Scilab Textbook Companion for Power Electronics by B. R. Gupta And V. Singhal[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

Power electronics devices

Scilab code Exa 1.1 Calculate the equivalent capacitance of depletion layer

```
//1.1
clc;
Ic=8*10^-3;
//let dv/dt =A
A=190*10^6;
C=Ic/A*10^12;
printf("Equivalent capacitance of depletion layer =
   %.1f uF", C)
```

Scilab code Exa 1.2 Calculate the voltage required to Turn ON the thyristor

```
//1.2
clc;
disp('When thyristor is not conducting there is no
   current through it')
disp('so Vo=20V')
VG=0.75;
```

```
IG=7*10^-3;
RG=2000;
Vs=VG+IG*RG;
printf("Voltage required to Turn On The thyristor = %.2f V", Vs)
R= 200;
VR=5*10^-3*R;
printf("/nVoltage drop across R = %.0f V", VR)
disp('Hence Vcc should be reduced to less than 1V')
Vconduct=0.7;
Vreq=VR+Vconduct;
printf("Voltage required = %.1f V", Vreq)
disp('Hence Vcc should be reduced to less than 1.7V')
```

Scilab code Exa 1.3 Find gate voltage gate current and resistance to be connected in series

```
//1.3
clc;
P_loss_avg=0.6;
P_loss_conduction=0.6*2*%pi/%pi;
Ig=0.314;
printf("Ig=%.3f A", Ig)
Vg=1+9*Ig;
printf("\nVg=%.3f V", Vg)
Rg=(24-9*Ig)/Ig;
printf("\nResistance to be connected in series=%.2f ohm", Rg)
```

Scilab code Exa 1.4 Calculate the minimum width of the gate pulse

```
//1.4
```

```
clc;
V=100;
L=10;
i=80*10^-3;
t=i*L/V*10^3;
printf("t= %.0f ms", t)
disp('So the width of the pulse should be more than
    8 ms')
```

Scilab code Exa 1.5 Calculate the minimum width of the gate pulse

```
//1.5
clc;
V=100;
R=10;
i=50*10^-3;
t=-0.5*log(1-((i*R/V)))*10^3
printf("t= %.1f ms", t)
disp('So the minimum width of the gate pulse is 2.5
    ms')
```

Scilab code Exa 1.6 Find if thyristor will turn ON and the value of resistance

```
//1.6
clc;
V=90;
R=25;
t=40*10^-6;
L=0.5;
i=(V/R)*(1-exp(-R*t/L))
iL=40*10^-3;
printf("The circuit current is= %.4f A", i)
```

```
disp('Since the circuit current is less than
   latching current of 40mA so thyristor will not
   turn ON')
R=V/(iL-i);
printf("R= %.0f Ohm", R)
disp('R should be less than 2743 ohm')
```

Scilab code Exa 1.7 Find if thyristor will turn OFF and maximum value of resistance

```
//1.7
clc;
V=100;
R=20;
t=50*10^-6;
L=0.5;
i=(V/R)*(1-exp(-R*t/L))
iH=50*10^-3;
printf("The circuit current is= %.5f A", i)
disp('Since the circuit current is less than holding
    current of 50mA so thyristor will turn OFF')
R=V/(iH-i);
printf("Maximum value of R= %.3f Ohm", R)
```

Scilab code Exa 1.8 Can a negative gate current turn off a thyristor

```
//1.8
clc;
disp('A negative gate current cannot turn off a
   thyristor. This is due to the reason that cathode
    region is much bigger in area than gate region')
```

Scilab code Exa 1.9 Find RMS current and form factor

```
//1.9
clc;
I=120;
gama=180;
th=360;
I_rms=I*(gama/th)^0.5;
printf("The RMS value of current= %.2f A",I_rms)
I_avg=I*(gama/th);
Form_factor=I_rms/I_avg;
printf("\nForm factor= %.3f A",Form_factor)
```

Scilab code Exa 1.10 Find the power supplied to load and average current

```
//1.10
clc;
disp('If the thyristor is fired at 60 degree')
Irms=(0.8405*((%pi-%pi*60/180)-sin(2*%pi)/2+sin(2*
    %pi*60/180)/2))^0.5;
R=100;
P=Irms^2*R;
printf("Power supplied to load=%.0f W",P)
disp('If the thyristor is fired at 45 degree')
Irms=(0.8405*((%pi-%pi*45/180)-sin(2*%pi)/2+sin(2*
    %pi*45/180)/2))^0.5;
R=100;
P=Irms^2*R;
printf("Power supplied to load=%.1f W",P)
disp('If the thyristor is fired at 60 degree')
Iavg=3.25/(2*%pi)*(-cos(%pi)+cos(%pi*60/180))
printf("Average Current=%.3f A",Iavg)
```

```
disp('If the thyristor is fired at 45 degree')
Iavg=3.25/(2*%pi)*(-cos(%pi)+cos(%pi*45/180))
printf("Average Current=%.3f A",Iavg)
```

Scilab code Exa 1.11 Calculate the average power loss

```
//1.11
clc;
//when conduction period is 2*pi
amplitude=200;
pd=1.8;
power_loss_average= amplitude*pd*2*%pi/(2*%pi);
printf("power loss average when conduction period is
    2*pi= %.0f W",power_loss_average)

//when conduction period is pi
amplitude=400;
pd=1.9;
power_loss_average= amplitude*pd*%pi/(2*%pi);
printf("\npower loss average when conduction period
   is pi= %.0f W",power_loss_average)
```

Scilab code Exa 1.12 Find the resistance to be connected in series and average power loss

```
//1.12
clc;
P_loss_peak=6;
Ig=0.763;
Vg=1+9*Ig;
Rg=(11-9*Ig)/Ig;
printf("\nResistance to be connected in series=%.3f
   ohm", Rg)
```

```
duty=0.3;
P_loss_average=P_loss_peak*duty;
printf("\nAverage power loss =%.1f W",
   P_loss_average)
```

Scilab code Exa 1.13 Find the value of power dissipation when the current flows for different periods of cycle

```
//1.13
clc;
disp('when current is constant 20A')
It=20;
Vt=0.9+0.02*It;
P_dissipation=Vt*It;
printf("Power dissipation=%.0f W",P_dissipation)
disp('when current is constant 20A for one half
   cycle in each full cycle')
P_dissipation=Vt*It/2;
printf("Power dissipation=%.0f W",P_dissipation)
disp('when current is constant 20A for one third
   cycle in each full cycle')
P_dissipation=Vt*It/3;
printf("Power dissipation=%.2f W",P_dissipation)
```

Scilab code Exa 1.14 Find different current ratings

```
//1.14
clc;
Isub=2000;
T=10*10^-3;
t=5*10^-3;
I=(Isub^2*t/T)^0.5;
printf("one cycle surge current rating=%.1f A", I)
```

```
//a=I^2t
a=I^2*T;
printf("\nI^2t=%.1f A^2Sec", a)
```

Scilab code Exa 1.15 Find source resistance gate current and voltage

```
//1.15
clc;
P=0.3;
Vs=12;
disp('Since load line has a slope of -100V/A, the
   source resistance for the gate is 100 ohm')
Rs=100;
// since Vs=Vg+Ig*Rs
// on solving Ig=35.5 mA
Ig=35.5*10^-3;
printf("\nGate current=%.4f A",Ig)
Vg=P/Ig;
printf("\nGate voltage=%.2f V",Vg)
```

Scilab code Exa 1.16 Find the thermal resistance and temperature

```
//1.16
clc;
l=0.2;
w=0.01;
d=0.01;
the_cond=220;
the_res=l/(the_cond*w*d);
printf("Thermal resistance = %.3f degree C/W",
   the_res)
T1=30;
P=3;
```

```
T2=P*the_res+T1;
printf("\nTemperature of the surface = %.2f degree C
    ", T2)
```

Scilab code Exa 1.17 Find the maximum loss

```
//1.17
clc;
l=2*10^-3;
A=12*10^-4;
the_cond=220;
the_res=l/(the_cond*A);
T=4; //T=T2-T1
P=T/the_res;
printf("Maximum loss which can be handled by module=
    %.2f W", P)
```

Scilab code Exa 1.18 Find the maximum loss

```
//1.18
clc;
T2=125;
T1=50;
T=T2-T1;
P=30;
Total_the_res=T/P;
the_res=Total_the_res-1-0.3;
printf("Thermal resistance of heat sink= %.1f degree
    C/W", the_res)
```

Scilab code Exa 1.19 Design a UJT relaxation oscillator

```
//1.19
clc;
T=1/50;
V=32;
Vp=0.63*V+0.5;
C=0.4*10^-6;
Ip=10*10^-6;
Rmax=(V-Vp)/Ip;
printf("Rmax=%.0f ohm", Rmax)
Vv=3.5;
Iv=10*10^-3;
Rmin=(V-Vv)/Iv;
printf("\nRmin=%.0f ohm", Rmin)
R=T/(C*log(1/(1-0.63)));
printf("\nR=%.0f ohm", R)
disp('since the value of R is between Rmin and Rmax
   so the value is suitable')
R4=50*10^-6/C;
printf("\nR4=%.0f ohm", R4)
R3=10^4/(0.63*V);
printf("\nR3=%.0f ohm", R3)
```

Scilab code Exa 1.20 Find the values of different components of circuit

```
//1.20
clc;
T=.5*10^-3;
V=10;
Vp=0.6*V+0.5;
Ip=5*10^-3;
Rmax=(V-Vp)/Ip;
printf("Rmax=%.0f ohm", Rmax)
C=1*10^-6;
```

```
R=T/(C*log(1/(1-0.6)));
printf("\nR=%.1f ohm", R)
disp('since the value of R is less than Rmax so the
    value is suitable')
```

Scilab code Exa 1.21 Find the time of conduction of thyristor

```
//1.21
clc;
R=0.8;
L=10*10^-6;
C=50*10^-6;
t0=10^6*%pi/((1/(L*C))-(R^2/(4*L^2)))^0.5;
printf("Time of conduction of thyristor= %.2f us",
    t0)
```

Scilab code Exa 1.22 Find the values of L and C

```
//1.22
clc;
Ip=16;
V=90;
// C/L=(Ip/V)^2;          (i)
// Assume that circuit is reverse biased for one-
    fourth period of resonant circuit. thus
//%pi/2*(L*C)^0.5=40*10^-6;          (ii)
// on solving (i) and (ii)
C=4.527*10^-6;
L=C/(Ip/V)^2*10^6;
C=4.527*10^-6*10^6;
printf("C=%.3f uF",C)
printf("\nL=%.2f uH",L)
```

Scilab code Exa 1.23 Find the value of C

```
//1.23
clc;
t_off=50*10^-6;
R1=10;
a=log(2);
C=t_off/(a*R1)*10^6;
printf("The value of C= %.2f uF",C)
```

Scilab code Exa 1.24 Calculate the value of C and L

```
//1.24
clc;
Vc=100;
IL=40;
t_off=40*10^-6*1.5;
C=IL*t_off/Vc;
printf("The value of capacitor= %.6f F",C)
//L>(VC^2*C/IL^2);
//IC_peak=Vc*(C/L)^0.5;
//IC_peak should be less than maximum load current
   so if L=2*10^-4
L=2*10^-4;
IC_peak=Vc*(C/L)^0.5;
printf("\nPeak capacitor current= %.2f A",IC_peak)
disp('Since the peak capacitor current less than
   maximum load current 40 A so  L=2*10^-4 and C=24
   uF')
```

Scilab code Exa 1.25 Find the commutation time and the current rating of the thyristor

```
//1.25
clc;
L=0.1*10^-3;
Vc=100;
C=10*10^-6;
IL=10;
t_off=Vc*C/IL*10^6;
printf("Commutation time= %.0f us",t_off)
disp('The commutation time  of the thyristor is more
    than the turn off time of the main thyristor i.e
   . 25us and is thus  sufficient to commutate the
   main thyristor')
IC_peak= Vc*(C/L)^0.5;
printf("Peak capacitor current= %.2f A",IC_peak)
disp('The maximum current rating of the thyristor
   should be more than 31.62A')
```

Scilab code Exa 1.26 Find the value of R and C

```
//1.26
clc;
Vm=230*2^0.5;
L=0.2*10^-3;
//a=dv/dt
a=25*10^6;
sig=0.65;
C=(1/(2*L))*(0.564*Vm/a)^2*10^9;
R=2*sig*(L/(C*10^-9))^0.5;
printf("The value of capacitor= %.2f nF",C)
printf("\nThe value of Resistor= %.1f Ohm",R)
```

