

Scilab Textbook Companion for
Introduction to Electric Drives
by J. S. Katre¹

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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.

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Chapter 1

Thyristors

Scilab code Exa 1.11.1 peak reverse recovery current

```
1 //Example 1.11.1: peak reverse recovery current
2 clc;
3 clear;
4 close;
5 //given data :
6 itt=10;// time in micro seconds
7 qtt=150;//charge in micro colums
8 prrc=((2*qtt)/itt);//peak reverse recovery current
   in amperes
9 disp(prrc,"peak reverse recovery current in amperes"
   )
```

Scilab code Exa 1.18.1 voltage

```
1 //Example 1.18.1: voltage of the capacitor
2 clc;
3 clear;
4 close;
```



```

5 format('v',7)
6 r=10; //in ohms
7 l=10; ///inductance in mH
8 c=10; //capacitance in micro farads
9 v=100; //in volts
10 t=((%pi)/(sqrt((1/(l*10^-3*c*10^-6))-(r^2/(4*(l
    *10^-3)^2))))); // time in seconds
11 vc= v*(1-cosd(t/(sqrt(l*10^-3*c*10^-6)))); //in volts
12 disp(vc,"the capacitor voltage in volts is")
13 //answer is wrong in the textbook

```

Scilab code Exa 1.18.2 voltage of the capacitor

```

1 //Example 1.18.2: voltage of the capacitor
2 clc;
3 clear;
4 close;
5 format('v',7)
6 r=15; //in ohms
7 l=12; ///inductance in mH
8 c=8; //capacitance in micro farads
9 v=100; //in volts
10 t=((%pi)/(sqrt((1/(l*10^-3*c*10^-6))-(r^2/(4*(l
    *10^-3)^2))))); // time in seconds
11 vc= v*(1-cosd(t/(sqrt(l*10^-3*c*10^-6)))); //in volts
12 disp(vc,"the capacitor voltage in volts is")
13 //this question is not solved in the textbook

```

Scilab code Exa 1.20.1 turn off time

```

1 //Example 1.20.1: Turn Off Time
2 clc;
3 clear;

```

```

4 close;
5 //given data :
6 format('v',6)
7 Vs=200;//in volts
8 R1=10;// in ohm
9 R2=R1;
10 C=5;// in micro-farad
11 Tc=(R1*C)/1.44;
12 disp(Tc,"The Circuit Turn Off Time,Tc(micro-sec) = "
    )

```

Scilab code Exa 1.20.2 state thyristor current and circuit turn off time

```

1 //Example 1.20.2: Peak Current and turn off time
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 Vs=200;//in volts
8 R1=10;// in ohm
9 R2=R1;
10 Vc=200;//in volts
11 C=10;// in micro-farad
12 I1=Vs/R1;
13 I2=(Vs+Vc)/R2;
14 It1=I1+I2;
15 disp(It1,"Peak Current ,It1 (A) = ")
16 Tc=(R1*C)/1.44;
17 disp(Tc,"The Circuit Turn Off Time,Tc(micro-sec) = "
    )

```

Scilab code Exa 1.21.1 inductance and capacitance

```

1 //Example 1.21.1: L and C
2 clc;
3 clear;
4 close;
5 //given data :
6 V=100; // in volts
7 Irm=40; // in A
8 tq=40; // in micro-sec
9 Del_t=(50/100)*tq; // in micro-sec
10 C=(Irm*(tq+Del_t))/V;
11 disp(C,"capacitance ,C(micro-farad) = ")
12 L_min=(V/Irm)^2*C;
13 disp(L_min,"minimum inductance ,L_min(micro-Henry) =
    ")
14 T=2.5; // assume one cycle period in ms
15 L_max=((0.01*(T*10^-3)^2)/(%pi^2*C*10^-6))*10^6;
16 disp(L_max,"Maximum inductance ,L_max(micro-Henry) =
    ")

```

Chapter 2

Gate triggering Circuits

Scilab code Exa 2.6.1 design the triggering circuit

```
1 //Example 2.6.1; // design
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 c1=0.1; //in micro farads
8 vbb=30; //in volts
9 n=0.51; //
10 ip=10; //in micro amperes
11 vv=3.5; //in volts
12 iv=10; //in mA
13 f=50; //in Hz
14 w=50; //eifth in micro seconds
15 vd=0.7; //in volts
16 vp=n*vbb+vd; //in volts
17 vc=vp; //in volts
18 x=log(vv/(vp-vd)); //
19 r1=-(w*10^-6/(c1*10^-6*x)); //
20 T=(1/(f))*10^3; //in ms
21 t1=T-(w*10^-3); // in ms
```

```

22 r=((t1*10^-3)/(c1*10^-6*log(1/(1-n)))); //
23 r2=(10^4/(n*vbb)); //in ohms
24 disp(round(r1),"resistance R1 in ohm is")
25 disp(r*10^-3,"resistance R in kilo ohm is")
26 disp(r2,"resistance R2 in ohm is")

