop per ampere of current
    supply in volts/ampere
//for 100kw generator
I_2=100*1000/500;//full load current in ampere
V_2=0.04*500;//full load voltage drop in volts
V_2pi=V_2/I_2;//voltage drop per ampere of current
    supply in volts/ampere
i_1=250/(1+(V_1pi/V_2pi));//in amperes
i_2=250/(1+(V_2pi/V_1pi));//in amperes
disp(i_1,'(a) Current delievered in 50kw generator (
    in amperes)=');
```

```
disp(i_2,'    Current delievered in 100kw generator
    (in amperes)=');
V_t=500-V_1pi*i_1;//in volts
disp(V_t,'(b) Terminal voltage (in volts)=')
```

Scilab code Exa 2.2 Find the load shared by two DC generators

```
//Caption:Find the load shared by two DC generators
//Exa:2.2
clc;
clear;
close;
E_g1=120;//in volts
E_g2=115;//in volts
R_a1=0.05;//armature winding resistance of first
    generator (in ohms)
R_a2=0.04;//armature winding resistance of second
    generator (in ohms)
R_f1=20;//feild winding resistance of first
    generator (in ohms)
R_f2=25;//feild winding resistance of seccond
    generator (in ohms)
P=25000;//in watts
V_t=(5275+sqrt((5275^2)-(4*45.09*25000)))/(2*45.09);
    //terminal voltage in volts
I_1=(E_g1-(V_t*(1+(R_a1/R_f1))))/R_a1;//in amperes
I_2=(E_g2-(V_t*(1+(R_a2/R_f2))))/R_a2;//in amperes
P_1=V_t*I_1/1000;//in kilo watts
P_2=V_t*I_2/1000;//in kilo watts
disp(P_1,'Power shared by generator -1(in Kilo Watts)
    = ');
```

```
disp(P_2,'Power shared by generator-2(in Kilo Watts)
    = ');
```

Scilab code Exa 2.3 Find the number of conductors

```
//Caption:Find the number of conductors
//Exa:2.3
clc;
clear;
close;
P=8;//no. of poles
A=8;
Phy=40*10^-3;//flux in weber
N=500;//speed in rpm
E_g=250;//no-load voltage in volts
Z=(E_g*60*A)/(P*N*Phy);
disp(Z,'Number of conductors=')
```

Scilab code Exa 2.4 Find the generated voltage and armature current

```
//Caption:Find the generated voltage and armature
    current
//Exa:2.4
clc;
clear;
```

```
close;
V_t=300;//in volts
V_b=1;//voltage drop per brush in volts
I=200;//in amperes
R_f=200;//shunt feild winding resistance in ohms
R_a=0.05;//armature winding resistance in ohms
R_se=0.04;//Series feild winding resistance in ohms
I_f=V_t/R_f;//in amperes
I_a=I+I_f;//in amperes
E_g=V_t+(R_a+R_se)*I_a+(2*V_b);
disp(E_g,'Value of generated voltage (in volts)=');
disp(I_a,'Value of armature current (in Ampers)=')
```

Scilab code Exa 2.5 Find the shunt feild current and armature current and generated emf in armature and load resistance

```
//Caption:Find the (a)shunt feild current (b)
   armature current (c)generated emf in armature (d)
   load resistance
//Exa:2.5
clc;
clear;
close;
V_t=250;//in volts
I=195;//in amperes
R_f=50;//shunt feild winding resistance in ohms
R_a=0.05;//armature winding resistance in ohms
I_f=V_t/R_f;//in amperes
I_a=I+I_f;//in amperes
E_g=V_t+(R_a*I_a);
R_L=V_t/I;
```

```
disp(I_f,'(a) Value of shunt feild current (in
   Amperes)=')
disp(I_a,'(b) Value of armature current (in Amperes)
   =')
disp(E_g,'(c) Value of generated voltage (in volts)=
   ');
disp(R_L,'(d) Value of load resistance (in ohms)=')
```

Scilab code Exa 2.6 Find the value of generated emf and armature current

```
//Caption:Find the value of generated emf and
   armature current
//Exa:2.6
clc;
clear;
close;
V_t=250;//in volts
V_AC=V_t;
V_b=1;//voltage drop per brush in volts
I=40;//in amperes
R_f=100;//shunt feild winding resistance in ohms
R_a=0.05;//armature winding resistance in ohms
R_se=0.04;//series feild winding resistance in ohms
V_BC=V_AC+I*R_se;//in volts
I_f=V_BC/R_f;//in amperes
I_a=I+I_f;//in amperes
E_g=V_BC+(R_a*I_a)*(2*V_b);
disp(I_a,' Value of armature current (in Amperes)=')
   ;
disp(E_g,' Value of generated voltage (in volts)=');
```

Scilab code Exa 2.7 Find the value of generated emf

```
//Caption:Find the value of generated emf
//Exa:2.7
clc;
clear;
close;
P=8;//no. of poles
A=8;
Z=760;//no.of conductors
Phy=35*10^-3;//flux in weber
N=500;//speed in rpm
E_g=(P*N*Phy*Z)/(60*A);
disp(E_g,'Value of generated emf (in volts)=')
```

Scilab code Exa 2.8 Find the speed of generator

```
//Caption:Find the speed of generator
//Exa:2.8
clc;
clear;
close;
P=8;//no. of poles
S=70;//no. of slots
```

```
C=22;//conductors per slot
A=8;
D=0.48;//in meter
Z=S*C;//no.of conductors
r=0.64;//ratio of pole arc to pole pitch
l=0.28;//length of pole shoe in meter
B=0.32;//air gap flux density in weber/meter^2
E_g=400;//in volts
Pole_arc=r*%pi*D/P;//in meter
Ao=Pole_arc*l;//Area of pole shoe in meter
Phy=Ao*B;//in weber
N=E_g*60*A/(Phy*Z*P);
disp(N,'Speed of generator (in rpm)=')
```

Scilab code Exa 2.9 Find the armature current and generated emf and flux per pole

```
//Caption:Find the (a)armature current (b)generated
   emf (c)flux/pole
//Exa:2.9
clc;
clear;
close;
V_t=200;//in volts
P=4;//no. of poles
A=2;
Z=676;//no.of conductors
R_L=10;//load resistance in ohms
R_a=0.34;//armature winding resistance in ohms
R_f=100;//feild winding resistance in ohms
N=600;//speed in rpm
```

```
I_f=V_t/R_f;//in amperes
I=V_t/R_L;//in amperes
I_a=I+I_f;
E_g=V_t+I_a*R_a;
Phy=E_g*60*A/(P*N*Z);
disp(I_a,'(a) Armature current (in amperes)=');
disp(E_g,'(b) Generated emf (in volts)=');
disp(Phy*1000,'(c) flux/pole (in mili weber)=');
```

Scilab code Exa 2.10 Find the load current and generated emf and flux per pole

```
//Caption:Find the (a)load current (b)generated emf
   (c)flux/pole
//Exa:2.10
clc;
clear;
close;
V_t=250;//in volts
P=6;//no. of poles
A=P;
Z=700;//no.of conductors
R_a=0.04;//armature winding resistance in ohms
R_f=100;//feild winding resistance in ohms
N=1000;//speed in rpm
I_f=V_t/R_f;//in amperes
I_a=7.2/R_a;//in amperes
I=I_a-I_f;//in amperes
E_g=V_t+I_a*R_a;
Phy=E_g*60*A/(P*N*Z);
disp(I,'(a) Load current (in amperes)=');
```

```
disp(E_g,'(b) Generated emf (in volts)=');
disp(Phy*1000,'(c) flux/pole (in mili weber)=');
```

Scilab code Exa 2.11 Find the armature current and generated emf and number of conductors of armature

```
//Caption:Find the (a)armature current (b)generated
   emf (c) no. of conductors of armature
//Exa:2.11
clc;
clear;
close;
P_o=22000;//power in watts
V_t=220;//in volts
V_b=1;//per brush drop in volts
P=4;//no. of poles
A=2;
R_se=0.04;//series resistance in ohms
R_a=0.05;//armature winding resistance in ohms
R_f=110;//feild winding resistance in ohms
Phy=7.8*10^-3;//in weber
N=1000;//speed in rpm
I=P_o/V_t;//in amperes
I_f=V_t/R_f;//in amperes
I_a=I+I_f;
E_g=V_t+I_a*(R_a+R_se)+2*V_b;
Z=E_g*60*A/(Phy*N*P)
disp(I_a,'(a) Armature current (in amperes)=');
disp(E_g,'(b) Generated emf (in volts)=');
disp(Z,'(c) No. of conductors of armature=');
```

Scilab code Exa 2.12 Find the power absorbed by the load

```
//Caption:Find the power absorbed by the load
//Exa:2.12
clc;
clear;
close;
P=6;//no. of poles
A=2;
Z=350;//no. of conductors
R_a=0.8;//armature winding resistance in ohms
R_f=120;//feild winding resistance in ohms
Phy=0.02;//in weber
N=1000;//speed in rpm
R_L=12;//load resistance in ohms
E_g=Phy*N*Z*P/(60*A);//emf induced in volts
V_t=E_g/(1+((1/R_f)+(1/R_L))*R_a);
I_L=V_t/R_L;//in amperes
P_o=V_t*I_L;//in watts
disp(P_o,'Power absorbed by the load (in watts)=')
```

Scilab code Exa 2.13 Find the percentage reduction in speed