Scilab code Exa 1.27 Find the value of R C and snubber power loss and power rating of resistance

```
//1.27
clc;
f=2000;
V=300;
RL=10;
//a=dv/dt
a=100*10^6;
R=300/100;
C=(0.632*V*RL)/(a*(R+RL)^2)*10^6;
printf("The value of capacitor= %.3f uF",C)
Power_Loss_snubber=0.5*C*10^-6*V^2*f;
printf("\nSnubber Power Loss= %.2f W",Power_Loss_snubber)
disp('All the energy stored in the capacitance C is dissipated in resistance R. Hence power Rating of R is 10.1W')
```

Scilab code Exa 1.28 Find the maximum permissible values

```
//1.28
clc;
C=6*10^-6;
R=4;
V=300;
L=6*10^-6;
b_max=V/L*10^-6; // b=di/dt
printf("The maximum permissible value of di/dt = %.0f MA/s",b_max)
Isc=V/R;
```

```
//a=dv/dt
a=((R*b_max*10^6)+(Isc/C))*10^-6;
printf("\nThe maximum permissible value of dv/dt = %.1f MV/s",a)
```

Scilab code Exa 1.29 Find number of thyristor in series and parallel

```
//1.29
clc;
Im=750;
De=0.25;
It=175;
np=(Im/It)/(1-De);
printf("np = %.2f ",np)
disp('so the no. of thyristors in parallel are 6')
Vs=3000;
De=0.25;
Vd=800;
ns=(Vs/Vd)/(1-De);
printf("ns = %.2f ",ns)
disp('so the no. of thyristors in series are 5')
```

Scilab code Exa 1.30 Find the value of R and C for static and dynamic equalizing circuits

```
//1.30
clc;
ns=5;
Vd=800;
Vs=3000;
Ib=8*10^-3;
dQ=30*10^-6;
R=(ns*Vd-Vs)/((ns-1)*Ib)
```

```
C=((ns-1)*dQ)/(ns*Vd-Vs)*10^6;
printf("The value of resistance = %.2f ohm ",R)
printf("\nThe value of capacitance = %.2f uF ",C)
```

Scilab code Exa 1.31 Find the value of resistance to be connected in series

```
//1.31
clc;
R=(1.5-1.2)/100;
printf(" The value of resistance to be connected in
    series= %.3f ohm",R)
```

Scilab code Exa 1.32 Find the steady and transient state rating and derating of thyristor

```
//1.32
clc;
ns=12;
Vd=800;
V=16000;
Ib=10*10^-3;
dQ=150*10^-6;
C=0.5*10^-6;
R=56*10^3;
Vd=(V+(ns-1)*R*Ib)/ns;
printf("maximum steady state voltage rating of each
    thyristor = %.2f V",Vd)
De=1-(V/(ns*Vd));
printf("\nSteady state voltage derating = %.3f ",De)
Vd=(V+(ns-1)*(dQ/C))/ns;
printf("\nmaximum transient state voltage rating of
    each thyristor = %.2f V",Vd)
De=1-(V/(ns*Vd));
```

```
printf("\ntransient state voltage derating = %.3f ",
    De)
```

Scilab code Exa 1.33 Find number of thyristor in series and parallel

```
//1.33
clc;
Im=1000;
De=0.14;
It=75;
np=(Im/It)/(1-De);
printf("np = %.2f ",np)
disp('so the no. of thyristors in parallel are 16')
Vs=7500;
De=0.14;
Vd=500;
ns=(Vs/Vd)/(1-De);
printf("ns = %.2f ",ns)
disp('so the no. of thyristors in series are 18')
```

Scilab code Exa 1.34 Find Stored charge and peak reverse current

```
//1.34
clc;
trr=2.5*10^-6;
//b=di/dt
b=35*10^6;
Qrr=0.5*trr^2*b*10^6;
printf(" Stored charge= %.3f uC",Qrr)
Irr=(2*Qrr*10^-6*b)^0.5;
printf(" Peak reverse current= %.1f A",Irr)
```

Chapter 2

Controlled Rectifiers

Scilab code Exa 2.3 Calculate the different parameters of half wave diode rectifier

```
//2.3
clc;
Vp_sec=230*2^0.5/4;
alph=asind(12/Vp_sec);
alph1=180-alph;
//the diode will conduct from 8.89 degree to 171.51
   degree
Angle_conduction=alph1-alph;
printf("Conduction Angle = %.2f degree",
   Angle_conduction)
Idc=4;
R=1/(2*Idc*%pi)*(2*Vp_sec*cosd(alph)+(2*12*alph*%pi
   /180)-12*%pi);
printf("\nResistance = %.2f ohm", R)
Irms=((1/(2*%pi*R^2))*(((Vp_sec^2/2+12^2)*(%pi-2*
   alph*%pi/180))+(Vp_sec^2/2*sind(2*alph))-(4*
   Vp_sec*12*cosd(alph))))^0.5;
P_rating=Irms^2*R;
printf("\nPower rating of resistor = %.2f W",
   P_rating)
```

```
Pdc=12*Idc;
t_charging=150/Pdc;
printf("\nCharging time = %.3f h", t_charging)
Rectifier_efficiency= Pdc/(Pdc+Irms^2*R);
printf("\nRectifier efficiency = %.2f ", Rectifier_efficiency)
PIV=Vp_sec+12;
printf("\nPIV = %.3f V",PIV)
```

Scilab code Exa 2.4 Calculate the different parameters of full wave centre tapped diode rectifier

```
//2.4
clc;
Vm=100;
R=5;
Idc=2*Vm/(%pi*R);
printf("\nIdc = %.3f A",Idc)
Vdc=Idc*R;
printf("\nVdc = %.3f V",Vdc)
Irms=0.707*Vm/R;
printf("\nIrms = %.3f A",Irms)
Vrms=Irms*R;
printf("\nVrms = %.3f V",Vrms)
Pdc=Idc^2*R;
printf("\nPdc = %.3f W",Pdc)
Pac=Irms^2*R;
printf("\nPac = %.3f W",Pac)
FF=Vrms/Vdc;
printf("\nFF = %.3f ",FF)
RF=(FF^2-1)^0.5;
printf("\nRF = %.3f ",RF)
TUF=0.5732;
printf("\nTUF = %.3f ",TUF)
PIV=2*Vm;
```

```
printf("\nPIV = %.0f V",PIV)
CF=0.707;
printf("\nCF = %.3f ",CF)
```

Scilab code Exa 2.5 Find the RMS and average voltage and current

```
//2.5
clc;
Vm=400;
alpha=30;
R=50;
Vdc=(Vm/(2*%pi))*(1+cosd(alpha));
printf("Average Load voltage = %.1f V", Vdc)
Load_current_average=Vdc/R;
printf("\nAverage Load current = %.3f A",
    Load_current_average)
V=400*(((%pi-(%pi/6))/(4*%pi))+(sind(60)/(8*%pi)))
    ^0.5;
printf("\nRMS voltage = %.1f V", V)
RMS_current=V/R;
printf("\nRMS current = %.3f A", RMS_current)
```

Scilab code Exa 2.6 Find the average current

```
//2.6
clc;
current_average=(1/(2*%pi))*(-10*cos(5*%pi/6)+10*cos
    (%pi/6)-(5*5*%pi/6)+(5*%pi/6));
printf("\nAverage  current = %.3f A",
    current_average)
```

Scilab code Exa 2.7 Find the average current

```
//2.7
clc;
// the thyristor will conduct when instantenous
   value of source emf is more than the back emf i.e
   . 2^0.5*100 sin wt=55.5
wt1=asind(55.5/(2^0.5*110));
wt2=180-wt1;
current_average=(1/(2*%pi))*(-15.554*(cosd(wt2)-cosd
   (wt1))-5.55*(2.7768-0.3684));
printf("\nAverage  current = %.2f A",
   current_average)
```

Scilab code Exa 2.8 Calculate the various parameters of a single phase half wave rectifier

```
//2.8
clc;
Vm=230*2^0.5;
Vdc=(Vm/(2*%pi))*(1+cosd(90));
Idc=Vdc/15;
Vrms=Vm*((((%pi-(%pi/2))/(4*%pi))+(sin(2*%pi)/(8*%pi)
   ))^0.5;
Irms=Vrms/15;
Pdc=Vdc*Idc;
Pac=Vrms*Irms;
Rec_effi=Pdc/Pac;
Form_factor=Vrms/Vdc;
printf("\n Form Factor = %.1f ", Form_factor)
ripple_factor=(Form_factor^2-1)^0.5;
printf("\n Ripple Factor = %.1f ", ripple_factor)
VA_rating=230*7.66;
printf("\n VA rating = %.1f VA", VA_rating)
TUF=Pdc/VA_rating;
```

```
printf("\n TUF = %.3f ", Form_factor)
PIV=Vm;
printf("\n PIV = %.1f V", PIV)
```

Scilab code Exa 2.9 Find the RMS and average voltage and current of a single phase full wave rectifier

```
//2.9
clc;
Vm=150*2^0.5;
Vdc=(Vm/(%pi))*(1+cosd(45));
R=30;
Load_current_average=Vdc/R;
printf("\nAverage Load current = %.2f A", Load_current_average)
Vrms=Vm*(((%pi-(%pi/4))/(2*%pi))+(sind(90)/(4*%pi)))^0.5;
printf("\nRMS voltage = %.1f V", Vrms)
RMS_current=Vrms/R;
printf("\nRMS current = %.3f A", RMS_current)
```

Scilab code Exa 2.10 Calculate the different parameters of full wave converter with centre tapped transformer

```
//2.10
clc;
Vdc=100;
Vm=(Vdc+1.7)*%pi/(2*cosd(30));
Vrms_sec=Vm/2^0.5;
Vrms_pri=230;
Turn_ratio=Vrms_pri/Vrms_sec;
printf("\nTurn Ratio = %.2f ", Turn_ratio)
Ip=15;
```

```
Irms_sec=(Ip^2/2)^0.5;
Trans_rating=2*Vrms_sec*Irms_sec;
printf("\nTransformer rating = %.2f VA",
   Trans_rating)
PIV=2*Vm;
printf("\nPIV = %.2f V", PIV)
printf("\nRMS value of thyristor current = %.2f A",
   Irms_sec)
```

Scilab code Exa 2.11 Calculate the voltage rating of full wave central tap and bridge rectifiers

```
//2.11
clc;
Idc=50;
Vdc=10*1000/Idc;
Vm=200*%pi/2;
PIV_central_tap=2*Vm;
V_rating_central_tap =2*PIV_central_tap;
printf("The rated voltage of full wave central tap
   transformer rectifier = %.2f V",
   V_rating_central_tap )
PIV_bridge=Vm;
V_rating_bridge=2*PIV_bridge;
printf("\nThe rated voltage of full wave bridge
   rectifier = %.2f V", V_rating_bridge )
```

Scilab code Exa 2.12 Find the output voltage firing angle and load current

```
//2.12
clc;
Vm=230*2^0.5;
```

```
Vrms=(800/1000*230^2)^0.5;
printf("Output Voltage = %.2f V", Vrms)
//Vrms=Vm*((%pi-alph)/(2*%pi)+sind(2*alph)/(4*%pi))
    ^0.5 on solving
alph=61;
printf("\nFiring angle = %.0f degree", alph)
I=800/Vrms;
printf("\nLoad current = %.2f A", I)
```

Scilab code Exa 2.13 Find the average power output of full wave mid point and bridge converter

```
//2.13
clc;
disp('For Mid point converter')
Vm=800/(2*2.5);
alph=0;
Vo=Vm/(%pi)*(1+cosd(alph));
Idc=30/2.5;
Pdc=Idc*Vo;
printf("Average output power = %.2f W", Pdc)
disp('For bridge converter')
Vm=800/(2.5);
alph=0;
Vo=Vm/(%pi)*(1+cosd(alph));
Idc=30/2.5;
Pdc=Idc*Vo;
printf("Average output power = %.2f W", Pdc)
```

Scilab code Exa 2.14 Find dc output voltage and power

```
//2.14
clc;
```

```
Vm=230*2^0.5;
alph=30;
Vo=Vm/(2*%pi)*(3+cosd(alph));
Idc=Vo/10;
printf("dc output voltage = %.1f V", Vo )
Pdc=Idc*Vo;
printf("\ndc power = %.2f W", Pdc )
```

Scilab code Exa 2.15 Find dc output voltage and power

```
//2.15
clc;
Vm=230*2^0.5;
Vo=2*Vm/%pi;
Idc=Vo/10;
printf("dc output voltage = %.2f V", Vo )
Pdc=Idc*Vo;
printf("\ndc power = %.2f W", Pdc )
```