```

Scilab code Exa 2.7.1 load current

```

1 //Example 2.7.1;// current
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',3)
7 v=100;//in volts
8 r=20;//in ohms
9 t=50;//in micro seconds
10 l=0.5;//in henry
11 il=(v/r)*(1-exp(-t*10^-6*(r/l)));//
12 disp("load current in (mA) "+string(il*10^3)+"")

```

Scilab code Exa 2.7.2 minimum width of gate pulse

```

1 //Example 2.7.2;//MINIMUM WIDTH
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 v=100;//in volts
8 r=20;//in ohms
9 l=0.5;//in henry
10 il=50;//in mA

```

```

11 t1=log(1-((i1*10^-3)/(v/r)))/(-(r/l));//
12 disp(t1*10^6,"minimum pulse width in micro seconds
    is")

```

Scilab code Exa 2.7.3 minimum width of gate pulse

```

1 //Example 2.7.3;//MINIMUM WIDTH
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 v=207;//in volts
8 r=10;//in ohms
9 l=1;//in henry
10 i1=100;//in mA
11 t1=log(1-((i1*10^-3)/(v/r)))/(-(r/l));//
12 disp(t1*10^6,"minimum pulse width in micro seconds
    is")

```

Scilab code Exa 2.7.4 resistance and duty cycle

```

1 //Example 2.7.4;//resistance and duty cycle
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 vr=15;//in volts
8 t=20;//in micro seconds
9 pd=0.3;//power dissipation in watts
10 Ig=poly(0,"Ig");
11 p=-5+Ig+10*Ig^2;//

```

```

12 x=roots(p);//
13 rg=(vr-(1+10*x(2,1)))/(x(2,1));//resistance in ohms
14 disp("part (a)")
15 disp(rg,"resistance Rg in ohm is")
16 pgm=5;//peak power in watts
17 d=(pd/pgm)*100;//duty cycle
18 disp("part (b)")
19 disp(d,"duty cycle in percentage is")
20 tt=(t)/(d/100);//in micro seconds
21 f=(1/(tt*10^-3));//triggering frequency in kHz
22 disp("part (c)")
23 disp(f,"triggering frequency in kHz is")

```

Scilab code Exa 2.7.5 gate source resistance

```

1 //Example 2.7.5;//resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',4)
7 vg=15;//in volys
8 vgk=0.7;//in volts
9 pg=0.5;// in watts
10 ig=pg/vgk;//in amperes
11 rg=(vg-vgk)/ig;//in ohms
12 disp(rg,"gate source resistance in ohm ")

```

Scilab code Exa 2.7.6 resistance and frequency

```

1 //Example 2.7.6;//resistance ,frequency
2 clc;
3 clear;

```

```

4 close;
5 //given data :
6 format('v',6)
7 li=3.7;//leakage current in mA
8 c1=0.1;//in micro farads
9 vp=16;//in volts
10 vv=1;//in volts
11 n=0.7;//
12 ip=0.7;//in milli amperes
13 iv=6;//in mA
14 f=1000;//in Hz
15 rb1=5.5;//in killo ohms
16 t=(1/f)*10^3;//in ms
17 tg=50;//in micro seconds
18 r2=((tg*10^-6/(c1*10^-6)));// in ohms
19 r1=500 ;//in ohms assume
20 vs=(r1+(rb1*10^3)+r2)*(li*10^-3);//in volts
21 r=((t*10^-3)/(c1*10^-6*log(1/(1-n))))*10^-3;//in
    killo ohms
22 rmin=(vs-vv)/iv;//minimum resistance in killo ohms
23 rmax=(vs-vp)/ip;//maxium resistance in killo ohms
24 fmin=(1/(rmax*10^3*c1*10^-6*log(1/(1-n))));//minimum
    frequency in Hz
25 fmax=(1/(rmin*10^3*c1*10^-6*log(1/(1-n))))*10^-3;//
    minimum frequency in Hz
26 disp(vs," Voltage is ,(V)=")
27 disp(r,"charging resistance in kilo ohm is")
28 disp(rmin,"minimum resistance in kilo ohm is")
29 disp(rmax,"maximum resistance in kilo ohm is")
30 disp(fmin,"minimum frequency is Hz is")
31 disp(fmax,"maximum frequency in kHz is")
32 //mimimum frequency is calculated wrong in the
    textbook