```
//Caption:Find the percentage reduction in speed
```

```
//Exa:2.13
clc;
clear;
close;
P1=200*10^3;//initial load in watts
P2=125*10^3;//final load in watts
V_t=250;//in volts
V_b=2;//total brush drop in volts
P=6;//no. of poles
R_a=0.015;//armature winding resistance in ohms
I_g1=P1/V_t;//in amperes
I_a1=I_g1;//in amperes
E_g1=V_t+I_a1*R_a+V_b;//in volts
I_g2=P2/V_t;//in amperes
I_a2=I_g2;//in amperes
E_g2=V_t+I_a2*R_a+V_b;//in volts
//since E_g is directly proportional to N
//therefore,E_g1/E_g2=N_1/N_2
r=E_g2/E_g1;
reduction=(1-r)*100;
disp(reduction,'Percentage reduction in speed (%)=')
```

Scilab code Exa 2.14 Find the speed

```
//Caption:Find the speed
//Exa:2.14
clc;
clear;
close;
V_t=400;//in volts
V_b=2;//total brush drop in volts
```

```
R_a=0.12;//armature winding resistance in ohms
N1=1000;//speed in rpm
I_a1=150;//in amperes
I_a2=100;//in amperes
R_L=V_t/I_a1;//load resistance in ohms
E_g1=V_t+I_a1*R_a+V_b;//in volts
V_to=R_L*I_a2;//in volts
E_g2=ceil (V_to+I_a2*R_a+V_b);//in volts
//Since E_g is directly proportional to N
//therefore,E_g1/E_g2=N1/N2
N2= N1*E_g2/E_g1;//in rpm
disp(ceil(N2),'Speed (in rpm)=')
```

Scilab code Exa 2.15 Find the Cu loss and iron and friction loss and torque

```
//Caption:Find the (a)Cu-loss (b)iron and friction
   loss (c) torque
//Exa:2.15
clc;
clear;
close;
P_o=25000;//output power in watts
V_t=250;//in volts
R_se=0.05;//series resistance in ohms
R_a=0.04;//armature winding resistance in ohms
R_f=50;//shunt feild winding resistance in ohms
Eff=0.89;//efficiency
N=1000;//speed in rpm
I=P_o/V_t;//in amperes
I_f=V_t/R_f;//in amperes
```

```
I_a=I+I_f;
P_cu=R_a*I_a^2+R_se*I_a^2+R_f*I_f^2;//copper loss in watts
disp(P_cu,'(a) Cu-loss (in watts)=');
P_i=P_o/Eff;//input power in watts
P_L=P_i-P_o;//total losses in watts
P_fric=P_L-P_cu;
disp(P_fric,'(b) Iron and friction loss (in watts)=');
T=P_i*60/(2*%pi*N);
disp(T,'(c) Torque (in N-m)=')
```

Scilab code Exa 2.16 Find the Flux per pole and total number of conductors and torque

```
//Caption:Find the (a)Flux per pole (b)total number of conductors (c) torque
//Exa:2.16
clc;
clear;
close;
I_a=50;//in amperes
P=6;//no.of poles
E_g=200;//in volts
N=1500;//speed in rpm
A=6;
L=0.25;//in meter
d=0.2;//in meter
B=0.9;//in tesla
Theta=360/P;//angle subtended by pole shoe in degrees
```

```
l=%pi*L*Theta/360;//arc length of pole shoe in meter
area=l*d;//in meter^2
Phy=B*area;
disp(Phy,'(a) Flux per pole (in Weber)=');
Z=ceil(E_g*60/(Phy*N));
disp(Z,'(b) Total no. of conductors=');
T=9.55*E_g*I_a/N;
disp(T,'(c) Torque (in Newton-meter)=')
```

Scilab code Exa 2.17 Find the Demagnetizing AT per pole and Cross magnetizing AT per pole and number of turns per pole

```
//Caption:Find the (a)Demagnetizing AT per pole (b)
   Cross magnetizing AT per pole (c) number of turns
    per pole
//Exa:2.17
clc;
clear;
close;
P=40000;//in watts
E_g=400;//in volts
A=4;
Pole=4;
Z=2*30*12;//no. of conductors
theta_m=10;//in degrees
I_a=P/E_g;//armature current in amperes
I=I_a/A;//current in each conductor in amperes
AT_d=Z*I*theta_m/360;
disp(AT_d,'(a) Demagnetizing Ampere Turns per pole='
   );
AT_cm=Z*I*((1/(2*Pole))-(theta_m/360));
```

```
disp(AT_cm,'(b) Cross magnetizing Ampere Turns per
    pole=');
n=Z*I*0.8/(2*Pole*100);
disp(n,'(c) Number of turns per pole=')
```

Scilab code Exa 2.18 Find the current supplied by each generator and output voltage and output KW of each machine

```
//Caption:Find the (a)current supplied by each
    generator (b)output voltage (c) output KW of each
     machine
//Exa:2.18
clc;
clear;
close;
V_t1=280;//terminal voltage of generator-1 in volts
V_nl1=240;//no-load voltage of generator-1 in volts
V_t2=300;//terminal voltage of generator-2 in volts
V_nl2=240;//no-load voltage of generator-2 in volts
I_s1=40;//supply current to generator-1 in amperes
I_s2=50;//supply current to generator-2 in amperes
V_d1=V_t1-V_nl1;//voltage drop for generator-1 in
    volts
V_d2=V_t2-V_nl2;//voltage drop for generator-2 in
    volts
V_d1_pa=V_d1/I_s1;//voltage drop per ampere for
    generator-1 in volts/ampere
V_d2_pa=V_d2/I_s2;//voltage drop per ampere for
    generator-2 in volts/ampere
I_2=(20+60)/(V_d1_pa+V_d2_pa);//in amperes
I_1=60-I_2;//in amperes
```

```
disp(I_1,'(a) Current supplied by generator-1(in
    amperes)=');
disp(I_2,'    Current supplied by generator-2(in
    amperes)=');
V_1=V_t1-(V_d1_pa*I_1);//in volts
V_2=V_t2-(V_d2_pa*I_2);//in volts
disp(V_1,'(b) Output voltage of generator-1(in volts
    )=');
disp(V_2,'(b) Output voltage of generator-2(in volts
    )=');
P_1=V_1*I_1/1000;//in kilo watts
P_2=V_2*I_2/1000;//in kilo watts
disp(P_1,'(c) Output KW of generator-1(in Kilo watts
    )=');
disp(P_2,'(c) Output KW of generator-2(in Kilo watts
    )=');
```

Scilab code Exa 2.19 Find the ratio of the speed as a generator to speed as a motor

```
//Caption:Find the ratio of the speed as a generator
     to speed as a motor
//Exa:2.19
clc;
clear;
close;
V=250;//in volts
I_L=80;//in amperes
R_a=0.12;//in ohms
R=100;//in ohms
I_f=V/R;//in amperes
```

```
I_a1=I_L+I_f;//in amperes (generator)
E_1=V+(I_a1*R_a);//in volts (generator)
I_a2=I_L-I_f;//in amperes (motor)
E_2=V-(I_a2*R_a);//in volts (motor)
Ratio=E_1/E_2;
disp(Ratio,'Ratio of speed as a generator to speed
    as motor=')
```

Scilab code Exa 2.20 Find the no load speed

```
//Caption:Find the no load speed
//Exa:2.20
clc;
clear;
close;
V=200;//in volts
I_a0=2;//in amperes
R_a=0.4;//in ohms
I_a1=50;//in amperes
N_1=1200;//in rpm
E_0=V-(I_a0*R_a);//in volts
E_1=V-(I_a1*R_a);//in volts
N_0=N_1*(E_0/E_1);//in rpm
disp(N_0,'No-load speed (in rpm)=')
```

Scilab code Exa 2.21 Find the speed of motor

```
//Caption:Find the speed of motor
//Exa:2.21
clc;
clear;
close;
V=250;//in volts
I_L1=5;//in amperes
R_a=0.2;//in ohms
R_f=250;//in ohms
I_f=V/R_f;//in amperes
I_a1=I_L1-I_f;//in amperes
I_L2=50;//in amperes
I_a2=I_L2-I_f;//in amperes
N_1=1000;//in rpm
E_2=V-(I_a2*R_a);//in volts
E_1=V-(I_a1*R_a);//in volts
N_2=N_1*(E_2/E_1);//in rpm
disp(N_2,'speed of motor (in rpm)=')
```

Scilab code Exa 2.22 Find the speed of machine

```
//Caption:Find the speed of machine
//Exa:2.22
clc;
clear;
close;
V=250;//in volts
P_i=50*10^3;//in watts
I_L1=P_i/V;//in amperes
```

```
R_a=0.02;//in ohms
R_f=50;//in ohms
I_f=V/R_f;//in amperes
I_a1=I_L1+I_f;//in amperes
I_L2=P_i/V;//in amperes
I_a2=I_L2-I_f;//in amperes
N_1=400;//in rpm
E_2=V-(I_a2*R_a)-(2*1);//in volts
E_1=V+(I_a1*R_a)+(2*1);//in volts
N_2=int(N_1*(E_2/E_1));//in rpm
disp(N_2,'speed of motor (in rpm)=')
```

Scilab code Exa 2.23 Determine the total torque and useful torque and useful flux per pole and rotational losses and efficiency

```
//Caption:Determine the (a)total torque(b)useful
    torque(c)useful flux per pole(d)rotational losses
    (e)efficiency
//Exa:2.23
clc;
clear;
close;
P=4;//no of poles
Z=560;//no of conductors
A=2;
V=250;//in volts
P_o=10*10^3;//in watts
R_a=0.2;//in ohms
I_f=1;//in amperes
I_a=60;//in amperes
N=1000;//in rpm
```