Scilab code Exa 2.16 Calculate the firing angle and power factor

```
//
clc;
disp('If E=100 V')
Vm=230*2^0.5;
E=100;
R=0.5;
Io=15;
alph=acosd((E+15*0.5)*%pi/(2*Vm));
printf("Firing Angle = %.2f degree", alph)
pf=(100*15+15^2*0.5)/(230*15);
printf("\nPower factor = %.3f lagging", pf)
disp('If E=-100 V')
```

```
E=-100;
alph=acosd((E+15*0.5)*%pi/(2*Vm));
printf("\nFiring Angle when E is -100 = %.2f W",
   alph)
pf=(100*15-15^2*0.5)/(230*15);
printf("\nPower factor = %.3f lagging", pf)
```

Scilab code Exa 2.17 Find the average value of load current

```
//2.17
clc;
Vm=230*2^0.5;
alph=40;
Io=((2*Vm/%pi*cosd(alph))-50)/5;
printf("Average value of load current = %.2f A", Io)
```

Scilab code Exa 2.18 Calculate the different parameters of full wave converter with bridge transformer

```
//2.18
clc;
Vdc=100;
Vm=(Vdc+2*1.7)*%pi/(2*cosd(30));
Vrms_sec=Vm/2^0.5;
Vrms_pri=230;
Turn_ratio=Vrms_pri/Vrms_sec;
printf("\nTurn Ratio = %.2f ", Turn_ratio)
Irms_sec=15/2^0.5;
Ip=15;
Trans_rating=Vrms_sec*Ip;
printf("\nTransformer rating = %.2f VA",
   Trans_rating)
PIV=Vm;
```

```
printf("\nPIV = %.2f V", PIV)
printf("\nRMS value of thyristor current = %.2f A",
    Irms_sec)
```

Scilab code Exa 2.19 Find the value of dc voltage rms voltage and form factor of a single phase semi converter

```
//2.19
clc;
Vm=230*2^0.5;
Vdc=Vm/%pi*(1+cosd(90));
printf("dc value of voltage = %.2f V", Vdc)
Vrms=230*((1/%pi)*(%pi-(%pi/2)+sin(%pi)/2))^0.5;
printf("\n RMS value of voltage= %.2f V", Vrms)
form_factor=Vrms/Vdc;
printf("\nForm factor = %.2f ", form_factor)
```

Scilab code Exa 2.20 Calculate the different parameters of single phase semi converter bridge

```
//2.20
clc;
Vm=230*2^0.5;
Vdc=Vm/%pi*(1+cosd(90));
printf("dc value of voltage = %.2f V", Vdc)
Vrms=230*((1/%pi)*(%pi-(%pi/2)+sin(%pi)/2))^0.5;
printf("\n RMS value of voltage= %.2f V", Vrms)
Is=(1-(%pi/2)/%pi)^0.5;
Is1=2/%pi*2^0.5*cos(%pi/4);
HF=((Is/Is1)^2-1)^0.5;
printf("\n Harmonic factor= %.3f ", HF)
Displacement_factor=cos(-%pi/4);
```

```
printf("\n Displacement factor= %.4f ",
    Displacement_factor)
Power_factor=Is1/Is*cos(-%pi/4);
printf("\n Power factor= %.4f lagging", Power_factor
    )
```

Scilab code Exa 2.21 Calculate the different parameters of single phase full converter

```
//2.21
clc;
Vm=230*2^0.5;
Vdc=2*Vm/%pi*cosd(60);
printf("dc value of voltage = %.2f V", Vdc)
Vrms=230;
printf("\n RMS value of voltage= %.2f V", Vrms)
Is1=2*2^0.5/%pi;
Is=1;
HF=((Is/Is1)^2-1)^0.5;
printf("\n Harmonic factor= %.3f ", HF)
Displacement_factor=cos(-%pi/3);
printf("\n Displacement factor= %.1f ",
    Displacement_factor)
Power_factor=Is1/Is*cos(-%pi/3);
printf("\n Power factor= %.2f lagging", Power_factor
    )
```

Scilab code Exa 2.22 Calculate the different parameters of single phase full controlled bridge converter

```
//2.22
clc;
Vm=230*2^0.5;
```

```
Vdc=2*Vm/%pi*cosd(30);
R=Vdc/4;
printf("dc value of voltage = %.1f V", Vdc)
IL=4;
I=2*2^0.5/%pi*IL;
P_input_active=230*I*cosd(30);
printf("\n Active input power= %.2f W",
   P_input_active)
P_input_reactive=230*I*sind(30);
printf("\n reactive input power= %.2f Vars",
   P_input_reactive)
P_input_appearent=230*I;
printf("\n Active input power= %.2f VA",
   P_input_appearent)

disp('When freewheeling diode is present')
Vm=230*2^0.5;
Vdc=Vm/%pi*(1+cosd(30));
printf("dc value of voltage = %.1f V", Vdc)
IL=Vdc/R;
I=2*2^0.5/%pi*IL*cosd(15);
P_input_active=230*I*cosd(15);
printf("\n Active input power= %.2f W",
   P_input_active)
P_input_reactive=230*I*sind(15);
printf("\n reactive input power= %.2f Vars",
   P_input_reactive)
P_input_appearent=230*I;
printf("\n Active input power= %.2f VA",
   P_input_appearent)
disp('When Th3 get open circuit')
Vdc=230/(2^0.5*%pi)*(1+cosd(30));
printf("dc value of voltage = %.3f V", Vdc)
Idc=Vdc/R;
printf("\nAverage dc output current = %.2f A", Idc)
```

Scilab code Exa 2.23 Calculate the different parameters of single phase full controlled bridge converter

```
//2.23
clc;
Vm=230*2^0.5;
Vdc=2*Vm/%pi*cosd(30);
printf("dc value of voltage = %.1f V", Vdc)
Irms=10;
I=10;
printf("\n RMS value of current= %.0f A", Irms)
Is1=2*2^0.5/%pi*I;
printf("\n Fundamental component of input current= %
    .0f A", Is1)
Is=10;
HF=((Is/Is1)^2-1)^0.5;
printf("\n Harmonic factor= %.3f ", HF)
Displacement_factor=cosd(-30);
printf("\n Displacement factor= %.3f ",
    Displacement_factor)
Power_factor=Is1/Is*cos(-%pi/6);
printf("\n Power factor= %.3f lagging", Power_factor
    )
Out_rms=230;
Form_factor=Out_rms/Vdc;
Ripple_factor=(Form_factor^2-1)^0.5;
printf("\n Ripple factor= %.3f ", Ripple_factor)
```

Scilab code Exa 2.24 Calculate peak circulating current and peak current of converter

```
//2.24
```

```
clc;
Vm=230*2^0.5;
alph1=60;
alph2=120;
w=100*%pi;
L=50*10^-3;
wt=2*%pi;
R=15;
Ip_circulating=2*Vm/(w*L)*(cos(wt)-cosd(alph1));
printf("\n Peak circulating current= %.1f A",
    Ip_circulating)
Ip_load=Vm/R;
Ip_converter1=Ip_circulating+Ip_load;
printf("\n Peak current of converter 1= %.2f A",
    Ip_converter1)
```

Scilab code Exa 2.25 Calculate inductance of current limiting reactor and peak current of converter

```
//2.25
clc;
Vm=230*2^0.5;
alph1=30;
alph2=150;
w=100*%pi;
wt=2*%pi;
R=10;
Ip_circulating=10.2;
L=2*Vm/(w*Ip_circulating)*(cos(wt)-cosd(alph1));
printf("\n Inductance of current limiting Reactor= %
    .4f H",L)
Ip_load=Vm/R;
Ip_converter1=Ip_circulating+Ip_load;
printf("\n Peak current of converter 1= %.2f A",
    Ip_converter1)
```

Scilab code Exa 2.26 Calculate inductance of current limiting reactor and resistance

```
//2.26
clc;
Vm=230*2^0.5;
alph1=45;
alph2=135;
w=100*%pi;
wt=2*%pi;
R=10;
Ip_circulating=11.5;
L=2*Vm/(w*Ip_circulating)*(cos(wt)-cosd(alph1));
printf("\n Inductance of current limiting Reactor= %
    .4f H",L)
Ip_converter1=39.7;
Ip_load= Ip_converter1-Ip_circulating ;
R=Vm/Ip_load;
printf("\n Load resistance= %.3f ohm", R)
```

Scilab code Exa 2.27 Find the parameters of three phase bridge rectifier circuit

```
//2.27
clc;
Vm=400*2^0.5/3^0.5;
Vdc=360;
alph=acosd(Vdc*%pi/(3*3^0.5*Vm));
printf("Firing Angle = %.1f degree", alph)
VL=400;
IL=200;
```

```
S=3^0.5*VL*IL;
printf("\nApparent Power = %.0f VA",S)
P=S*cosd(alph);
printf("\nActive Power = %.1f W",P)
Q=(S^2-P^2)^0.5;
printf("\nReactive Power = %.1f VA",Q)
disp('When AC line voltage is 440V')
V=440;
alph=acosd(Vdc*%pi/(3*2^0.5*V));
printf("Firing Angle = %.1f degree", alph)
disp('When AC line voltage is 360V')
V=360;
alph=acosd(Vdc*%pi/(3*2^0.5*V));
printf("Firing Angle = %.1f degree", alph)
```

Scilab code Exa 2.28 Find the parameters of three phase full converter

```
//2,28
clc;
Vm=2^0.5*400/3^0.5;
Vdc=3*3^0.5*Vm/%pi*cos(%pi/3);
Idc=150;
Pdc=Vdc*Idc;
printf("Output Power = %.1f W", Pdc)
Iavg_thy=Idc/3;
printf("\nAverage thyristor current = %.0f A",
   Iavg_thy)
Irms_thy=Idc*(2/6)^0.5;
printf("\nRMS value of thyristor current = %.1f A",
   Irms_thy)
Ip_thy=Idc;
printf("\nPeak current through thyristor  = %.0f A",
    Ip_thy)
PIV=2^0.5*400;
printf("\nPeak inverse voltage = %.1f V", PIV)
```

Scilab code Exa 2.29 Find the firing angle of a 3 phase fully controlled bridge converter

```
//2.29
clc;
Vm=400*2^0.5/3^0.5;
Vrms=(400*100)^0.5;
alph=acosd(((Vrms/(Vm*3^0.5))^2-0.5)/(3*3^0.5/(4*%pi)))/2;
printf("Firing angle = %.2f degree", alph)
```

Scilab code Exa 2.30 Find the parameters of six pulse thyristor converter

```
//2.30
clc;
Vm=415*2^0.5/3^0.5;
Vdc=460;
Idc=200;
alph=acosd(Vdc*%pi/(3*3^0.5*Vm));
printf("Firing Angle = %.2f degree", alph)
Pdc=Vdc*Idc;
printf("\ndc Power = %.2f W", Pdc)
Iac=Idc*(120/180)^0.5;
printf("\nAC line current = %.2f A", Iac)
Ip=Idc;
Irms_thy=Ip*(120/360)^0.5;
printf(" \nRMS thyristor current = %.1f A", Irms_thy)
```

Scilab code Exa 2.31 Find the parameters of three phase semi converter bridge circuit

```
//2.31
clc;
Vm=400*2^0.5/3^0.5;
alph=0;
Vdc_max=3*3^0.5*Vm/(2*%pi)*(1+cosd(alph));
Vdc=0.5*Vdc_max;
alph=acosd((Vdc/(3*3^0.5*Vm/(2*%pi)))-1)
printf("Firing Angle = %.2f degree", alph)
R=10;
Idc=Vdc/R;
disp('For discontinious load')
Vrms=(3^0.5*Vm)*((3/(4*%pi))*(%pi-(%pi/2)+0.5*sin(%pi)))^0.5;
printf("\nRMS value of voltage = %.2f V", Vrms)
Irms=Vrms/R;
printf("\nRMS value of current = %.2f A", Irms)
I_avg=Idc/3;
printf("\nAverage value of thyristor current = %.2f A", I_avg)
I_rms=Irms/3^0.5;
printf("\nRMS value of thyristor current = %.2f A", I_rms)
efficiency=Vdc*Idc/(Vrms*Irms);
printf("\nRectification efficiency = %.3f A", efficiency)
Irms_line_current=Irms*(120/180)^0.5;
VA_input=3*400/3^0.5*Irms_line_current;
TUF=Vdc*Idc/VA_input;
printf("\nTransformer utilization factor = %.2f ", TUF)
output_power_active=Irms^2*R;
input_power_active=output_power_active;
pf_input=input_power_active/VA_input;
printf("\ninput power factor = %.2f lagging", pf_input)
```