```
V_b=1*2//in volts
E=V-(I_a*R_a)-V_b;//in volts
T=60*E*I_a/(2*%pi*N);//in Newton-meter
disp(T,'(a) Total torque (in Newton-meter)=');
T_useful=P_o*60/(2*%pi*N);
disp(T_useful,'(b) Useful torque (in Newton-meter)=');
Phy=60*E*A/(N*P*Z);
disp(Phy,'(c) Useful flux per pole (in Weber)=');
P_d=(V*I_a)-((I_a^2)*R_a)-(V_b*I_a);//in Watts
P_rot=P_d-P_o;
disp(P_rot,'(d) Rotational losses (in Watts)=');
P_i=V*(I_a+I_f);//in Watts
Eff=P_o*100/P_i;
disp(Eff,'(e) Efficiency (in %)=');
```

Scilab code Exa 2.24 Determine the speed and percentage change in torque

```
//Caption:Determine the speed and percentage change in torque
//Exa:2.24
clc;
clear;
close;
V=460;//in volts
R_a=0.8;//in ohms
I_a1=40;//in amperes
I_a2=30;//in amperes
N_1=500;//in rpm
E_1=V-(I_a1*R_a);//in volts
E_2=V-(I_a2*R_a);//in volts
```

```
N_2=int(E_2*I_a1*N_1/(E_1*I_a2));
disp(N_2,'Speed (in rpm)=');
ratio=(I_a2/I_a1)^2;
T_c=(1-ratio)*100;
disp(T_c,'Percentage change in torque=')
```

Scilab code Exa 2.25 Determine the speed

```
//Caption:Determine the speed
//Exa:2.25
clc;
clear;
close;
V=220;//in volts
R_a=0.1;//in ohms
I_a1=100;//in amperes
I_a2=sqrt(I_a1^2/2);//in amperes
N_1=800;//in rpm
E_1=V-(I_a1*R_a);//in volts
E_2=V-(I_a2*R_a);//in volts
N_2=int(E_2*I_a1*N_1/(E_1*I_a2));
disp(N_2,'Speed (in rpm)=');
```

Scilab code Exa 2.26 Determine the speed

```
//Caption:Determine the speed
//Exa:2.26
clc;
clear;
close;
V=250;//in volts
R_a=0.25;//in ohms
I_a1=50;//in amperes
I_a2=I_a1/0.9;//in amperes
N_1=750;//in rpm
E_1=V-(I_a1*R_a);//in volts
E_2=V-(I_a2*R_a);//in volts
N_2=int(E_2*N_1/(E_1*0.9));
disp(N_2,'Speed (in rpm)=');
```

Scilab code Exa 2.27 Determine the speed at half load and 125 percent full load

```
//Caption:Determine the speed (a)at half load (b)125
    % full load
//Exa:2.27
clc;
clear;
close;
V=120;//in volts
V_b=3;//in volts
R_a=0.2;//in ohms
R_f=60;//in ohms
I_L1=40;//in amperes
I_f=V/R_f;//inn amperes
I_a1=I_L1-I_f;//in amperes
```

```
N_1=1800;//in rpm
E_1=V-(I_a1*R_a)-V_b;//in volts
I_L2=I_L1/2;
I_a2=I_L2-I_f;
E_2=V-(I_a2*R_a)-V_b;//in volts
N_2=int(E_2*N_1/E_1);
disp(N_2,'(a) Speed at half load(in rpm)=');
I_L3=I_L1*1.25;
I_a3=I_L3-I_f;
E_3=V-(I_a3*R_a)-V_b;//in volts
N_3=int(E_3*N_1/E_1);
disp(N_3,'(b) Speed at 125% load(in rpm)=');
```

Scilab code Exa 2.28 Determine the value of resistance

```
//Caption:Determine the value of resistance
//Exa:2.28
clc;
clear;
close;
V=220;//in volts
R_a=0.1;//in ohms
N_1=800;//in rpm
N_2=520;//in rpm
I_a1=20;//in ampers
E_1=V-(I_a1*R_a);//in volts
E_2=N_2*E_1/N_1;//in volts
R_A=-(E_2-V+I_a1*R_a)/20;
disp(R_A,'Additional resistance(in ohms)=');
```

Scilab code Exa 2.29 Determine the value of additional resistance at starting and at 1000rpm

```
//Caption:Determine the value of additional
    resistance (a)at starting (b)at 1000rpm
//Exa:2.29
clc;
clear;
close;
V=240;//in volts
R_a=0.3;//in ohms
N_1=1500;//in rpm
I_a=40;//in ampers
E=V-(I_a*R_a);//in volts
R_1=(V-I_a*R_a)/I_a;
disp(R_1,'(a) Additional resistance at starting (in
    ohms)=');
N_2=1000;//in rpm
E_2=N_2*E/N_1;//in volts
R_2=-(E_2-V+I_a*R_a)/I_a;
disp(R_2,'(b) Additional resistance at 1000 rpm (in
    ohms)=');
```

Scilab code Exa 2.30 Determine the speed at full load and speed at double full load and stalling torque in terms of full load torque

```
//Caption:Determine the (a)speed at full load (b) speed at double full load (c)stalling torque in terms of full load torque
//Exa:2.30
clc;
clear;
close;
V=250;//in volts
R_a=0.2;//in ohms
N_1=800;//in rpm
R_f=250;//in ohms
I_f=V/R_f;//in amperes
I=41;//in ampers
I_a1=I-I_f;//in amperes
E_1=V-(I_a1*R_a);//in volts
E_2=V-(I_a1*(R_a+2));//in volts
N_2=E_2*N_1/E_1;
disp(N_2,'(a) Speed at full load (in rpm)=');
I_a2=I_a1*2;//in amperes
E_3=V-I_a2*(R_a+2);//in volts
N_3=E_3*N_1/E_1;//in rpm
disp(N_3,'(b) Speed at double full load (in rpm)=');
I_ao=V/(R_a+2);
r=I_ao/I_a1;
disp(r,'(c) stalling torque is (times full load torque) =')
```

Scilab code Exa 2.31 Determine the resistance to be inserted in series

```
//Caption:Determine the resistance to be inserted in
    series
//Exa:2.31
clc;
clear;
close;
V=200;//in volts
R_a=0.4;//in ohms
N_1=1000;//in rpm
N_2=800;//in rpm
I_a1=20;//in amperes
E_1=V-(I_a1*R_a);//in volts
I_a2=0.8*I_a1;//in amperes
E_2=N_2*I_a2*E_1/(N_1*I_a1);//in volts
R=-(E_2-193.6)/16;
disp(R,'the resistance to be inserted in series (in
   ohms)=')
```

Scilab code Exa 2.32 Determine the resistance to be inserted in series

```
//Caption:Determine the resistance to be inserted in
    series
//Exa:2.32
clc;
clear;
close;
V=500;//in volts
R_a=0.5;//in ohms
I_a1=60;//in amperes
E_1=V-(I_a1*R_a);//in volts
I_a2=sqrt(((0.75)^3)*I_a1^2);//in amperes
```

```
E_2=0.75*E_1*I_a2/I_a1;//in volts
R=-(E_2-480.5)/38.97;
disp(R,'the resistance to be inserted in series (in
    ohms)=')
```

Scilab code Exa 2.33 Determine the output and efficiency when input current is 20A and 100A

```
//Caption:Determine the output and efficiency when
    input current is (a)20A (b)100A
//Exa:2.33
clc;
clear;
close;
V=500;//in volts
R_a=0.2;//in ohms
I_o=4;//in amperes
I_f=1;//in amperes
P_c=V*I_o-(((I_o-I_f)^2)*R_a);//in watts
I_1=20;///in amperes
P_i1=V*I_1;//in watts
P_a1=((I_1-I_f)^2)*R_a;//in watts
P_L1=P_c+P_a1;//in watts
P_o1=P_i1-P_L1;//in watts
disp(P_o1,'(a) Output (in watts)=');
disp(P_o1/P_i1*100,'  Efficiency (in %)=');
I_2=100;///in amperes
P_i2=V*I_2;//in watts
P_a2=((I_2-I_f)^2)*R_a;//in watts
P_L2=P_c+P_a2;//in watts
P_o2=P_i2-P_L2;//in watts
```

```
disp(P_o2,'(b) Output (in watts)=');
disp(P_o2/P_i2*100,' Efficiency (in %)=');
```

Scilab code Exa 2.34 Determine the no load speed and Full load speed and Speed Regulation

```
//Caption:Determine the (a)no load speed  (b)Full
   load speed (c)Speed Regulation
//Exa:2.34
clc;
clear;
close;
V=240;//in volts
V_b=2;//in volts
R_a=0.15;//in ohms
P=4;
Z=700;
Phy=0.06;//in Webers
A=P;
I_o=7;//in amperes
I_f=2;//in amperes
I=90;//in amperes
I_ao=I_o-I_f;//in amperes
E_bo=V-I_ao*R_a-V_b;//in volts
N_o=E_bo*60*A/(P*Phy*Z);//in rpm
disp(N_o,'(a)no load speed (in rpm)=');
I_a=I-I_f;//in amperes
E_b1=V-I_a*R_a-V_b;//in volts
N=E_b1*N_o/(E_bo*0.98);
disp(N,'(b)Full load speed (in rpm)=');
SR=100*(N_o-N)/N;
```

```
disp(SR,'(c)Speed Regulation (in %)=');
```

Scilab code Exa 2.35 Determine the no load speed and Percentage reduction in flux per pole