Scilab code Exa 2.32 Find the parameters of three phase fully controlled bridge converter

```
//2.31
clc;
Vm=400*2^0.5/3^0.5;
alph=0;
Vdc_max=3*3^0.5*Vm/(%pi)*cosd(alph);
Vdc=0.5*Vdc_max;
alph=acosd(0.5);
printf("Firing Angle = %.2f degree", alph)
R=10;
Idc=Vdc/R;
disp('For discontinious load')
Vrms=(3^0.5*Vm)*(3*3^0.5/(4*%pi)*cosd(2*alph)+0.5)^0.5;
printf("\nRMS value of voltage = %.2f V", Vrms)
Irms=Vrms/R;
printf("\nRMS value of current = %.2f A", Irms)
I_avg=Idc/3;
printf("\nAverage value of thyristor current = %.2f A", I_avg)
I_rms=Irms/3^0.5;
printf("\nRMS value of thyristor current = %.2f A", I_rms)
efficiency=Vdc*Idc/(Vrms*Irms);
printf("\nRectification efficiency = %.3f A", efficiency)
Irms_line_current=Irms*(120/180)^0.5;
VA_input=3*400/3^0.5*Irms_line_current;
TUF=Vdc*Idc/VA_input;
printf("\nTransformer utilization factor = %.2f ", TUF)
output_power_active=Irms^2*R;
```

```
input_power_active=output_power_active;
pf_input=input_power_active/VA_input;
printf("\ninput power factor = %.2f lagging",
   pf_input)
```

Scilab code Exa 2.33 Calculate the overlap angles

```
//2.33
clc;
Vm=326.56;
f=50;
Ls=0.2*10^-3;
Io=200;
w=2*%pi*f;
a=3*w*Ls*Io/%pi;
b=3*3^0.5*Vm/%pi;
disp('For firing angle 20 degree')
alph=20;
Angle_overlap= acosd((b*cosd(alph)-a)/b)-alph;
printf("Overlap angle= %.1f degree", Angle_overlap)
disp('For firing angle 30 degree')
alph=30;
Angle_overlap= acosd((b*cosd(alph)-a)/b)-alph;
printf("Overlap angle= %.2f degree", Angle_overlap)
disp('For firing angle 60 degree')
alph=60;
Angle_overlap= acosd((b*cosd(alph)-a)/b)-alph;
printf("Overlap angle= %.4f degree", Angle_overlap)
```

Scilab code Exa 2.34 Find the value of circulating currents for 3 phase dual converter

```
//2.34
```

```
clc;
Vm=400*2^0.5/3^0.5;
f=50;
w=2*%pi*f;
L=60*10^-3;
alph=0;
disp('Circulating current at wt=0')
wt=0;
ir=3*Vm/(w*L)*(sind(wt-30)-sind(alph))
printf("Circulating current at wt 0 is= %.3f A", ir)
disp('Circulating current at wt=30')
wt=30;
ir=3*Vm/(w*L)*(sind(wt-30)-sind(alph))
printf("Circulating current at wt 30 is= %.3f A", ir
    )
disp('Circulating current at wt=90')
wt=90;
ir=3*Vm/(w*L)*(sind(wt-30)-sind(alph))
printf("Circulating current at wt 90 is= %.3f A", ir
    )
disp('Maximum Circulating current will occur at wt
    =120')
wt=120;
ir=3*Vm/(w*L)*(sind(wt-30)-sind(alph))
printf("Maximum Circulating current is= %.3f A", ir)
```

Scilab code Exa 2.35 Find the value of inductance

```
//2.35
clc;
Vm=400*2^0.5/3^0.5;
f=50;
w=2*%pi*f;
ir=42;
L=3*Vm/(w*ir)*(sind(120-30)-sind(0))
```

```
printf("Inductance= %.3f H", L)
```

Chapter 3

Inverters

Scilab code Exa 3.1 Find the maximum output frequency

```
//3.1
clc;
R=80;
L=8*10^-3;
C=1.2*10^-6;
a=R^2;
b=4*L/C;
printf("R^2 = %.0f ", a)
printf("4*L/C = %.0f ", b)
disp('since R^2<4L/C it will work as series inverter
    ')
fmax=(1/(L*C)-(R^2/(4*L^2)))^0.5;
printf("Maximum frequency = %.2f rad/sec", fmax)
```

Scilab code Exa 3.2 Find the frequency of output

```
//3.2
clc;
```

```
f=1416.16;
T=1/f;
Toff=14*10^-6;
fo=1/(T+2*Toff);
printf("output frequency = %.1f Hz", fo)
```

Scilab code Exa 3.3 Find the available circuit turn off time and maximum possible frequency

```
//3.3
clc;
R=4;
L=50*10^-6;
C=6*10^-6;
a=R^2;
b=4*L/C;
wr=(1/(L*C)-(R^2/(4*L^2)))^0.5;
fr=wr/(2*%pi);
Tr=1/fr;
fo=6000;
wo=2*%pi*fo;
toff=%pi*(1/wo-1/wr);
printf("Avialable circuit turn off time = %.8f sec",
    toff)
fmax=1/(2*(%pi/wr+6*10^-6));
printf("\nMaximum frequency = %.1f Hz", fmax)
```

Scilab code Exa 3.4 Design a parallel inverter

```
//3.4
clc;
tq=50*10^-6;
Vin=40;
```

```
Vo=230;
IL=2;
IL_ref=2*Vo/Vin;
// C/L=(IL-ref/Vin)^2;                (i)
// Assume that circuit is reverse biased for one-fourth period of resonant circuit. thus
//%pi/3*(L*C)^0.5=50*10^-6;               (ii)
// on solving (i) and (ii)
C=13.73*10^-6;
L=C/(IL_ref/Vin)^2*10^6;
C=13.73*10^-6*10^6;
printf("C=%.3f uF",C)
printf("\nL=%.2f uH",L)
```

Scilab code Exa 3.5 Calculate the various parameters of single phase half bridge inverter

```
//3.5
clc;
V=30;
Vrms1=2*V/(2^0.5*%pi);
printf("RMS value of fundamental component of input voltage = %.1f V", Vrms1)
VL=V/2;
R=3;
Pout=VL^2/R;
printf("\nOutput Power = %.0f W", Pout)
Ip_thy=VL/R;
printf("\nPeak current in each thyristor = %.0f A", Ip_thy)
Iavg=Ip_thy/2;
printf("\naverage current in each thyristor = %.1f A", Iavg)
PIV=2*VL;
printf("\nPeak reverse blocking voltahe = %.0f V",
```

```
PIV)
```

Scilab code Exa 3.6 Calculate the various parameters of single phase full bridge inverter

```
//3.6
clc;
V=30;
Vrms1=4*V/(2^0.5*%pi);
printf("RMS value of fundamental component of input voltage = %.1f V", Vrms1)
VL=V;
R=3;
Pout=VL^2/R;
printf("\nOutput Power = %.0f W", Pout)
Ip_thy=VL/R;
printf("\nPeak current in each thyristor = %.0f A", Ip_thy)
Iavg=Ip_thy/2;
printf("\naverage current in each thyristor = %.1f A", Iavg)
PIV=VL;
printf("\nPeak reverse blocking voltahe = %.0f V", PIV)
```

Scilab code Exa 3.7 Calculate the various parameters of full bridge inverter

```
//3.7
clc;
R=10;
V=200;
IL_rms_funda=9.28/2^0.5;
```

```
printf("RMS value of fundamental component of load
    current=%.2f A", IL_rms_funda)
IL_peak=(9.28^2+6.55^2+1.89^2+0.895^2+0.525^2);
printf("\nPeak value of load current=%.2f A",
    IL_peak)
Irms_harmonic=(11.56^2-9.28^2)^0.5/2^0.5;
printf("\nRMS harmonic current=%.3f A",Irms_harmonic
    )
TMH=(11.56^2-9.28^2)^0.5/9.28;
printf("\nTotal harmonic distortion=%.3f",TMH)
IL_rms=11.56/2^0.5;
Po=IL_rms^2*R;
printf("\nTotal output power=%.1f W",Po)
Po_funda=IL_rms_funda^2*R;
printf("\nFundamental Component of power=%.3f W",
    Po_funda)
Iavg=Po/V;
printf("\nAverage input current=%.4f A",Iavg)
Ip_thy=11.56;
printf("\nPeak thyristor current=%.2f A", Ip_thy)
```

Scilab code Exa 3.8 Calculate the value of C for proper load commutation

```
//3.8
clc;
toff=12*1.5*10^-6;
f=4000;
wt=2*%pi*f*toff;
Xl=10;
R=2;
Xc=R*tan(wt)+Xl;
C=1/(2*%pi*f*Xc)*10^6;
printf("Value of C for proper load commutation = %.2
    f uF", C)
```

Scilab code Exa 3.9 Calculate peak value of load current

```
//3.9
clc;
I1=6.84;
I3=0.881;
I5=0.32;
I7=0.165;
Ip=(I1^2+I3^2+I5^2+I7^2)^0.5;
printf("Peak value of load current=%.2f A", Ip)
```

Scilab code Exa 3.10 Find the different parameters of 3 phase bridge inverter for 120degree conduction mode

```
//3.10
clc;
Ip_load=400/(2*10);
Irms_load=(Ip_load^2*2/3)^0.5;
printf("RMS value of the load current = %.2f A",
   Irms_load)
Po=Irms_load^2*10*3;
printf("\nOutput power = %.2f W", Po)
Iavg_thy=Ip_load/3;
printf("\nAverage thyristor current = %.2f A",
   Iavg_thy)
Irms_thy=(Ip_load^2/3)^0.5;
printf("\nRMS value thyristor current = %.2f A",
   Irms_thy)
```

Scilab code Exa 3.11 Find the different parameters of 3 phase bridge inverter for 180degree conduction mode

```
//3.11
clc;
R=10;
RL=R+R/2;
i1=400/15;
i2=i1;
i3=i1;
Irms_load=(1/(2*%pi)*(i1^2*2*%pi/3+(i1/2)^2*4*%pi/3))^0.5;
printf("RMS value of the load current = %.3f A",Irms_load)
Po=i1^2*R*3;
printf("\nOutput power = %.2f W", Po)
Iavg_thy=1/(2*%pi)*(i1*%pi/3+(i1/2*2*%pi/3));
printf("\nAverage thyristor current = %.2f A",Iavg_thy)
Irms_thy= (1/(2*%pi)*(i1^2*%pi/3+(i1/2)^2*2*%pi/3))^0.5;
printf("\nRMS value thyristor current = %.2f A",Irms_thy)
```

Scilab code Exa 3.12 Find the RMS value of load current and thyristor current of 3 phase bridge inverter for 180degree conduction mode

```
//3.12
clc;
R=10;
RL=R+R/2;
i1=450/15;
Irms_load=(1/(2*%pi)*(i1^2*2*%pi/3+(i1/2)^2*4*%pi/3))^0.5;
printf("RMS value of the load current = %.2f A",
```

```
Irms_load)
Irms_thy= (1/(2*%pi)*(i1^2*%pi/3+(i1/2)^2*2*%pi/3))^0.5;
printf("\nRMS value thyristor current = %.0f A", Irms_thy)
```

Scilab code Exa 3.13 Find the parameters of single phase full bridge inverter

```
//3.13
clc;
Vdc=200;
VL=Vdc*(5*30/180)^0.5;
printf("RMS value of the output voltage = %.2f V", VL)
Vdc=220;
delta=(VL/Vdc)^2*180/5;
printf("\nPulse width = %.2f degree", delta)
V=VL/((5*33/180)^0.5);
printf("\nMaximum possible input voltage = %.2f V", V)
```

Scilab code Exa 3.14 Calculate the RMS value of the output voltage

```
//3.14
clc;
Vdc=200;
delta=120;
VL=Vdc*(delta/180)^0.5;
printf("RMS value of the output voltage = %.1f V", VL)
```

Scilab code Exa 3.15 Calculate the RMS value of the output voltage

```
//3.15
clc;
Vdc=150;
VL=Vdc*(20/180+60/180+20/180)^0.5;
printf("RMS value of the output voltage = %.2f V",
   VL)
```

Chapter 4

Choppers

Scilab code Exa 4.1 Calculate the period of conduction and blocking

```
//4.1
clc;
f=1000;
T=1/f;
Vav=150;
V=230;
Ton=(Vav/V)*T;
printf("Period of conduction = %.6f sec", Ton)
Toff=T-Ton;
printf("\nPeriod of blocking = %.6f sec", Toff)
```

Scilab code Exa 4.2 Calculate the period of conduction and blocking

```
//4.2
clc;
f=500;
T=1/f;
Vav=15*(0.06+0.03)+100;
```

```
V=200;
Ton=(Vav/V)*T;
printf("Period of conduction = %.7f sec", Ton)
Toff=T-Ton;
printf("\nPeriod of blocking = %.7f sec", Toff)
```