```
//Caption:Determine the (a)no load speed  (b)
   Percentage reduction in flux per pole
//Exa:2.35
clc;
clear;
close;
V=220;//in volts
V_b=1;//in volts
R_f=110;//in ohms
R_a=0.14;//in ohms
I_o=7;//in amperes
I_f=2;//in amperes
I=90;//in amperes
N_1=700;//in rpm
I_ao=I_o-I_f;//in amperes
E_bo=V-I_ao*R_a-V_b;//in volts
I=55;//in amperes
I_a1=I-I_f;//in amperes
E_b1=V-I_a1*R_a-V_b;//in volts
N_o=E_bo*N_1/E_b1;
disp(N_o,'(a)no load speed (in rpm) =');
I_a2=35;//in amperes
N_2=900;//in rpm
E_b2=V-I_a2*R_a-V_b;//in volts
Phy_r=E_b2*N_1/(E_b1*N_2);
R=(1-Phy_r)*100;
```

```
disp(R,'(b)Percentage reduction in flux per pole (in
    %)=');
```

Scilab code Exa 2.36 Determine the full load speed and Speed regulation and HP rating and Full load efficiency

```
//Caption:Determine the (a)full load speed (b)Speed
    regulation (c)HP rating (d)Full load efficiency
//Exa:2.36
clc;
clear;
close;
V=240;//in volts
R_f=120;//in ohms
R_a=0.25;//in ohms
I_1=60;//in amperes
I_f=V/R_f;//in amperes
I_a1=I_1-I_f;//in amperes
E_b1=V-I_a1*R_a;//in volts
N_o=1000;//in rpm
I=6;//in amperes
I_ao=I-I_f;//in amperes
E_bo=V-I_ao*R_a;//in volts
N_1=N_o*E_b1/E_bo;
disp(N_1,'(a)Full load speed (in rpm) =');
SR=100*(N_o-N_1)/N_o;
disp(SR,'(b)Speed regulation (in %) =');
P_o=E_b1*I_a1-(E_bo*I_ao);
HP=P_o/746;
disp(HP,'(c)HP rating (in HP)=');
P_i=V*I_1;
```

```
Eff=P_o*100/P_i;
disp(Eff,'(d)Efficiency (in %)=')
```

Scilab code Exa 2.37 Determine the speed Torque and Efficiency

```
//Caption:Determine the (a)speed  (b)Torque (c)
    Efficiency
//Exa:2.37
clc;
clear;
close;
V=240;//in volts
P=4;
Phy=0.008;//in webers
Z=1000;
A=2;
R_f=240;//in ohms
R_a=0.4;//in ohms
I_1=25;//in amperes
I_f=V/R_f;//in amperes
I_a1=I_1-I_f;//in amperes
E_b=V-I_a1*R_a;//in volts
N=E_b*60*A/(P*Z*Phy);
disp(N,'(a)speed (in rpm) =');
P_m=E_b*I_a1;
T_g=(9.55*P_m)/N;
disp(T_g,'(b)Torque (in N-m)=');
P_f=P_m-800;
P_i=V*I_1;
Eff=P_f*100/P_i;
disp(Eff,'(c)Efficiency (in %)=')
```

Scilab code Exa 2.38 Determine the efficiency and power input

```
//Caption:Determine the efficiency and power input
//Exa:2.38
clc;
clear;
close;
P_out=20000;//in watts
P_in=23000;//in watts
V=250;//in volts
R_f=125;//in ohms
R_a=0.2;//in ohms
I_L=P_in/V;//in amperes
I_f=V/R_f;//in amperes
I_a1=I_L-I_f;//in amperes
P_cu=(I_a1^2)*R_a;
P_fcu=V*I_f;
P_tcu=P_cu+P_fcu;
P_fric=P_in-P_out-P_tcu;
P_o=12000;//in watts
P_m=P_o+P_fric
I_a2=53.85;
P_tcu2=((I_a2^2)*R_a)+250;
P_in_2=P_m+P_tcu2;
disp(P_in_2,'Power input (in watts)=');
Eff=P_o*100/P_in_2;
disp(Eff,'Efficiency (in %)=')
```

Scilab code Exa 2.39 Determine the efficiency armature current and max efficiency

```
//Caption:Determine the (a)efficiency (b)armature
   current (c)max efficiency
//Exa:2.39
clc;
clear;
close;
V=240;//in volts
R_f=240;//in ohms
R_a=0.6;//in ohms
I_o=5;//in amperes
I=18;//in amperes
I_f=V/R_f;//in amperes
I_ao=I_o-I_f;
I_a1=I-I_f;
E_bo=V-I_ao*R_a;//in volts
E_b1=V-I_a1*R_a;//in volts
P_dnL=E_bo*I_ao;//in watts
P_m=E_b1*I_a1;//in watts
P_o=P_m-P_dnL;
P_i=V*I;//in watts
Eff=P_o/P_i;
disp(Eff*100,'(a)Efficiency (in %)=')
I_a=sqrt((P_dnL+V*1)/R_a)
disp(I_a,'(b)Armature current (in Amperes)=')
E_b=V-I_a*R_a;
P_m2=E_b*I_a;//in watts
P_out=P_m2-P_dnL;//in watts
```

```
P_in=V*I_a;//in watts
Eff_m=P_out/P_in;
disp(Eff_m*100,'(c)Max Efficiency (in %)=')
```

Scilab code Exa 2.40 Calculate the Speed at full load and developed torque and Shaft power and Efficiency

```
//Caption:Calculate the (a)Speed at full load and
   developed torque (b)Shaft power (c)Efficiency
//Exa:2.40
clc;
clear;
close;
V=230;//in volts
R_a=0.4;//in ohms
I_a1=3.4;//in amperes
R_f=170;//in ohms
E_b1=V-I_a1*R_a;
I_f=V/R_f;
I_L=41;//in amperes
I_a2=I_L-I_f;
E_b2=214.142;//in volts
N_1=1000;//in rpm
N_2=N_1*E_b2/(E_b1*0.96);//in rpm
disp(N_2,'(a)Speed at full load (in rpm)=')
T_a=9.55*E_b2*I_a2/N_2;
disp(T_a,'Torque Developed (in N-m)=')
P_r=E_b1*I_a1;
P_m=E_b2*I_a2;
P_f=P_m-P_r;
disp(P_f,'(b)Shaft Power (in watts)=')
```

```
P_in=V*I_L;
Eff=P_f/P_in;
disp(Eff*100,'(c)Efficiency (in %)=')
```

Scilab code Exa 2.41 Calculate the value of external resistance when the load torque is independent of speed and when the load torque is proportional to speed andthe load torque varies as square of the speed

```
//Caption:Calculate the value of external resistance
    when (a)the load torque is independent of speed
   (b)the load torque is proportional to speed (c)
   the load torque varies as square of the speed
//Exa:2.41
clc;
clear;
close;
V=240;//in volts
R_a=0.25;//in ohms
R_f=120;//in ohms
I_f=V/R_f;
I_L=26;//in amperes
I_a=I_L-I_f;
N_1=1000;//in rpm
N_2=900;//in rpm
E_b1=V-I_a*R_a;
r=N_1/N_2;
R=(E_b1-(E_b1/r))/I_a;
disp(R,'(a)Value of external resistance when the
   load torque is independent of speed (in ohms)= ')
   ;
I_a2=I_a/r;
```

```
R1=(E_b1-(E_b1/r))/I_a2;
disp(R1,'(b)Value of external resistance when the
    load torque is proportional to speed (in ohms)= '
    );
I_a2_n=I_a/r^2;
R2=(E_b1-(E_b1/r))/I_a2_n;
disp(R2,'(a)Value of external resistance when the
    load torque is independent of speed (in ohms)= ')
    ;
```

Scilab code Exa 2.43 Find the efficiency of the motor

```
//Caption:Find the efficiency of the motor
//Exa:2.43
clc;
clear;
close;
V=240;//in volts
P=10000;//in watts
R_a=0.25;//in ohms
R_f=160;//in ohms
I_f=V/R_f;
I_L=5.2;//in amperes
I_ao=I_L-I_f;
W=V*I_ao-I_ao^2*R_a;
I_a=(V-sqrt(V^2-4*R_a*(P+W)))/(2*R_a);
P_in=P+W+I_a^2*R_a+I_f^2*R_f;
Eff=P/P_in;
disp(Eff*100,'Efficiency of the motor (in %)=')
```

Scilab code Exa 2.44 Find the armature voltage drop

```
//Caption:Find the armature voltage drop
//Exa:2.44
clc;
clear;
close;
V=440;//in volts
N_1=1000;//in rpm
N_2=1050;//in rpm
r=N_1/N_2;
V_drop=2*(V-V*r)
disp(V_drop,'Armature voltage drop (in volts)=')
```

Scilab code Exa 2.45 Find the no load speed

```
//Caption:Find the no load speed
//Exa:2.45
clc;
clear;
close;
V=220;//in volts
R_a=2.5;//in ohms
N_1=859;//in rpm
```

```
I_ao=0;
I_a=8;//in amperes
E_b1=V-I_a*R_a;
E_bo=V-I_ao*R_a;
N_o=N_1*E_bo/E_b1;
disp(N_o,'No Load Speed (in RPM)=')
```

Scilab code Exa 2.46 Find the percentage reduction in feild flux and value of additional resistance

```
//Caption:Find the percentage reduction in feild
   flux and value of additional resistance
//Exa:2.46
clc;
clear;
close;
V=220;//in volts
R_a=0.2;//in ohms
R_f=110;//in ohms
N_1=700;//in rpm
N_2=900;//in rpm
T_a1=90;//in N-m
T_a2=70;//in N-m
I_1=27;//in amperes
I_f=V/R_f;
I_a1=I_1-I_f;
E_b1=V-I_a1*R_a;
x=(V+sqrt(V^2-4*276.43*4.168))/(2*276.43);
disp((1-x)*100,'percentage reduction in feild flux (
   %)=');
I_f2=x*I_f;
```