Scilab code Exa 4.3 Calculate the duty cycle for the rated torque and half of rated torque

```
//4.3
clc;
Vs=240;
emf_800=Vs-20*0.5;
emf_600=230*600/800;
Vav=emf_600+20*0.5;
Duty_cycle=Vav/Vs;
printf("Duty cycle when motor develop the rated
   torque = %.4f ", Duty_cycle)
//when motor develop half of the rated torque
Vav=emf_600+10*0.5;
Duty_cycle=Vav/Vs;
printf("\nDuty cycle when motor develop half of the
   rated torque = %.4f ", Duty_cycle)
```

Scilab code Exa 4.4 Find the different parameters of a dc chopper

```
//4.4
clc;
Duty_cycle=0.4;
Vs=200;
Vd=2;
Vav=Duty_cycle*(Vs-Vd);
printf("Average output voltage = %.1f V", Vav)
```

```
VL=Duty_cycle^0.5*(Vs-Vd);
printf("\nRMS output voltage = %.3f V", VL)
R=8;
Po=VL^2/R;
Pi=Duty_cycle*Vs*(Vs-Vd)/R;
Chopper_efficiency=Po/Pi*100;
printf("\nChopper efficiency = %.0f percent",
   Chopper_efficiency)
Rin=R/Duty_cycle;
printf("\nInput resistance = %.0f Ohm", Rin)
V1=126.05/2^0.5;
printf("\nRMS value of fundamental component = %.3f
   V", V1)
```

Scilab code Exa 4.5 Find the chopper frequency

```
//4.5
clc;
Duty_cycle=0.25;
V=400;
Vav=Duty_cycle*V;
Vn=V-Vav;
L=0.05;
di=10;
Ton=L*di/Vn;
T=Ton/Duty_cycle;
f=1/T;
printf("\nChopper frequency = %.0f Hz", f)
```

Scilab code Exa 4.6 Find the different parameters of a chopper feeding a RL load

```
//4.6
```

```
clc;
V=200;
R=4;
L=6*10^-3;
f=1000;
T=1/f;
Duty_cycle=0.5;
E=0;
Imax=V/R*((1-exp(-Duty_cycle*T*R/L))/(1-exp(-T*R/L)))-E/R;
printf("\nImax = %.2f A", Imax)
Imin=V/R*((exp(Duty_cycle*T*R/L)-1)/(exp(T*R/L)-1))-E/R;
printf("\nImin = %.2f A", Imin)
Maximum_ripple=V/(R*f*L);
printf("\nMaximum ripple = %.2f A", Maximum_ripple)
IL_avg=(Imax+Imin)/2;
printf("\nAverage Load current = %.0f A", IL_avg)
iL=(Imin^2+(Imax-Imin)^2/3+Imin*(Imax-Imin))^0.5;
printf("\nRMS value of Load current = %.2f A", iL)
Iavg=0.5*IL_avg;
printf("\nAverage value of input current = %.2f A", Iavg)
Irms=Duty_cycle^0.5*iL;
printf("\nRMS value of input current = %.3f A", Irms)
```

Scilab code Exa 4.7 Calculate the load inductance

```
//4.7
clc;
V=300;
E=0;
R=5;
f=250;
```

```
Id=0.2*30;
L=V/(4*f*Id);
printf("Load inductance = %.3f H", L)
```

Scilab code Exa 4.8 Calculate the current

```
//4.8
clc;
V=200;
E=100;
R=0.5;
t=2*10^-3;
L=16*10^-3;
Imin=10;
i=(V-E)/R*(1-exp(-R*t/L))+Imin*exp(-R*t/L);
printf("Current at the instant of turn off thyristor
    = %.2f A", i)
t=5*10^-3;
i_5=i*exp(-R*t/L);
printf("\nCurrent after 5ms of turn off thyristor =
   %.2f A", i_5)
```

Scilab code Exa 4.9 Find the speed of motor

```
//4.9
clc;
emf=220;
duty_cycle=0.6;
Vi=220*duty_cycle;
Ra=1;
I=20;
emf_back=Vi-I*Ra;
N_no_load=1000;
```

```
N=emf_back*N_no_load/emf;
printf("\nSpeed of motor = %.1f rpm", N)
```

Scilab code Exa 4.10 Calculate average load voltage

```
//4.10
clc;
Ton=25*10^-3;
Toff=10*10^-3;
V=230;
VL=V*Ton/(Ton+Toff);
printf("\nAverage value of Load voltage = %.3f V",
    VL)
```

Scilab code Exa 4.11 Find maximum minimum and average load current and load voltage

```
//4.11
clc;
V=100;
R=0.5;
L=1*10^-3;
T=3*10^-3;
Duty_cycle=0.3333;
E=0;
Imax=V/R*((1-exp(-Duty_cycle*T*R/L))/(1-exp(-T*R/L))
    )-E/R;
printf("\nImax = %.2f A", Imax)
Imin=V/R*((exp(Duty_cycle*T*R/L)-1)/(exp(T*R/L)-1))-
    E/R;
printf("\nImin = %.1f A", Imin)
IL_avg=(Imax+Imin)/2;
printf("\nAverage Load current = %.1f A", IL_avg)
```

```
Vavg=Duty_cycle*V;
printf("\nAverage Load Voltage = %.2f V", Vavg)
```

Scilab code Exa 4.12 Find maximum minimum and average output voltage

```
//4.12
clc;
V=100;
R=0.2;
L=0.8*10^-3;
T=2.4*10^-3;
Duty_cycle=1/2.4;
E=0;
Imax=V/R*((1-exp(-Duty_cycle*T*R/L))/(1-exp(-T*R/L)))-E/R;
printf("\nImax = %.2f A", Imax)
Imin=V/R*((exp(Duty_cycle*T*R/L)-1)/(exp(T*R/L)-1))-E/R;
printf("\nImin = %.2f A", Imin)
Vavg=Duty_cycle*V;
printf("\nAverage output Voltage = %.2f V", Vavg)
```

Scilab code Exa 4.13 Calculate the series inductance in the circuit

```
//4.13
clc;
V=500;
f=400;
I=10;
L=V/(4*f*I);
printf("Series inductance = %.5f H", L)
```

Scilab code Exa 4.14 Calculate the motor speed and current swing

```
//4.14
clc;
Motor_output=300*735.5/1000;
efficiency=0.9;
Motor_input=Motor_output/efficiency;
Vdc=800;
Rated_current=Motor_input*1000/800;
R=0.1;
L=100*10^-3;
T=1/400;
emf=Vdc-Rated_current*0.1;
Duty_cycle=0.2;
emf_n=Duty_cycle*Vdc-Rated_current*0.1;
N=900/(emf/emf_n);
printf("\nSpeed of motor = %.2f rpm", N)
dia=(Vdc-Duty_cycle*Vdc)/L*Duty_cycle*T;
printf("\nCurrent swing = %.1f A", dia)
```

Scilab code Exa 4.15 Calculate the value of capacitance and inductance

```
//4.15
clc;
Vc=200;
Im=60;
toff=15*10^-6;
C1=toff*Im/Vc;
C=5*10^-6*10^6;
printf("\nCapacitance = %.0f uF", C)
Ipc=Im*1.5-Im;
L=C/(Ipc/Vc)^2*10^6;
```

```
printf("\nInductance = %.1f uH", L)
```

Scilab code Exa 4.16 Calculate the period of conduction of a step up chopper

```
//4.16
clc;
Vav=250;
V=200;
Toff=0.6*10^-3;
Ton=(Vav/V)*Toff-Toff;
printf("Period of conduction = %.5f sec", Ton)
```

Scilab code Exa 4.17 Calculate the period of conduction of a step up chopper

```
//4.16
clc;
Vav=250;
V=150;
Toff=1*10^-3;
Ton=(Vav/V)*Toff-Toff;
printf("Period of conduction = %.6f sec", Ton)
```

Chapter 5

AC Regulators

Scilab code Exa 5.1 Calculate the different parameters of AC voltage regulator using integral cycle control

```
//5.1
clc;
Vin=150;R=8;
duty_cycle=36/(36+64);
VL=Vin*duty_cycle^0.5;
printf("RMS output voltage=%.0f V", VL)
Po=VL^2/R;
printf("\nPower output =%.1f W", Po)
 // since losses are neglected
 Pi=Po;
printf("\nPower Input =%.1f W", Pi)
Irms_load=VL/R;
Irms_input=11.25;
VA_input=Irms_input*Vin;
pf_input=Po/VA_input;
printf(" \nInput Power factor =%.1f lagging",
   pf_input)
Ip_thy=2^0.5*Vin/R;
Iavg_thy=duty_cycle*Ip_thy/%pi;
printf("\nAverage thyristor Current =%.3f A",
```

```
Iavg_thy)
Irms_thy=Ip_thy*duty_cycle^0.5/2;
printf("\nRMS thyristor Current =%.3f A", Irms_thy)
```

Scilab code Exa 5.2 Calculate the different parameters of single phase half wave AC regulator

```
//5.2
clc;
Vm=2^0.5*150;
alph=60;
R=8;
Vin=150;
Vavg_out=Vm*(cosd(alph)-1)/(2*%pi);
printf("Average output voltage =%.2f V", Vavg_out)
disp('The average output voltage is negative only a part of positive half cycle appears at the output whereas the whole negative half cycle appears at the output')
VL=Vm*(1/(4*%pi)*(2*%pi-60*%pi/180+sind(120)/2))^0.5;
printf("\nRMS output voltage =%.2f V", VL)
Po=VL^2/R;
printf("\nPower output =%.1f W", Po)
Iin=VL/R;
VA_input=Iin*Vin;
pf_input=Po/VA_input;
printf(" \nInput Power factor =%.2f lagging", pf_input)
Iavg_out=Vavg_out/R;
Iavg_input=Iavg_out;
printf(" \nAverage input current =%.2f A", Iavg_input)
disp('The average input current is negative because input current during positive half cycle is less
```

```
    than during negative half cycle ')
```

Scilab code Exa 5.3 Calculate the different parameters of single phase full wave AC regulator

```
//5.3
clc;
Vin=150;
Vm=2^0.5*Vin;
alph=60;
R=8;
Vavg_out=Vm*(cosd(alph)+1)/(%pi);
printf("Average output voltage over half cycle =%.2f
    V", Vavg_out)
VL=Vm*(1/(2*%pi)*(%pi-60*%pi/180+sind(120)/2))^0.5;
printf("\nRMS output voltage =%.2f V", VL)
Po=VL^2/R;
printf("\nPower output =%.1f W", Po)
Iin=VL/R;
VA_input=Iin*Vin;
pf_input=Po/VA_input;
printf(" \nInput Power factor =%.1f lagging",
   pf_input)

Iavg_thy=Vm*(1+cosd(alph))/(2*%pi*R);
printf("\nAverage thyristor Current =%.2f A",
   Iavg_thy)
Irms_thy=Vm/(2*R)*(1/(%pi)*(%pi-%pi/3+sind(120)/2))
   ^0.5;
printf("\nRMS thyristor Current =%.3f A", Irms_thy)
```

Scilab code Exa 5.4 Calculate the different parameters of single phase full wave AC regulator

```
//5.4
clc;
Vin=120;
Vm=2^0.5*Vin;
alph=90;
R=10;

VL=Vm*(1/(2*%pi)*(%pi-90*%pi/180+sind(180)/2))^0.5;
printf("\nRMS output voltage =%.2f V", VL)
Po=VL^2/R;
IL=VL/R;
VA_input=IL*Vin;
pf_input=Po/VA_input;
printf(" \nInput Power factor =%.3f lagging", pf_input)

Iavg_thy=Vm*(1+cosd(alph))/(2*%pi*R);
printf("\nAverage thyristor Current =%.2f A", Iavg_thy)
Irms_thy=IL/2^0.5;
printf("\nRMS thyristor Current =%.3f A", Irms_thy)
Irms_load=VL/R;
printf("\nRMS Load Current =%.3f A", Irms_load)
```

Scilab code Exa 5.5 Find RMS output voltage and average power

```
//5.5
clc;
Vin=110;
Vm=2^0.5*Vin;
alph=60;
R=400;
VL=Vm*(1/(2*%pi)*(%pi-60*%pi/180+sind(120)/2))^0.5;
printf("\nRMS output voltage =%.2f V", VL)
Po=VL^2/R;
```

```
printf("\nPower output =%.2f W", Po)
```

Scilab code Exa 5.6 Find the firing angle

```
//5.6
clc;
disp('When the power delivered is 80% we have')
//0.8=1/(%pi)*(%pi-alph+sin(2*alph)/2)
//on solving
alph=60.5;
printf("Firing angle=%.1f degree",alph)
disp('When the power delivered is 30% we have')
//0.3=1/(%pi)*(%pi-alph+sin(2*alph)/2)
//on solving
alph=108.6;
printf("Firing angle=%.1f degree",alph)
```

Scilab code Exa 5.7 Find the conduction angle and RMS output voltage

```
//5.7
clc;
f=50;
Vin=150;
w=2*%pi*f;
L=22*10^-3;R=4;
th=atand(w*L/R);
Beta=180+th;
printf("Conduction angle of thyristor=%.0f degree",
   Beta)
Vm=2^0.5*Vin;
VL=Vm*(1/(2*%pi)*(%pi++sind(120)/2-sind(2*240)/2))
   ^0.5;
printf("\nRMS output Voltage=%.0f V", VL)
```

Scilab code Exa 5.8 Calculate the different parameters of single phase full wave AC regulator

```
//5.8
clc;
f=50;
Vin=230;
w=2*%pi*f;
L=20*10^-3;R=5;
th=atand(R/(w*L));
printf("Firing angle=%.2f degree",th)
disp('Therefore, Range of firing angle is 38.51 degree to 180 degree')
Beta=180;
printf("Conduction angle of thyristor=%.0f degree",Beta)
IL=Vin/((R^2+w^2*L^2))^0.5;
printf(" \nRMS load current =%.2f A", IL)
Po=IL^2*R;
printf(" \nPower Output =%.2f W", Po)
pf_input=Po/(Vin*IL);
printf(" \nInput Power factor =%.3f lagging",pf_input)
```

Scilab code Exa 5.10 Find the current and voltage rating

```
//5.10
clc;
V=415;
P=20*10^3;
disp('For Triacs')
```

```
I_line=P/(3^0.5*V);
Irms=I_line*1.5;
printf("RMS current rating of each triac=%.2f A",Irms)
Vrms=1.5*V;
printf("\nRMS Voltage rating of each triac=%.2f V",Vrms)
disp('For reverse connected thyristors')
Irms_thy=1.5*I_line/2^0.5;
printf("RMS current rating of each thyristor=%.2f A", Irms_thy)
Vrms_thy=1.5*V;
printf("\nRMS voltage rating of each thyristor=%.2f V", Vrms_thy)
```

Scilab code Exa 5.11 Calculate the different parameters of 3 phase star connected resistance load with firing angle 30 degree

```
//5.11
clc;
R=15;
Vrms_input_phase=415/3^0.5;
VL=3^0.5*2^0.5*Vrms_input_phase*(1/(%pi)*(%pi/6-30*%pi/(180*4)+sind(60)/8))^0.5;
printf("\nRMS value of output voltage per phase=%.2f V", VL)
Po=3*VL^2/R;
printf("\nPower output =%.1f W", Po)
I_line=VL/R;
printf("\nLine Current =%.2f A", I_line)
VA_input=3*Vrms_input_phase*I_line;
pf_input=Po/VA_input;
printf("\nInput Power Factor =%.3f lagging",pf_input)
```

Scilab code Exa 5.12 Calculate the different parameters of 3 phase star connected resistance load with firing angle 60 degree

```
//5.12
clc;
R=15;
Vrms_input_phase=415/3^0.5;
VL=3^0.5*2^0.5*Vrms_input_phase*(1/(%pi)*(%pi/6-60*%pi/(180*4)+sind(120)/8))^0.5;
printf("\nRMS value of output voltage per phase=%.2f V", VL)
Po=3*VL^2/R;
printf("\nPower output =%.1f W", Po)
I_line=VL/R;
printf("\nLine Current =%.2f A", I_line)
VA_input=3*Vrms_input_phase*I_line;
pf_input=Po/VA_input;
printf("\nInput Power Factor =%.3f lagging", pf_input)
```

Chapter 6

Cycloconverters

Scilab code Exa 6.1 Find the input voltage SCR rating and Input Power Factor

```
//6.1
clc;
Vo_max=250;
Vm=Vo_max*%pi*2^0.5/(3*sin(%pi/3));
Vrms=Vm/2^0.5;
printf("RMS value of input voltage =%.1f V", Vrms)
I=50;
Irms=I*2^0.5/3^0.5;
PIV=3^0.5*Vm;
Irms_input=(I^2/3)^0.5;
Po=Vo_max*I*0.8;
Pi_per_phase=1/3*Po;
pf_input=Pi_per_phase/(Irms_input*Vrms)
printf("\nInput power factor =%.3f lagging",
   pf_input)
```

Scilab code Exa 6.2 Find RMS value of output voltage for firing angle 30 and 45 degree

```
//6.2
clc;
Vo_max=250;
alph=30;
Vo=Vo_max*cosd(alph);
printf("RMS value of output voltage for firing angle
    30 degree =%.1f V", Vo)
alph=45;
Vo=Vo_max*cosd(alph);
printf("\nRMS value of output voltage for firing
   angle 45 degree =%.2f V", Vo)
```

Scilab code Exa 6.3 Find RMS value of output voltage for firing angle 0 and 30 degree

```
//6.3
clc;
Vrms=230;
alph=0;
Vo=6*2^0.5*Vrms/(%pi*2^0.5)*sin(%pi/6)*cosd(alph);
printf("RMS value of output voltage for firing angle
    0 degree =%.2f V", Vo)
alph=30;
Vo=6*2^0.5*Vrms/(%pi*2^0.5)*sin(%pi/6)*cosd(alph);
printf("\nRMS value of output voltage for firing
   angle 30 degree =%.1f V", Vo)
```

Chapter 7

Applications of Thyristors

Scilab code Exa 7.1 Find the value of Voltage which will turn On the crowbar

```
//7.1
clc;
Vzb=14.8;
Vt=0.85;
V=Vzb+Vt;
printf("The value of Voltage which will turn On the
   crowbar=%.2f V",V)
```

Scilab code Exa 7.2 Find the value of input voltage

```
//7.2
clc;
Rth=50*15/(50+15);
I=20*10^-3;
Vzb=14.8;
Vt=0.85;
V=Rth*I;// Voltage drop across the thevenin's
   resistance
```

```
Vi=V+Vzb+Vt;
printf("The value of input voltage Vi=%.3f V",Vi)
```

Scilab code Exa 7.3 Find the value of R and C

```
//7.3
clc;
V=200;
I=4*10^-3;
R=V/I;
printf("Resistance=%.0f ohm", R)
Vc=0;
RL=V/10;
tq=15*10^-6;
C=tq/(RL *log(2))*10^6;
printf("\nCapacitance=%.3f uF", C)
```

Scilab code Exa 7.4 Find Duty cycle and Ratio for different output powers

```
//7.4
clc;
V=230;
R=60;
Po_max=V^2/R;
disp('When power output is 400')
Po=400;
Duty_cycle=Po/Po_max;
printf("Duty cycle=%.4f", Duty_cycle)
Ton=0.4537;
T=1;
Toff=1-Ton;
Ratio=Ton/Toff;
```

```
printf("\nRatio of Ton and Toff when power output is
    400=%.4f", Ratio)
disp('When power output is 700')
Po=700;
Duty_cycle=Po/Po_max;
printf("Duty cycle=%.4f", Duty_cycle)
Ton=0.794;
T=1;
Toff=1-Ton;
Ratio=Ton/Toff;
printf("\nRatio of Ton and Toff when power output is
    700=%.4f", Ratio)
```

Scilab code Exa 7.5 Find RMS value of output voltage

```
// 7.5
clc;
V=230;
Ton=12;
Toff=19;
Duty_cycle=Ton/(Ton+Toff);
printf("Duty cycle=%.4f", Duty_cycle)
Vrms_output=V*Duty_cycle^0.5;
printf("\nRMS output voltage=%.1f V", Vrms_output)
```

Scilab code Exa 7.6 Find the power supplied to heater for different firing angles

```
//7.6
clc;
Vin=230;
Vm=2^0.5*Vin;
alph=90;
```

```
R=50;
VL=Vm*(1/(2*%pi)*(%pi-90*%pi/180+sind(180)/2))^0.5;
Po=VL^2/R;
printf("Power supplied when firing angle is 90 degree =%.2f W", Po)
alph=120;
R=50;
VL=Vm*(1/(2*%pi)*(%pi-120*%pi/180+sind(240)/2))^0.5;
Po=VL^2/R;
printf("\nPower supplied when firing angle is 120 degree =%.2f W", Po)
```

Scilab code Exa 7.7 Find the firing angles when different powers are supplied to heater

```
//7.7
clc;
V=230;
R=10;
Pmax=V^2/R;
P=2645;
VL=(P*R)^2;
//VL=Vm*(1/(2*%pi)*(%pi-alph*%pi/180+sind(2*alph)/2))^0.5;
//on solving
alph=90;
printf("Firing angle when 2645 W Power is supplied = %.0f degree", alph)
P=1587;
VL=(P*R)^2;
//VL=Vm*(1/(2*%pi)*(%pi-alph*%pi/180+sind(2*alph)/2))^0.5;
//on solving
alph=108.6;
printf("\nFiring angle when 2645 W Power is supplied
```

```
=%.1f degree", alph)
```

Scilab code Exa 7.8 Find the current rating and peak inverse voltage

```
//7.8
clc;
disp('For triac')
P=20000;
V=400;
I=P/(V*3^0.5);
printf("Current rating of traic=%.2f A",I)
PIV=2^0.5*V;
printf("\nPIV of traic=%.2f V",PIV)
disp('When two thyristors are connected in
    antiparallel')
I=I/2^0.5; //since each thyristor will conduct for
    half cycle
printf("Current rating =%.2f A",I)
PIV=2^0.5*V;
printf("\nPIV =%.2f V",PIV)
```

Scilab code Exa 7.9 Find firing angle and power factor of converter in the armature circuit

```
//7.9
clc;
Vm=230*2^0.5;
Vf=2*Vm/%pi;
Rf=200;
If=Vf/Rf;
T=50;
Kt=0.8;
Ia=T/(Kt*If);
```

```
w=2*%pi*900/60;
Vb=Kt*w*If;
Ra=0.3;
Va=Vb+Ia*Ra;
alph_a=acosd(Va*%pi/Vm-1)
printf("Firing angle of converter in the armature
    circuit=%.3f degree",alph_a)
Po_a=Va*Ia;
Iin=Ia*((%pi-alph_a*%pi/180)/%pi)^0.5;
VA_input=Iin*230;
pf=Po_a/VA_input;
printf("\npower factor of converter in the armature
    circuit=%.3f lagging",pf)
```

Scilab code Exa 7.10 Find the torque developed and motor speed

```
//7.10
clc;
Vm=230*2^0.5;
Vf=2*Vm/%pi;
alph_a=%pi/4;
Va=(2*Vm/%pi)*cos(alph_a);
Rf=200;
If=Vf/Rf;
Kt=1.1;
Ia=50;
T=Ia*(Kt*If);
printf("Torque of motor=%.3f Nm", T)
Ra=0.25;
Vb=Va-Ia*Ra-2;
w=Vb/(Kt*If);
N=w*60/(2*%pi);
printf("\nSpeed of motor=%.1f rpm", N)
```

Scilab code Exa 7.11 Find armature current and Firing angle of the semi converter

```
//7.11
clc;
Vm=675*2^0.5;
Ia1=30;
N1=350;
N2=500;
Ia2=Ia1*N2/N1;
printf("Armature current of the semi converter=%.2f
   A",Ia2)
Va1=(1+cos(90.5*%pi/180))*Vm/%pi;
Eb1=Va1-Ia1*(0.22+0.22);
Eb2=Eb1*Ia2*N2/(Ia1*N1);
Va2=Eb2+Ia2*(0.22+0.22);
alph_a=acosd(Va2*%pi/Vm-1);
printf("\nFiring angle of the semi converter=%.2f
   degree",alph_a)
```

Scilab code Exa 7.12 Find the firing angle of converter in the armature circuit and power fed back to the source

```
//7.12
clc;
Vm=230*2^0.5;
Eg=-131.9
Ia=50;
Ra=0.25;
Va=Eg+Ia*Ra+2;
alph_a=acosd(Va*%pi/(2*Vm))
```

```
printf("Firing angle of converter in the armature
   circuit=%.2f degree",alph_a)
Po=abs(Va*Ia);
printf("\npower back to source=%.3f W",Po)
```

Scilab code Exa 7.13 Find the firing angle of converter in the armature circuit

```
//7.13
clc;
Vm=400*2^0.5/(3^0.5);
Vf=3*3^0.5*Vm/%pi;
Rf=250;
If=Vf/Rf;
Kt=1.33;
Ia=50;
w=2*%pi*1200/60;
Vb=Kt*w*If;
Ra=0.3;
Va=Vb+Ia*Ra;
alph_a=acosd(Va/Vf);
printf("Firing angle of converter in the armature
   circuit=%.3f degree",alph_a)
```