```
R=(V-I_f2*R_f)/I_f2;
disp(R,'Value of additional resistance (in ohms)=')
```

Scilab code Exa 2.47 Find the new speed as a percentage of the original speed

```
//Caption:Find the new speed as a percentage of the
   original speed
//Exa:2.47
clc;
clear;
close;
V=400;//in volts
R_f=200;//in ohms
I_1=25;//in amperes
I_f=V/R_f;
I_a1=I_1-I_f;
x=(-V+sqrt(V^2+4*345*400))/(2*345);
disp(x*100,'New Speed is= ');
disp('percent of original speed')
```

Chapter 3

Single Phase Transformers

Scilab code Exa 3.1 Determine the number of turns of primary and secondary windings and emf per turn

```
//Caption:Determine the (a)number of turns of
   primary and secondary windings (b)emf per turn
//Exa:3.1
clc;
clear;
close;
A=500*10^-4;//in m^2
B_max=1.5;//in tesla
f=50;//in Hz
E_1=5000;//in volts
E_2=500;//in volts
S_f=0.85;//Stacking factor
N_1=int(E_1/(4.44*f*B_max*A*S_f));
disp(N_1,'(a)Number of turns in primary winding=');
N_2=int(E_2*N_1/E_1);
disp(N_2,'Number of turns in secondary winding=');
disp(E_1/N_1,'(b)Emf per turn (in Volts)=');
```

Scilab code Exa 3.2 Determine the number of turns of primary and secondary windings and cross section area of the core

```
//Caption:Determine the (a)number of turns of
   primary and secondary windings (b)cross section
   area of the core
//Exa:3.2
clc;
clear;
close;
B_max=1.4;//in tesla
f=50;//in Hz
E_1=660;//in volts
E_2=440;//in volts
E_T1=1.1;//in volts
N_1=int(E_1/E_T1);
disp(N_1,'(a)Number of turns in primary winding=');
N_2=int(E_2*N_1/E_1);
disp(N_2,'Number of turns in secondary winding=');
A=E_1/(4.44*f*N_1*B_max);
disp(A,'(b)Cross section area of the core (in m^2)='
   );
```

Scilab code Exa 3.3 Determine the number of turns of primary and secondary windings

```
//Caption:Determine the number of turns of primary
   and secondary windings
//Exa:3.3
clc;
clear;
close;
Phy_max=7.82*10^-3;//in webers
f=50;//in Hz
E_1=5000;//in volts
E_2=500;//in volts
N_1=int(E_1/(4.44*f*Phy_max));
disp(N_1,'Number of turns in primary winding=');
N_2=int(E_2*N_1/E_1);
disp(N_2,'Number of turns in secondary winding=');
```

Scilab code Exa 3.4 Determine the Secondary voltage current flowing through windings and max value of flux

```
//Caption:Determine the (a)Secondary voltage (b)
   current flowing through windings (c)max value of
   flux
//Exa:3.4
clc;
clear;
close;
f=50;//in Hz
E_1=2500;//in volts
N_1=500;
```

```
N_2=100;
P=50*1000;//in watts
E_2=E_1*N_2/N_1;
disp(E_2,'(a)Secondary Voltage (in volts)=');
I_1=P/E_1;
disp(I_1,'(b)Primary current (in amperes)=');
I_2=P/E_2;
disp(I_2,'   Secondary current (in amperes)=');
Phy_max=E_1/(4.44*f*N_1);
disp(Phy_max,'(c)Max value of flux (in Wb)=')
```

Scilab code Exa 3.5 Determine the No load power factor iron loss component of current and magnetising component of current

```
//Caption:Determine the (a)No load power factor(b)
   iron loss component of current (c)magnetising
   component of current
//Exa:3.5
clc;
clear;
close;
f=50;//in Hz
W=80;//in watts
V=4400;//in volts
I=0.04;//in amperes
pf=W/(V*I);
disp(pf,'(a)No load power factor=');
I_w=I*pf;
disp(I_w,'(b)Iron loss component of current (in
   amperes)=');
I_m=I*sqrt(1-pf^2);
```

```
disp(I_m,'(c)Magnetising component of current (in
    amperes)')
```

Scilab code Exa 3.6 Determine the No load input power magnetising component of current and no load power factor

```
//Caption:Determine the (a)No load input power (b)
    magnetising component of current and no load
    power factor
//Exa:3.6
clc;
clear;
close;
f=50;//in Hz
P=20*1000;//in watts
E_1=2200;//in volts
E_2=220;//in volts
I=1.3;//in amperes
I_w=0.5;//in amperes
W=E_2*I_w;
disp(W,'(a)No load input power (in watts)=')
pf=I_w/I;
disp(pf,'(b)No load power factor=');
I_m=I*sqrt(1-pf^2);
disp(I_m,'   Magnetising component of current (in
    amperes)')
```

Scilab code Exa 3.7 Determine the Equivalent resistance leakage reactances and impedance reffered to high voltage side and Equivalent resistance leakage reactances and impedance reffered to high voltage side and Total copper loss of transformer

```
//Caption:Determine the (a)Equivalent resistance, leakage reactances and impedance reffered to high voltage side (b)Equivalent resistance,leakage reactances and impedance reffered to high voltage side (c)Total copper loss of transformer
//Exa:3.7
clc;
clear;
close;
f=50;//in Hz
P=30*1000;//in watts
E_1=3000;//in volts
E_2=300;//in volts
R_1=2.5;//in ohms
R_2=0.018;//in ohms
X_1=3.8;//in ohms
X_2=0.052;//in ohms
a=E_1/E_2;
R1=R_1+a^2*R_2;
X1=X_1+a^2*X_2;
Z1=sqrt(R1^2+X1^2);
disp(R1,'(a)Equivalent resistance reffered to high voltage side (in ohms)=');
disp(X1,'   Equivalent reactance reffered to high voltage side (in ohms)=');
```

```
disp(Z1,'   Equivalent impedance reffered to high
    voltage side (in ohms)=');
R2=R_1/a^2+R_2;
X2=X_1/a^2+X_2;
Z2=sqrt(R2^2+X2^2);
disp(R2,'(b)Equivalent resistance reffered to low
    voltage side (in ohms)=');
disp(X2,'   Equivalent reactance reffered to low
    voltage side (in ohms)=');
disp(Z2,'   Equivalent impedance reffered to low
    voltage side (in ohms)=');
I_1=P/E_1;
I_2=P/E_2;
P_cu=I_1^2*R1;
disp(P_cu,'(c)Total copper loss of transformer (in
    watts)=')
```

Scilab code Exa 3.8 Find the equivalent circuit parameters reffered to primary side

```
//Caption:Find the equivalent circuit parameters
    reffered to primary side
//Exa:3.8
clc;
clear;
close;
a=400/200;
I_o_Lv=2;//in amperes
I_o_Hv=I_o_Lv/a;//in amperes
V_o=400;//in volts
P_occ=90;//in watts
```

```
pf=P_occ/(V_o*I_o_Hv);
I_w=I_o_Hv*pf;
disp(I_w,'I_w (in Amperes)=');
I_m=I_o_Hv*sqrt(1-pf^2);
disp(I_m,'Magnetising current I_m (in Amperes)=');
R_o=V_o/I_w;
disp(R_o,'R_o (in ohms)=');
X_o=V_o/I_m;
disp(X_o,'Magnetizing reactance X_o (in ohms)=');
V_sc=20;//in volts
I_sc=10;//in amperes
P_sc=100;//in watts
Z_o1=V_sc/I_sc;
R_o1=P_sc/I_sc^2;
disp(R_o1,'Effective resistance reffered to primary
   side (in ohms)=');
X_o1=sqrt(Z_o1^2-R_o1^2);
disp(X_o1,'Effective reactance reffered to primary
   side (in ohms)=')
```

Scilab code Exa 3.9 Find the readings of transformers when it is connected for OC test and SC test

```
//Caption:Find the readings of transformers when it
   is connected for (a)OC test (b)SC test
//Exa:3.9
clc;
clear;
close;
V1=460;//in volts
V2=230;//in volts
```

```
a=V1/V2;
R1=0.4;//in ohms
R2=0.1;//in ohms
X1=0.5;//in ohms
X2=0.12;//in ohms
R_o=650;//in ohms
X_o=250;//in ohms
I_w=V1/R_o;
I_m=V1/X_o;
P_occ=V1*I_w;
disp('Readings of transformer for OC test');
disp(V1,'Voltage Reading (in volts)=');
disp(sqrt(I_w^2+I_m^2),'Current Reading (in Amperes)
    =');
disp(P_occ,'Power output reading (in watts)=');
R_01=R1+a^2*R2;
X_01=X1+a^2*X2;
Z=sqrt(R_01^2+X_01^2);
I=4000/V1;
V_sc=I*Z;
P_sc=I^2*R_01;
disp('Readings of transformer for SC test');
disp(V_sc,'Voltage Reading (in volts)=');
disp(I,'Current Reading (in Amperes)=');
disp(P_sc,'Power output reading (in watts)=');
```

Scilab code Exa 3.10 Find the equivalent circuit parameters of the transformer reffered to LV side and also calculate the secondary voltage

```
//Caption:Find the equivalent circuit parameters of
    the transformer reffered to LV side and also
```