Scilab code Exa 7.14 Find the input power speed and torque of separately excited dc motor

```
//7.14
clc;
V=500;
Ia=200;
Ra=0.1;
Pi=V*Ia*0.5;
```

```
printf("Input power=%.0f W", Pi)
Va=0.5*500;
Eb=Va-Ia*Ra;
If=2;
Kt=1.4;
w=Eb/(Kt*If)
N=w*60/(2*%pi)
printf("\nSpeed=%.2f rpm", N)
T=Kt*If*Ia;
printf("\nTorque=%.0f N-m", T)
```

Scilab code Exa 7.15 Find the average voltage power dissipated and motor speed of the chopper

```
//7.15
clc;
Rb=7.5;
Ra=0.1;
Kt=1.4;
Ia=120;
If=1.6;
Duty_cycle=0.35;
Vavg=Rb*Ia*(1-Duty_cycle);
printf("Average voltage across chopper=%.0f V", Vavg
   )
Pb=Rb*Ia^2*(1-Duty_cycle);
printf("\nPower dissipated in breaking resistance=%
   .0f W", Pb)
Eb=Vavg+Ia*Ra;
w=Eb/(Kt*If);
N=w*60/(2*%pi);
printf("\nSpeed=%.2f rpm", N)
```

Scilab code Exa 7.16 Find the speed for different values of torque

```
//7.16
clc;
Vm=220*2^0.5;
alph=90;
Va=3*3^0.5*Vm*(1+cosd(alph))/(2*%pi);
Kt=2;
Ra=0.72;
disp('For armature current of 5A')
Ia=5;
T=Ia*Kt;
printf("\nTorque=%.2f N-m", T)
Eb=Va-Ia*Ra;
w=Eb/(Kt);
N=w*60/(2*%pi);
printf("\nSpeed=%.2f rpm", N)
disp('For armature current of 10A')
Ia=10;
T=Ia*Kt;
printf("\nTorque=%.2f N-m", T)
Eb=Va-Ia*Ra;
w=Eb/(Kt);
N=w*60/(2*%pi);
printf("\nSpeed=%.2f rpm", N)
disp('For armature current of 20A')
Ia=20;
T=Ia*Kt;
printf("\nTorque=%.2f N-m", T)
Eb=Va-Ia*Ra;
w=Eb/(Kt);
N=w*60/(2*%pi);
printf("\nSpeed=%.2f rpm", N)
disp('For armature current of 30A')
Ia=30;
T=Ia*Kt;
printf("\nTorque=%.2f N-m", T)
Eb=Va-Ia*Ra;
```

```
w=Eb/(Kt);
N=w*60/(2*%pi);
printf("\nSpeed=%.2f rpm", N)
disp('For armature current of 50A')
Ia=50;
T=Ia*Kt;
printf("\nTorque=%.2f N-m", T)
Eb=Va-Ia*Ra;
w=Eb/(Kt);
N=w*60/(2*%pi);
printf("\nSpeed=%.2f rpm", N)
disp('For armature current of 60A')
Ia=60;
T=Ia*Kt;
printf("\nTorque=%.2f N-m", T)
Eb=Va-Ia*Ra;
w=Eb/(Kt);
N=w*60/(2*%pi);
printf("\nSpeed=%.2f rpm", N)
```

Scilab code Exa 7.17 Find the speed at no load and firing angle

```
//7.17
clc;
Vm=400*2^0.5;
alph=30;
Vavg=3*3^0.5*Vm/(2*%pi*3^0.5)*(1+cosd(alph));
I=5;
R=0.1;
Eb=Vavg-I*R;
N=Eb/0.3;
printf("Speed at no load=%.0f rpm",N)
N=1600;
Eb=N*0.3;
I=50;
```

```
V=Eb+I*R;
alph=acosd(3^0.5*2*%pi*V/(Vm*3*3^0.5)-1)
printf("\nFiring angle =%.2f degree",alph)
```

Scilab code Exa 7.18 Find the motor speed

```
//7.18
clc;
Vdc=2*2^0.5*230/%pi;
TL=25;
Kt=0.25;
Ia=(TL/Kt)^0.5;
w=(Vdc-1.5*Ia)/(Kt*Ia);
N=w*60/(2*%pi);
printf("Motor speed=%.2f rpm",N)
```

Scilab code Exa 7.19 Find the load torque stator applied voltage and rotor current

```
//7.19;
clc;
p=4
f=50;
ns=2*f*60/p;
TL_1300=40*(1300/1440)^2;
printf("Load torque=%.2f Nm",TL_1300)
n=1300;
s=(ns-n)/ns;
r2s=0.08*2^2; // in book r2'=r2s
x2s=0.12*2^2;
I2s=(TL_1300*2*%pi*s*25/(3*r2s))^0.5;
I2=2*I2s;
printf("\nRotor current=%.2f A",I2)
```

```
r1=0.64;
x1=1.1;
V1=I2s*((r1+r2s/s)^2+(x1+x2s)^2)^0.5;
Vstator=3^0.5*V1;
printf("\nStator applied voltage=%.1f V",Vstator)
```

Scilab code Exa 7.20 Find the load torque stator applied voltage and rotor current

```
//7.20
clc;
r2s=0.32;
r1=0.64;
x2s=0.48;
x1=1.1;
s=r2s/(r1^2+(x1+x2s)^2)^0.5;
printf("\nSlip=%.4f ",s)
V1=400/3^0.5;
Tmax=1.5*V1^2/(2*%pi*25)*(1/(r1+(r1^2+(x1+x2s)^2)^0.5))
printf("\nMaximum Torque=%.2f Nm",Tmax)
n=25*(1-s);
N=n*60;
printf("\nSpeed=%.2f rpm",N)
disp('at 25 Hz')
x1=0.55;
x2s=0.24;
s=r2s/(r1^2+(x1+x2s)^2)^0.5;
printf("\nSlip=%.4f ",s)
V1=0.5*400/3^0.5;
Tmax=1.5*V1^2/(2*%pi*12.5)*(1/(r1+(r1^2+(x1+x2s)^2)^0.5))
printf("\nMaximum Torque=%.2f Nm",Tmax)
n=12.5*(1-s);
N=n*60;
```

```
printf("\nSpeed=%.3f rpm",N)
```

Scilab code Exa 7.21 Find the starting torques at different frequencies

```
//7.21
clc;
r2s=0.32;
r1=0.64;
x2s=0.48;
x1=1.1;

V1=400/3^0.5;
Tstarting=3*V1^2*r2s/(2*%pi*25)*(1/((r1+r2s)^2+(x1+
    x2s)^2))
printf("\nStarting Torque=%.2f Nm",Tstarting)

disp('at 25 Hz')
x1=0.55;
x2s=0.24;
V1=0.5*400/3^0.5;
Tstarting=3*V1^2*r2s/(2*%pi*12.5)*(1/((r1+r2s)^2+(x1
    +x2s)^2))
printf("\nStarting Torque=%.2f Nm",Tstarting)
```

Chapter 8

Integrated circuits and operational amplifiers

Scilab code Exa 8.1 Find dc currents and voltages

```
//8.1
clc;
Vcc=12;
Re=3.8*10^3;
Rc=4.1*10^3;
Ie=(Vcc-0.7)/Re*10^3;
printf("Ie=%3f mA",Ie)
Ic=0.5*Ie;
printf("\nIc=%3f mA",Ic)
Vo=Vcc-Ic*Rc*10^-3;
printf("\nVo=%1f V",Vo)
```

Scilab code Exa 8.2 Calculate the different parameters of differential amplifier

```
//8.2
```

```
clc;
Vcc=12;
Re=1*10^6;
Rc=1*10^6;
Ie=(Vcc-0.7)/Re*10^3;
re=25*2/Ie;
printf("re=%.0f ohm",re)
Vgd=Rc/(2*re);
printf("\nVoltage gain for the differential input=%
   .1f ",Vgd)
Vi=2.1*10^-3;
Vo_Ac=Vgd*Vi;
printf("\nAC output voltage=%.4f V",Vo_Ac)
Beta=75;
Zi=2*Beta*re;
printf("\nInput impedance=%.0f ohm",Zi)
Rc=1*10^6;
RE=10^6;
CMG=Rc/(re+2*RE);
printf("\nCommon mode gain=%.3f ",CMG)
CMRR=Vgd/CMG;
printf("\nCommon mode rejection ratio=%.2f ",CMRR)
```

Scilab code Exa 8.3 Find the closed loop gain output and error voltage

```
//8.3
clc;
open_loop_gain=100000;
FF=0.01;
Closed_loop_gain=open_loop_gain/(1+open_loop_gain*FF
   );
printf("Closed loop gain=%.1f",Closed_loop_gain)
Vi=2*10^-3;
output=Vi*Closed_loop_gain;
printf("\nOutput=%.4f V",output)
```

```
Error_voltage=output/open_loop_gain*10^6;
printf("\nError voltage=%.3f uV",Error_voltage)
```

Scilab code Exa 8.4 Find the closed loop gain output and error voltage

```
//8.4
clc;
open_loop_gain=15000;
FF=0.01;
Closed_loop_gain=open_loop_gain/(1+open_loop_gain*FF);
printf("Closed loop gain=%.3f",Closed_loop_gain)
Vi=2*10^-3;
output=Vi*Closed_loop_gain;
printf("\nOutput=%.4f V",output)
Error_voltage=output/open_loop_gain*10^6;
printf("\nError voltage=%.3f uV",Error_voltage)
```

Scilab code Exa 8.5 Find the input and output impedances

```
//8.5
clc;
Av=100000;
beta=0.01;
Zi=2*10^6;
Closed_loop_input_imped=Zi*(1+Av*beta)*10^-6;
printf("Closed loop input impedance=%.0f Mega-ohm",Closed_loop_input_imped)
Zo=75;
Closed_loop_output_imped=Zo/(1+Av*beta);
printf("\nClosed loop output impedance=%.4f ohm",Closed_loop_output_imped)
```

Scilab code Exa 8.6 Find closed loop gain and desensitivity

```
//8.6
clc;
Av=100000;
beta=0.001;
Closed_loop_gain=Av/(1+Av*beta);
printf("\nClosed loop gain=%.1f ",Closed_loop_gain)
Desensitivity=(1+Av*beta);
printf("\nDesensitivity=%.0f",Desensitivity)
```

Scilab code Exa 8.7 Find the closed loop gain and upper cut off frequency

```
//8.7
clc;
f_unity=10^6;
Av=100000;
open_loop_upper_cutoff_f=f_unity/Av;
printf("open loop upper cutoff frequency=%.0f Hz",
    open_loop_upper_cutoff_f)
disp('when beta=0.001')
beta=0.001;
Closed_loop_gain=Av/(1+Av*beta);
printf("\nClosed loop gain=%.1f ",Closed_loop_gain)
upper_cutoff_frequency=f_unity/Closed_loop_gain;
printf("\nUpper cutoff frequency=%.0f Hz",
    upper_cutoff_frequency)
disp('when beta=0.01')
beta=0.01;
Closed_loop_gain=Av/(1+Av*beta);
printf("\nClosed loop gain=%.1f ",Closed_loop_gain)
upper_cutoff_frequency=f_unity/Closed_loop_gain;
```

```
printf("\nUpper cutoff frequency=%.0f Hz",upper_cutoff_frequency)
disp('when beta=0.1')
beta=0.1;
Closed_loop_gain=Av/(1+Av*beta);
printf("\nClosed loop gain=%.3f ",Closed_loop_gain)
upper_cutoff_frequency=f_unity/Closed_loop_gain;
printf("\nUpper cutoff frequency=%.0f Hz",upper_cutoff_frequency)
```

Scilab code Exa 8.8 Find the slew rate

```
//8.8
clc;
Imax=10*10^-6;
C=4000*10^-12;
Slew_rate=Imax/C;
printf("Slew rate=%.0f V/s", Slew_rate)
```

Scilab code Exa 8.9 Find the slew rate distortion of the op amp

```
//8.9
clc;
f=10*10^3;
Vp=6
Initial_slope_of_sine_wa=2*%pi*f*Vp*10^-6;
printf("Initial slope of sine wave= %.5f V/us",Initial_slope_of_sine_wa)
disp('Since slew rate of the amplifier is 0.4V/us, there is no slew rate distortion')
```

Scilab code Exa 8.10 Find the slew rate distortion of the op amp and amplitude of the input signal

```
//8.10
clc;
f=10*10^3;
Vp=10;
Initial_slope_of_sine_wa=2*%pi*f*Vp*10^-6;
printf("Initial slope of sine wave= %.3f V/us",
   Initial_slope_of_sine_wa)
disp('Since slew rate of the amplifier is 0.5V/us,
   so slew rate distortion will occur')
Sr=0.5*10^6;
Vp=Sr/(2*%pi*f);
printf("Amplitude of the input signal=%.2f V",Vp)
```