```
   calculate the secondary voltage
//Exa:3.10
clc;
clear;
close;
V1=300;//in volts
I_o=0.8;//in amperes
W_o=70;//in watts
pf=W_o/(V1*I_o);
I_w=I_o*pf;
I_m=I_o*sqrt(1-pf^2);
R_0=V1/I_w;
X_0=V1/I_m;
a=300/600;
V_sc=20;//in volts
I_sc=12;//in amperes
P_sc=90;//in watts
Z_02=V_sc/I_sc;
R_02=P_sc/I_sc^2;
X_02=sqrt(Z_02^2-R_02^2);
R_01=a^2*R_02;
X_01=a^2*X_02;
I_2=6000/(600*0.8);
V2=I_2*(R_02*pf+X_02*sqrt(1-pf^2));
disp(R_0,'R_O (in ohms)=');
disp(X_0,'X_O Magnetising reactance (in ohms)=');
disp(R_01,'Equivalent Resistance reffered to LV Side
    (in ohms)=');
disp(X_01,'Equivalent Reactance reffered to LV Side
   (in ohms)');
disp(600-V2,'Secondary Terminal Voltage (in volts)='
   )
```

Scilab code Exa 3.11 Find the equivalent circuit parameters of the transformer reffered to LV side and also calculate the efficiency

```
//Caption:Find the equivalent circuit parameters of
   the transformer reffered to LV side and also
   calculate the efficiency
//Exa:3.11
clc;
clear;
close;
V1=200;//in volts
I_o=0.8;//in amperes
W_o=80;//in watts
pf=W_o/(V1*I_o);
I_w=I_o*pf;
I_m=I_o*sqrt(1-pf^2);
R_0=V1/I_w;
X_0=V1/I_m;
a=200/400;
V_sc=25;//in volts
I_sc=10;//in amperes
P_sc=90;//in watts
Z_02=V_sc/I_sc;
R_02=P_sc/I_sc^2;
X_02=sqrt(Z_02^2-R_02^2);
R_01=a^2*R_02;
X_01=a^2*X_02;
I_2=12;
I_1=I_2/a;
V2=sqrt((V1*pf+I_1*R_01)^2+(V1*sqrt(1-pf^2)+I_1*X_01
```

```
    )^2);
P_iron=80;//in watts
P_cu=(12/10)^2*90;
P_total=P_cu+P_iron;
Eff=6000*0.8/(6000*0.8+P_total);
disp(R_0,'R_O (in ohms)=');
disp(X_0,'X_O Magnetising reactance (in ohms)=');
disp(R_01,'Equivalent Resistance reffered to LV Side
     (in ohms)=');
disp(X_01,'Equivalent Reactance reffered to LV Side
    (in ohms)');
disp(Eff*100,'Efficiency (in %)=')
```

Scilab code Exa 3.12 Calculate Efficiency of transformer Load KVA at which max efficiency occurs and max efficiency and voltage regulation

```
//Caption:Calculate (a)Efficiency of transformer (b)
    Load KVA at which max efficiency occurs and max
    efficiency (c)voltage regulation
//Exa:3.12
clc;
clear;
close;
V1=2000;//in volts
pf=0.8;
I1=10000/V1;//in amperes
P_iron=60;//in watts
V_sc=40;//in volts
I_sc=4;//in amperes
a=2000/200;
P_sc=70;//in watts
```

```
Z_01=V_sc/I_sc;
R_01=P_sc/I_sc^2;
X_01=sqrt(Z_01^2-R_01^2);
R_02=R_01/a^2;
X_02=X_01/a^2;
I2=I1*a/2;//At half load
Del_V=I2*(R_02*pf+X_02*sqrt(1-pf^2));
V2=200-Del_V;
P_o=V2*I2*pf;//in watts
P_cu=(2.5/4)^2*P_sc;//At half load
Eff=0.5*P_o/(0.5*P_o+P_iron+P_cu);
disp(Eff*100,'(a)Efficiency (in %)=');
I_1=sqrt(P_iron/R_01);
KVA_Load=10*I_1/5;
disp(KVA_Load,'(b)Load KVA at which max efficiency
    occurs=');
Eff_max=P_o/(P_o+P_iron+P_iron);
disp(Eff_max*100,'  Max Efficiency (in %)=');
I_2=50;//at full load
VR=(I_2*(R_02*pf-X_02*sqrt(1-pf^2)))/200;
disp(VR*100,'(c)Voltage Regulation (in %)=')
```

Scilab code Exa 3.13 Determine the KVA rating of auto transformer with additive and subtractive polarity also find the efficiency at full load and unity power factor

```
//Caption:Determine the KVA rating of auto
    transformer with additive and subtractive
    polarity also find the efficiency at full load
    and unity power factor
//Exa:3.13
```

```
clc;
clear;
close;
P=120*1000;//in watts
V1=2400;//in volts
V2=240;//in volts
I1=P/V1;//in amperes
I2=P/V2;//in amperes
KVA_1=V1*(I1+I2)/1000;
P_trans=V2*I2/1000;
P_cond_1=KVA_1-P_trans;
P_loss_1=((1/0.98)-1)^2*P_trans;
Eff_a=1-(P_loss_1/KVA_1)
disp(KVA_1,'KVA Rating of transformer with additive
    polarity (in KVA)=');
disp(Eff_a*100,'Efficiency of auto transformer with
    additive polarity (in %)=');
KVA_2=V1*(I2-I1)/1000;
P_trans=V2*I2/1000;
P_cond_2=KVA_2-P_trans;
P_loss=((1/0.98)-1)^2*P_trans;
Eff_s=1-(P_loss/KVA_2)
disp(KVA_2,'KVA Rating of transformer with
    subtractive polarity (in KVA)=');
disp(Eff_s*100,'Efficiency of auto transformer with
    subtractive polarity (in %)=');
```

Scilab code Exa 3.14 Calculate the parameters reffered to LV Side and also find the voltage regulation at full load and efficiency of transformer at full load and half load

```
//Caption:Calculate the parameters reffered to LV Side and also find the voltage regulation at full load and efficiency of transformer at full load and half load at 0.8pf lagging
//Exa:3.14
clc;
clear;
close;
a=0.5;
V1=200;//in volts
I_o=0.8;//in amperes
W_o=75;//in watts
pf=W_o/(V1*I_o);
pf2=0.8;
R_O=V1/(I_o*pf);
X_O=V1/(I_o*sqrt(1-pf^2));
V_sc=20;//in volts
I_sc=10;//in amperes
P_sc=90;//in watts
Z_02=V_sc/I_sc;
R_02=P_sc/I_sc^2;
X_02=sqrt(Z_02^2-R_02^2);
R_01=a^2*R_02;
X_01=a^2*X_02;
I_2=4000/400;//in amperes
VR=I_2*(R_02*pf2+X_02*sqrt(1-pf2^2))/400;
disp(R_O,'R_O (in ohms)=');
disp(X_O,'X_O Magnetising reactance (in ohms)=');
disp(R_01,'Equivalent Resistance reffered to LV Side (in ohms)=');
disp(X_01,'Equivalent Reactance reffered to LV Side (in ohms)');
disp(VR*100,'Voltage Regulation at full load (in %)=');
P_o=(400-I_2*(R_02*pf2+X_02*sqrt(1-pf2^2)))*I_2*pf2;
P_i=75;//in watts
P_cu=P_sc;
P_cu_h=0.5^2*P_cu;
```

```
Eff=P_o/(P_o+P_i+P_cu);
disp(Eff*100,'Efficiency at full load (in %)=');
P_o_h=(400-I_2*0.5*(R_02*pf2+X_02*sqrt(1-pf2^2)))*
    I_2*0.5*pf2;
Eff_h=P_o_h/(P_o_h+P_i+P_cu_h);
disp(Eff_h*100,'Efficiency at half load (in %)=');
```

Scilab code Exa 3.15 Calculate the circuit parameters reffered to LV Side and also calculate the regulation and efficiency of transformer at full load and half load

```
//Caption:Calculate the circuit parameters reffered
    to LV Side and also calculate the regulation and
    efficiency of transformer at full load and half
    load at 0.8 pf
//Exa:3.15
clc;
clear;
close;
a=0.5;
V1=250;//in volts
I_o=1.2;//in amperes
W_o=80;//in watts
pf=W_o/(V1*I_o);
pf2=0.8;
R_0=V1/(I_o*pf);
X_0=V1/(I_o*sqrt(1-pf^2));
V_sc=25;//in volts
I_sc=10;//in amperes
P_sc=95;//in watts
Z_02=V_sc/I_sc;
```

```
R_02=P_sc/I_sc^2;
X_02=sqrt(Z_02^2-R_02^2);
R_01=a^2*R_02;
X_01=a^2*X_02;
I_2=6000/500;//in amperes
VR=I_2*(R_02*pf2+X_02*sqrt(1-pf2^2))/500;
VR_h=0.5*I_2*(R_02*pf2+X_02*sqrt(1-pf2^2))/500;
disp(R_0,'R_O (in ohms)=');
disp(X_0,'X_O Magnetising reactance (in ohms)=');
disp(R_01,'Equivalent Resistance reffered to LV Side
    (in ohms)=');
disp(X_01,'Equivalent Reactance reffered to LV Side
    (in ohms)');
disp(VR*100,'Voltage Regulation at full load (in %)=
    ');
disp(VR_h*100,'Voltage Regulation at half load (in %
    )=');
P_o=(500-I_2*(R_02*pf2+X_02*sqrt(1-pf2^2)))*I_2*pf2;
P_i=80;//in watts
P_cu=(12/10)^2*P_sc;
P_cu_h=0.5^2*P_cu;
Eff=P_o/(P_o+P_i+P_cu);
disp(Eff*100,'Efficiency at full load (in %)=');
P_o_h=(500-I_2*0.5*(R_02*pf2+X_02*sqrt(1-pf2^2)))*
    I_2*0.5*pf2;
Eff_h=P_o_h/(P_o_h+P_i+P_cu_h);
disp(Eff_h*100,'Efficiency at half load (in %)=');
```

Scilab code Exa 3.16 Find the efficiency of transformer at full load and 75 percent of full load

```
//Caption:Find the efficiency of transformer at full
    load and 75 percent of full load (a)at unity
   power factor (b)0.8 power factor
//Exa:3.16
clc;
clear;
close;
I_2=200;//in amperes
R_02=0.008;//in ohms
x=0.75;
P_cu=x^2*I_2^2*R_02;//in watts
P_i=190;//in watts
KVA=40;
P_o=40*1000;//in watts
Eff=P_o/(P_o+P_i+I_2^2*R_02);
Eff_2=KVA*1000*0.8/(KVA*1000*0.8+P_i+I_2^2*R_02);
disp(Eff*100,'(a)Efficiency of transformer at full
   load and at unity power factor (in %)=');
disp(Eff_2*100,'(b)Efficiency of transformer at full
    load and at 0.8 power factor (in %)=');
Eff_3=x*P_o/(x*P_o+P_i+P_cu);
Eff_4=x*P_o*0.8/(x*0.8*P_o+P_i+P_cu);
disp(Eff_3*100,'(a)Efficiency of transformer at 75%
   of load and at unity power factor (in %)=');
disp(Eff_4*100,'(b)Efficiency of transformer at 75%
   of load and at 0.8 power factor (in %)=');
```

Scilab code Exa 3.17 Determine the Load at which max efficiency occurs and value of max efficiency and New core loss and Cu loss

```
//Caption:Determine the (a)Load at which max
```

```
   efficiency occurs and value of max efficiency (b)
   New core loss and Cu loss
//Exa:3.17
clc;
clear;
close;
KVA=20;
P_i=250;//in watts
P_cu=500;//in watts
x=sqrt(P_i/P_cu);
disp(x*100,'(a)Max efficiency will occur at');
disp('Percent of full load');
P_o=x*KVA*1000;
Eff=P_o/(P_o+P_i+P_i);
disp(Eff*100,'Maximum Efficiency (in %)=');
P_cu_n=(P_i+P_cu)/(0.85^2+1);
P_i_n=P_i+P_cu-P_cu_n;
disp(P_i_n,'(b)Core Loss (in watts)=');
disp(P_cu_n,'   Copper Loss (in watts)=')
```

Scilab code Exa 3.18 Calculate the secondary current at which max efficiency will occur and also calculate the max efficiency

```
//Caption:Calculate the secondary current at which
   max efficiency will occur and also calculate the
   max efficiency at 0.8pf lagging
//Exa:3.18
clc;
clear;
close;
a=1000/200;
```

```
R_1=0.25;//in ohms
R_2=0.018;//in ohms
R_02=R_2+R_1/a^2;
P_i=240;//in watts
I_2=sqrt(P_i/R_2);
disp(I_2,'The secondary current at which max
    efficiency will occur (in Amperes)=');
P_o=200*I_2*0.8;//in watts
P_t=2*P_i;//in watts
Eff=P_o/(P_o+P_t);
disp(Eff*100,'Max efficiency at 0.8pf lagging(in %)=
    ')
```

Scilab code Exa 3.19 Find the iron loss copper loss at full load Load KVA at which maximum efficiency occurs and maximum efficiency of transformer

```
//Caption:Find the (a)iron loss (b)copper loss at
    full load (c)Load KVA at which maximum efficiency
     occurs (d)maximum efficiency of transformer at
    0.8pf lagging
//Exa:3.19
clc;
clear;
close;
KVA=150;
pf=0.8;
Eff=0.96;
P_o=KVA*1000*pf;//in watts
P_cu=P_o*((1/Eff)-1)*(1-0.5)*4/3;
P_i=4999.9-P_cu;
disp(P_i,'(a)Iron Loss (in watts)=');
```

```
disp(P_cu,'(b)Copper Loss at full load (in watts)=')
    ;
x=sqrt(P_i/P_cu);
disp(x*KVA,'(c)Load KVA at which maximum efficiency
    occurs (in KVA)=');
Eff_max=x*KVA*1000*0.8/(x*KVA*1000*0.8+2*P_i);
disp(Eff_max*100,'(d)maximum efficiency of
    transformer at 0.8pf lagging(in %)=')
```

Scilab code Exa 3.22 Calculate Efficiency at full load and half load

```
//Caption:Calculate (a)Efficiency at full load and
    at unity power factor (b)Efficiency at half load
    and 0.8 power factor (c)Efficiency at 75 percent
    of load and 0.7 power factor (d)load KVA at which
     maximum efficiency will occcur (e)maximum
    efficiency at 0.85 power factor
//Exa:3.22
clc;
clear;
close;
KVA=100;
P_cu=1200;//in watts
P_i=960;//in watts
x1=1;
pf1=1;
P_o_1=x1*KVA*pf1*1000;
Eff_1=P_o_1/(P_o_1+P_i+x1^2*P_cu);
disp(Eff_1*100,'(a)Efficiency at full load and at
    unity power factor (in %)=');
x2=0.5;
```

```
pf2=0.8;
P_o_2=x2*KVA*1000*pf2;
Eff_2=P_o_2/(P_o_2+P_i+x2^2*P_cu);
disp(Eff_2*100,'(b)Efficiency at half load and at
    0.8 power factor (in %)=');
x3=0.75;
pf3=0.7;
P_o_3=x3*KVA*1000*pf3;
Eff_3=P_o_3/(P_o_3+P_i+x3^2*P_cu);
disp(Eff_3*100,'(c) Efficiency at 75 percent of load
     and 0.7 power factor(in %)=');
KVA_max=KVA*sqrt(P_i/P_cu);
disp(KVA_max,'(d)load KVA at which maximum
    efficiency will occcur (in KVA)=');
Eff_max=KVA_max*1000*0.85/(KVA_max*1000*0.85+2*P_i);
disp(Eff_max*100,'(e)maximum efficiency at 0.85
    power factor(in %)=')
```

Scilab code Exa 3.23 Calculate the core loss and copper loss and also find the value of load current at which max efficiency will be attained

```
//Caption:Calculate the core loss and copper loss
    and also find the value of load current at which
    max efficiency will be attained
//Exa:3.23
clc;
clear;
close;
KVA=100;
V2=11000;//in volts
x1=1;
```

```
x2=0.5;
pf1=0.8;
pf2=1;
Eff_1=0.985;
Eff_2=0.99;
P_cu=(KVA*1000*x1*pf1*((1/Eff_1)-1)-x2*KVA*1000*((1/
    Eff_2)-1))*(4/3);// in watts
P_i=1218-P_cu;// in watts
I_fl=KVA*1000/V2;
I_2=I_fl*sqrt(P_i/P_cu);
disp(P_cu,'Copper loss (in watts)=');
disp(P_i,'Core loss (in watts)=');
disp(I_2,'Load current (in amperes)=')
```

Scilab code Exa 3.24 Calculate the efficiency of the transformer at 75 percent of full load and maximum efficiency

```
//Caption:Calculate the efficiency of the
    transformer at 75 percent of full load and
    maximum efficiency
//Exa:3.24
clc;
clear;
close;
P_o=500;//in watts
Eff_fl=0.9;
Eff_hl=0.9;
P_cu=(((P_o-0.5*P_o)/Eff_fl)-0.5*P_o)*4/3;// in
    watts
P_i=0.5*P_cu;// in watts
Eff=P_o*0.75/(P_o*0.75+P_i+0.75^2*P_cu);
```

```
disp(Eff*100,'Efficiency of transformer at 75
   percent of full load(in %)=');
P_o_max=P_o*sqrt(P_i/P_cu);
Eff_max=P_o_max/(P_o_max+P_i+P_i);
disp(Eff_max*100,'Maximum efficiency (in %)=')
```

Scilab code Exa 3.25 Calculate the efficiency of the transformer on full load and half load at unity power factor

```
//Caption:Calculate the efficiency of the
   transformer on full load and half load at unity
   power factor
//Exa:3.25
clc;
clear;
close;
KVA=100;
P_i=1300;//in watts
P_cu=1200;//in watts
pf=1;
Eff_fl=KVA*1000*pf/(KVA*1000*pf+P_i+P_cu);
disp(Eff_fl*100,'Efficiency of transformer at full
   load (in %)=');
Eff_hl=KVA*1000*0.5*pf/(KVA*0.5*1000*pf+P_i+0.25*
   P_cu);
disp(Eff_hl*100,'Efficiency of transformer at half
   load (in %)=');
```

Scilab code Exa 3.26 Find the voltage regulation

```
//Caption:Find the voltage regulation
//Exa:3.26
clc;
clear;
close;
KVA=100;
Eff_max=0.98;
x=0.8;
pf=0.8;
P_o=x*KVA*1000*pf;//in watts
P_i=(P_o-P_o*Eff_max)/(2*Eff_max);//in watts
P_cu=P_i/x^2;
R_equ=P_cu/(KVA*1000);
Z_equ=0.05;
X_equ=sqrt(Z_equ^2-R_equ^2);
VR=R_equ*pf+X_equ*sqrt(1-pf^2);
disp(VR*100,'Voltage Regulation (in %)=')
```

Scilab code Exa 3.27 Calculate the percentage resistance and reactance drops and the percentage of full load at which max efficiency will occur

```
//Caption:Calculate the percentage resistance and reactance drops and the percentage of full load at which max efficiency will occur
//Exa:3.27
clc;
clear;
close;
KVA=20;
V1=1100;//in volts
V2=220;//in volts
a=V1/V2;
P_i=175;//in watts
R1=0.25;//in ohms
R2=0.012;//in ohms
X1=1.1;//in ohms
X2=0.055;//in ohms
R_02=R2+R1/a^2;
X_02=X2+X1/a^2;
I2=KVA*1000/V2;
V_r=I2*R_02*100/V2;
disp(V_r,'Percentage Resistance drop (in %)=');
V_re=I2*X_02*100/V2;
disp(V_re,'Percentage Reactance drop (in %)=');
P_cu=I2^2*R_02;
x=sqrt(P_i/P_cu);
disp(x*100,'Max Efficiency will occur at');
disp('percent of full load');
```

Scilab code Exa 3.28 Find the voltage regulation