Scilab code Exa 8.11 Find the different parameters of inverting amplifier

```
//8.11
clc;
Rf=100*10^3;
R1=1000;
Gain=-Rf/R1;
printf("Closed loop gain=%.0f", Gain)
Av=100000;
Zo=75;
f_unity=10^6;
beta=R1/(R1+Rf);
Z_closed=Zo/(1+Av*beta);
printf("\nClosed loop output impedance=%.6f ohm",
   Z_closed)
closed_loop_upper_cut_f=f_unity*beta;
printf("\nClosed loop upper cutoff frequency=%.0f
   Hz", closed_loop_upper_cut_f)
closed_loop_input_impe=1000;
```

```
printf("\nClosed loop input impedance=%.0f ohm",
    closed_loop_input_impe)
```

Scilab code Exa 8.12 Find the different parameters of non inverting amplifier

```
//8.12
clc;
R2=100*10^3;
R1=100;
Zin=2*10^6;
Zo=75;
Gain=(R1+R2)/R1;
printf("Closed loop voltage gain=%.0f", Gain)
Av=100000;

beta=R1/(R1+R2);
Z_closed=Zin*(1+Av*beta)*10^-6;
printf("\nClosed loop input impedance=%.1f mega-ohm"
    , Z_closed)

closed_loop_output_impe=Zo/(1+Av*beta);
printf("\nClosed loop output impedance=%.3f ohm",
    closed_loop_output_impe)
```

Scilab code Exa 8.13 Find the different parameters of ac amplifier

```
//8.13
clc;
R1=1000;
R2=100000;
Avf=(R1+R2)/R1;
printf("Closed loop gain=%.0f", Avf)
```

```
beta=R1/(R1+R2);
f_unity=1000000;
f2=f_unity*beta;
printf("\nUpper cut off frequency=%.0f Hz", f2)
disp('Critical frequencies')
C1=10^-6;
R3=150*10^3;
fc=1/(2*%pi*R3*C1);
printf("\nCritical frequency when R is 150 Kohm=%.3f Hz", fc)
R3=15*10^3;
fc=1/(2*%pi*R3*C1);
printf("\nCritical frequency when R is 15 Kohm=%.2f Hz", fc)
R3=1*10^3;
fc=1/(2*%pi*R3*C1);
printf("\nCritical frequency when R is 1 Kohm=%.2f Hz", fc)
disp('The lower cutt off frequency is the highest of the above three critical frequencies i.e.159.15 Hz')
```

Scilab code Exa 8.14 Find the output voltage

```
//8.14
clc;
Rf=50*10^3;
R1=10*10^3;
R2=R1;
R3=R1;
V1=0.5;
V2=1.5;
V3=0.2;
Vo=-Rf*((V1/R1)+(V3/R3)+(V2/R2));
printf("Output voltage=%.0f V",Vo)
```

Scilab code Exa 8.17 Find the output voltage

```
//8.17
clc;
R1=50*10^3;
R=10*10^3;
Vs1=4.5;
Vs2=5;
Vo=R1/R*(Vs2-Vs1);
printf("Output voltage=%.1f V", Vo)
```

Scilab code Exa 8.18 Find CMRR in dB

```
//8.18
clc;
Vcom=0.5*(2+2);
Acom=5*10^-3/Vcom;
CMRR=20*log10(50/Acom);
printf("CMRR=%.2f dB",CMRR)
```

Scilab code Exa 8.21 Find the different parameters of high pass filter

```
//8.21
clc;
R2=5.6*10^3;
R1=1*10^3;
Avf=1+R2/R1;
printf("Mid band Gain=%.2f", Avf)
Vin=1.6;
```

```
Vo=Avf*Vin;
printf("\nOutput voltage=%.3f mV", Vo)
R=1000;
C=0.001*10^-6;
fc=1/(2*%pi*R*C);
printf("\nCutt off frequency=%.2f Hz", fc)
Gain=0.707*Avf;
printf("\nGain=%.3f", Gain)
```

Scilab code Exa 8.22 Find the different parameters of low pass filter

```
//8.22
clc;
R2=5.6*10^3;
R1=10*10^3;
Avf=1+R2/R1;
printf("Mid band Gain=%.2f", Avf)
Vin=1.1;
Vo=Avf*Vin;
printf("\nOutput voltage=%.3f mV", Vo)
R=10000;
C=0.001*10^-6;
fc=1/(2*%pi*R*C);
printf("\nCutt off frequency=%.2f Hz", fc)
Vo=0.707*Avf;
printf("\nOutput voltage=%.3f mV", Vo)
```

Chapter 9

Number systems

Scilab code Exa 9.1 Convert decimal number into equivalent binary number

```
//9.1
clc;
x=10;
disp('The binary number is')
a=dec2bin(x);
disp('',a)
```

Scilab code Exa 9.2 Convert decimal number into equivalent binary number

```
//9.2
clc;
x=25;
disp('The binary number is')
a=dec2bin(x);
disp('',a)
```

Scilab code Exa 9.3 Convert binary number into equivalent decimal number

```
//9.3
clc;
a='101110';
disp('The decimal no. is')
x=bin2dec(a);
disp('',x)
```

Scilab code Exa 9.4 Convert decimal number into equivalent binary number

```
//9.4
clc;
x=15;
disp('The binary number of decimal 15 is')
a=dec2bin(x);
disp('',a)
x=31;
disp('The binary number of decimal 31 is')
a=dec2bin(x);
disp('',a)
```

Scilab code Exa 9.5 Calculate the subtraction of two binary numbers

```
//9.5
clc;
a='11001';
```

```
b=bin2dec(a);
c='10001';
f=bin2dec(c);
d=b-f;
s=dec2bin(d);
disp('Subtraction of two binary numbers=')
disp(s)
```

Scilab code Exa 9.6 Calculate the subtraction of two binary numbers

```
//9.6
clc;
a='1010';
b=bin2dec(a);
c='0111';
f=bin2dec(c);
d=b-f;
s=dec2bin(d);
disp('Subtraction of two binary numbers=')
disp(s)
```

Scilab code Exa 9.7 Express the decimals in 16 bit signed binary system

```
//9.7
clc;
a=8;
b=dec2bin(a);
disp(b)
disp('The 16 bit signed binary number of +8=0000
    0000 0000 1000')
disp('The 16 bit signed binary number of -8=1000
    0000 0000 1000')
a=165;
```

```
b=dec2bin(a);
disp(b)
disp('The 16 bit signed binary number of +165=0000 0000 1010 0101')
disp('The 16 bit signed binary number of −165=1000 0000 1010 0101')
```

Scilab code Exa 9.8 Calculate the twos complement representation

```
//9.8
clc;
a='0001 1111';
disp(a)
disp('Since the MSB is 0 so this is a positive number and its 2 s complement representation is')
b=bin2dec(a);
disp(b)
a='1110 0101';
disp(a)
disp('Since the MSB is 1 so this is a negative number and its 2 s complement representation is')
c=bin2dec(a);
xc= bitcmp (c ,8);
b=xc+1;
disp(b)
a='1111 0111';
disp(a)
disp('Since the MSB is 1 so this is a negative number and its 2 s complement representation is')
c=bin2dec(a);
xc= bitcmp (c ,8);
b=xc+1;
disp(b)
```

Scilab code Exa 9.9 Find the largest positive and negative number for 8 bits

```
//9.9
clc;
disp('The largest 8 bit positive number is +127 and
   is represented in binary as')
a='0111 1111';
disp(a)
disp('The largest 8 bit negative number is -128 and
   is represented in binary as')
a='1000 0000';
disp(a)
```

Scilab code Exa 9.10 Calculate addition and subtraction of the numbers

```
//9.10
clc;
c=24;
xc= bitcmp (c ,8);
A=xc+1;
B=16;
Ans=A+B;
a=dec2bin(Ans)
disp(a)
disp('Since the MSB is 1 so the number is negative
   and equal to -8')

Ans=A-B;
a=dec2bin(Ans)
disp(a)
```

```
disp('Since the MSB is 1 so the number is negative
   and equal to -40')
```

Scilab code Exa 9.11 Calculate addition and subtraction of the numbers

```
//9.11
clc;
c=60;
xc= bitcmp (c ,8);
A=xc+1;
d=28;
xd= bitcmp (d ,8);
B=xd+1;
Ans=B+A;
a=dec2bin(Ans)
disp(a)
disp('Since the MSB is 1 so the number is negative
   and equal to -88')
Ans=B-A;
a=dec2bin(Ans,8)
disp(a)
disp('Since the MSB is 0 so the number is positive
   and equal to +32')
```

Scilab code Exa 9.12 Convert decimal number into equivalent binary number

```
// 9.12
clc;
q =0;
b =0;
s =0;
```

```
a =0.6875;    // accepting the decimal input from
    user
d = modulo (a ,1) ;
a = floor ( a ) ;
while (a >0)
x = modulo (a ,2) ;
b = b + (10^ q ) * x ;
 a = a /2;
 a = floor ( a ) ;
 q = q +1;
 end
 for i =1:10
 // for fractional part
d = d *2;
 q = floor ( d ) ;
 s = s + q /(10^ i ) ;
 if d >=1 then
 d =d -1;
 end
end
m=b+s;
printf("Equivalent binary number=%.4f",m)
```

Scilab code Exa 9.13 Convert decimal number into equivalent binary number

```
// 9.13
clc;
q =0;
b =0;
s =0;
a =0.634;    // accepting the decimal input from user
d = modulo (a ,1) ;
a = floor ( a ) ;
while (a >0)
```

```
x = modulo (a ,2) ;
b = b + (10^ q ) * x ;
 a = a /2;
 a = floor ( a ) ;
 q = q +1;
 end
 for i =1:10
 // for fractional part
d = d *2;
 q = floor ( d ) ;
 s = s + q /(10^ i ) ;
 if d >=1 then
 d =d -1;
 end
end
m=b+s;
printf("Equivalent binary number=%.7f",m)
```

Scilab code Exa 9.14 Convert decimal number into equivalent binary number

```
// 9.14
clc;
clear;
q =0;
b =0;
s =0;
a =39.12;    // accepting the decimal input from user
d = modulo (a ,1) ;
a = floor ( a ) ;
while (a >0)
x = modulo (a ,2) ;
b = b + (10^ q ) * x ;
 a = a /2;
 a = floor ( a ) ;
```

```
 q = q +1;
 end
 for i =1:10
 // for fractional part
d = d *2;
 q = floor ( d ) ;
 s = s + q /(10^ i ) ;
 if d >=1 then
 d =d -1;
 end
end
m=b+s;
printf("Equivalent binary number=%.7f",m)
```

Scilab code Exa 9.15 Find the addition of binary numbers

```
//9.15
clc;
a='1011010101';
d=bin2dec(a);
c='100011010';
b=bin2dec(c);
e=d+b;
f=dec2bin(e);
disp('addition of binary numbers =')
disp(f)
```

Scilab code Exa 9.16 Convert binary number into equivalent decimal number

```
//9.16
clc;
p =1;
```

```
q =1;
z =0;
b =0;
w =0;
f =0;
bin =11001.001011; // binary input
d = modulo (bin ,1) ;
d= d *10^10;
a = floor ( bin ) ;
while (a >0)
r = modulo (a ,10) ;
b(1,q) = r ;
a=a /10;
a= floor ( a ) ;
q = q +1;
end
for m =1: q -1
c=m -1;
f=f+b(1,m) *(2^ c);
end
while (d >0)
e = modulo (d ,2)
w (1 , p ) = e
d = d /10;
d = floor ( d )
p = p +1;
end
for n =1: p -1
z = z + w (1 , n ) *(0.5) ^(11 - n ) ;
end
z = z *10000;
z = round ( z ) ;
z = z /10000;
x=f+z;
printf("Equivalent decimal number=%.6f",x)
```

Scilab code Exa 9.17 Convert hexadecimal number into equivalent decimal number

```
//9.17
clc;
a='8A3';
disp('The decimal no. is')
x=hex2dec(a);
disp('',x)
```

Scilab code Exa 9.18 Convert decimal number into equivalent hexadecimal number

```
//9.18
clc;
a=268;
disp('The hexa decimal no. is')
x=dec2hex(a);
disp('',x)
```

Scilab code Exa 9.19 Convert decimal number into equivalent hexadecimal number

```
//9.19
clc;
a=5741;
disp('The hexa decimal no. is')
x=dec2hex(a);
disp('',x)
```

Scilab code Exa 9.20 Convert hexadecimal number into equivalent decimal number

```
//9.20
clc;
a='D70';
disp('The decimal no. is')
x=hex2dec(a);
disp('',x)
```