```
//Caption:Find the voltage regulation
```

```
//Exa:3.28
clc;
clear;
close;
KVA=500;
V2=500;//in volts
x=0.75;
pf=1;
Eff_max=0.97;
P_i=(KVA*x*1000*pf-KVA*x*1000*pf*Eff_max)/(2*Eff_max
    );//in watts
P_cu=P_i/x^2;
R_equ=P_cu/(KVA*1000);
X_equ=sqrt(0.1^2-R_equ^2);//in ohms
VR=R_equ*0.8+X_equ*0.6;
disp(VR*100,'Voltage Regulation (in %)=')
```

Scilab code Exa 3.29 Calculate the value of iron loss and copper loss which will give max efficiency and also the max efficiency

```
//Caption:Calculate the value of iron loss and
    copper loss which will give max efficiency and
    also the max efficiency
//Exa:3.29
clc;
clear;
close;
KVA=25;
P_iron=350;//in watts
//For max efficiency P_iron=P_cu
P_cu=P_iron;
```

```
disp(P_iron,'Iron loss (in watts)=');
disp(P_cu,'Copper Loss (in watts)=');
Eff=KVA*1000/(KVA*1000+P_iron+P_cu);
disp(Eff*100,'Maximum Efficiency (in %)=');
```

Scilab code Exa 3.30 Find the Efficiency and voltage regulation of transformer

```
//Caption:Find the Efficiency and voltage regulation
    of transformer
//Exa:3.30
clc;
clear;
close;
P_i=100;//in watts
V2=400;//in volts
P_sc=200;//in watts
I_2=11.4;//in amperes
R_02=P_sc/I_2^2;//in ohms
KVA=5;
I_2fl=KVA*1000/V2;
P_cu=I_2fl^2*R_02;
pf=0.9;
Eff=KVA*1000*pf/(KVA*1000*pf+P_cu+P_i);
disp(Eff*100,'Efficiency (in %)=');
V_2sc=40;//in volts
Z_02=V_2sc/I_2;
X_02=sqrt(Z_02^2-R_02^2);
VR=I_2fl*(R_02*pf+X_02*sqrt(1-pf^2))/V2;
disp(VR*100,'Voltage Regulation (in %)=')
```

Chapter 4

Three Phase Transformers

Scilab code Exa 4.1 Find the value of line current

```
//Caption:Find the value of line current
//Exa:4.1
clc;
clear;
close;
a=2200/200;//transformation ratio
P=450*1000;//in watts
pf=0.85;
V_s=200;//in volts
I_2=P/(pf*V_s);//in amperes
I_1=1.15*I_2/a;
disp(I_1,'Value of line currents (in Amperes)=')
```

Scilab code Exa 4.2 Find the value of line current

```
//Caption:Find the value of line current
//Exa:4.2
clc;
clear;
close;
a=2200/200;//transformation ratio
P_1=400*1000;//in watts
P_2=500*1000;//in watts
pf=0.8;
V_s=200;//in volts
I_2=P_1/(pf*V_s);//in amperes
I_1=1.15*I_2/a;
I_1T=I_1/2;
I_2M=P_2/(pf*V_s*a);
I_p=sqrt((I_1T^2)+(I_2M^2));
disp(I_p,'Value of line current (in Amperes)=')
```

Scilab code Exa 4.3 Determine the efficiency of transformer

```
//Caption:Determine the efficiency of transformer at
    (a)full load and 0.85pf (b)75 percent of full
   load and unity pf (c)max efficieny at unity pf
//Exa:4.3
clc;
clear;
close;
P=100*1000;//in watts
P_iron=1500;//in watts
x=0.8;
P_cu=1500/x^2;//in watts
pf=0.8;
```

```
a=5000/400;//transformation ratio
P_t=P_iron+P_cu;
P_o=0.85*P;//in watts
Eff=P_o/(P_o+P_t);
disp(Eff*100,'(a)Efficiency at full load and 0.85pf
    (in %)=');
P_cu_1=0.75*P_cu;//in watts
P_t_1=P_cu_1+P_iron;//in watts
P_o_1=0.75*P;
Eff_1=P_o_1/(P_o_1+P_t_1);
disp(Eff_1*100,'(b)Efficiency at 75 percent of full
    load and unity pf(in %)=');
P_t_2=2*P_iron;
P_o_2=P;
Eff_2=P_o_2/(P_o_2+P_t_2);
disp(Eff_2*100,'(c)max efficieny at unity pf(in %)='
    );
```

Scilab code Exa 4.4 Find the value of line voltage and line current and output

```
//Caption:Find the value of line voltage,line
    current,and output when the transformer winding
    is connected as (a) Star-delta (b)delta-star
//Exa:4.4
clc;
clear;
close;
a=10;//transformation ratio
V_s=3300;//in volts
I_1=10;//in amperes
```

```
V_1=V_s/sqrt(3);
V_2=V_1/a;
I_2=sqrt(3)*a*I_1;
P_o=sqrt(3)*V_2*I_2;
disp("For Star-Delta Configruation")
disp(V_2,'Line voltage (in volts)=');
disp(I_2,'Line current (in amperes)=');
disp(P_o,'Output (in watts)=');
V_2p=V_s/a;
V_2L=sqrt(3)*V_2p;
I_2L=I_1*a/sqrt(3);
P_o2=sqrt(3)*V_2*I_2;
disp("For Delta-Star Configruation")
disp(V_2L,'Line voltage (in volts)=');
disp(I_2L,'Line current (in amperes)=');
disp(P_o2,'Output (in watts)=');
```

Scilab code Exa 4.5 Find the Efficiency

```
//Caption:Find the Efficiency
//Exa:4.5
clc;
clear;
close;
P=1200*1000;//in watts
R_1=2;//in ohms
R_2=0.03;//in ohms
P_iron=20000;//in watts
V_1p=6600;//in volts
V_2p=1100/sqrt(3);//in volts
a=V_1p/V_2p;
```

```
R_o2=R_2+(R_1/a^2);//in ohms
I_2p=P/(sqrt(3)*1100);//in amperes
P_cu=3*R_o2*I_2p^2;
P_t=P_iron+P_cu;
P_o=0.9*P;//in watts
Eff=P_o/(P_o+P_t);
disp(Eff*100,'Efficiency (in %)=')
```

Scilab code Exa 4.6 Find the percentage resistance and reactance drop and efficiency and voltage regulation

```
//Caption:Find the percentage resistance,reactance
   drop,efficiency and voltage regulation
//Exa:4.6
clc;
clear;
close;
P=1500*1000;//in watts
phy=acosd(0.8);
V_1P=300;//in volts
V_1L=6600;//in volts
I_1P=131.21/sqrt(3);
Z_1=V_1P/I_1P;//in ohms
R_1=30*1000/(3*I_1P^2);
X_1=sqrt((Z_1^2)-(R_1^2));
R=I_1P*R_1*100/V_1L;
X=I_1P*X_1*100/V_1L;
disp(R,'% Resistance drop (in %)=');
disp(X,'% Reactance drop (in %)=');
VR=(R*cosd(phy))+(X*sind(phy));
disp(VR,'Voltage regulation (in %)=')
```

```
I_1_FL=P/(sqrt(3)*V_1L);
P_t=(30+25)*1000;//in watts
P_o=P*0.8;//in watts
Eff=P_o/(P_o+P_t);
disp(Eff*100,'Efficiency (in %)=')
```

Scilab code Exa 4.7 Determine the KVA Load and Percentage rated load and Total KVA Rating and Ratio of star bank to delta bank transformer rating and percentage increase in load

```
//Caption:Determine the (a)KVA Load (b)Percentage
   rated load (c)Total KVA Rating (d)Ratio of star-
   star bank to delta-delta bank transformer rating
   (e)% increase in load
//Exa:4.7
clc;
clear;
close;
KVA=25;
KVA_s=50/sqrt(3);
disp(KVA_s,'(a)KVA Load supplied by each transformer
    (in KVA)=');
r=KVA_s/KVA;
disp(r,'(b)Percent of rated load (in %)=');
KVA_t=2*25*0.866;
disp(KVA_t,'(c)Total KVA rating (in KVA)=');
ratio=KVA_t/75;
disp(ratio,'(d)Ratio=');
KVA_s2=50/3;
Inc=KVA_s/KVA_s2;
disp(Inc*100,'(e)Increase in load (in %)=')
```

Scilab code Exa 4.8 Determine the Current flowing in various sections and Power transformed and Power conducted directly

```
//Caption:Determine the (a)Current flowing in
   various sections (b)Power transformed (c)Power
   conducted directly
//Exa:4.8
clc;
clear;
close;
P=400*1000;//in watts
pf=0.8;
V_1=550;//in volts
V_2=440;//in volts
I_2=P/(sqrt(3)*V_2*pf);// in amperes
I_1=I_2*V_2/V_1;//in amperes
I=I_2-I_1;
disp(I,'(a)Currents in sections Oa,Ob and Oc (in
   amperes)=');
disp(I_1,' Currents in sections Aa,Bb and Cc (in
   amperes)=');
P_trans=P*(1-(V_2/V_1));
disp(P_trans/1000,'(b)Power transformed by
   transformer action (in Kw)=');
P_cond=P-P_trans;
disp(P_cond/1000,'(c)Power Conducted directly(in Kw)
   =')
```