```

Scilab code Exa 2.7.7 resistance


```

1 //Example 2.7.7;// resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',4)
7 il=50;//in mA
8 pw=50;//pulse width in micro seconds
9 i=10;//in mA
10 v=100;//in volts
11 if1=50;//in mA
12 rmax=(v/(if1-i));//maximum resistance in killo ohms
13 disp(rmax,"maximum resistance in kilo ohm is")

```

Scilab code Exa 2.7.8 resistance and gate power dissipation and frequency

```

1 //Example 2.7.8;// resistance and gate power
  dissipation and frequency
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 g=16;//in volts/ampere
8 vr=15;//in volts
9 t=4;//in micro seconds
10 ig=500;//in mA
11 rg=(vr/(ig*10^-3))-g;//resistance in ohms
12 disp("part (a)")
13 disp(rg,"resistance in series with SCR gate in ohm
  is")
14 ig=500;//in mA
15 rg=(vr/(ig*10^-3))-g;//resistance in ohms
16 pg=(ig*10^-3)^2*(g);//
17 disp("part (b)")

```

```

18 disp(pg,"gate power dissipation in Watt is")
19 ogv=0.3;//in watts
20 d=(ogv/pg)*100;//
21 t1=(t)/(d/100);//in micro seconds
22 f1=(1/(t1*10^-3));//frequency in kHz
23 disp("part (c)")
24 disp(f1,"triggering frequency in kHz is")

```

Scilab code Exa 2.7.9 series resistance

```

1 //Example 2.7.9;//series resistance and power
  dissipation
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 vr=12;//in volts
8 t=50;//in micro seconds
9 d=0.2;//duty cycle
10 pd=5;//power dissipation in watts
11 Ig=poly(0,"Ig");
12 p=-5+1.5*Ig+8*Ig^2;//
13 x=roots(p);//
14 rg=(vr-(1.5+8*x(2,1)))/(x(2,1));//resistance in ohms
15 pg=d*pd;//average power loss in watts
16 disp(round(rg),"resistance Rg in ohm is")
17 disp(pg,"average power loss in Watt is")

```

Scilab code Exa 2.7.10 design

```

1 //Example 2.7.10;// design
2 clc;

```

```

3 clear;
4 close;
5 //given data :
6 format('v',6)
7 vs=20;//in volts
8 c1=0.1;//in micro farads
9 vv=2.5;//in volts
10 n=0.66;//
11 ip=10;//in micro amperes
12 iv=10;//in mA
13 f=1;//in KHz
14 tg=40;//in micro seconds
15 vd=0.8;//in volts
16 vp=(n*vs+vd);//in volts
17 r1=((tg*10^-6/(c1*10^-6)));// in ohms
18 r=((1)/(f*10^3*c1*10^-6*log(1/(1-n))))*10^-3;//in
    killo ohms
19 rmin=(vs-vv)/iv;//minimum resistance in killo ohms
20 rmax=(vs-vp)/ip;//maxium resistance in killo ohms
21 r2=10^4/(n*vs);//in ohms
22 disp(vp,"Vp in volts is")
23 disp(r1,"R1 in ohm is")
24 disp(r,"R in kilo ohm is")
25 disp(rmin,"minimum resistance in kilo ohm is")
26 disp(rmax*10^3,"maximum resistance in kilo ohm is")
27 disp(round(r2),"R2 in ohm is")

```

Scilab code Exa 2.7.11 trigger angle

```

1 //Example 2.7.11;// trigger angle
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',5)

```

```

7  vm=120*sqrt(2); //in volts
8  vrb=0.7; //in volts
9  rb=500; //in ohms
10 rl=1000; //in ohms
11 rmin=1000; //in ohms
12 r=4000; //in ohms
13 alpha=asind((0.7*(rl+rmin+r+rb))/(rb*vm)); //in
    degree
14 disp(alpha,"triggering angle in degree is")

```

Scilab code Exa 2.7.12 pulse width

```

1  //Example 2.7.12; // pulse width
2  clc;
3  clear;
4  close;
5  //given data :
6  format('v',5)
7  v=200; //in volts
8  il=100; //latch current in mA
9  l=0.2; //inductance in henry
10 dit=v/l; //in amp/sec
11 dt=(il*10^-3)/dit; //in seconds
12 disp("part (a)")
13 disp(dt*10^6,"minimum pulse width required to turn
    on the SCR is in micro seconds")
14 r=20; //in ohms
15 x=(il*10^-3*r)/v; //
16 t=(log(1-x))*(-l/r); //
17 disp("part (b)")
18 disp(round(t*10^6),"minimum pulse width in micro
    seconds is")
19 //part b answer is calculated wrong in the textbook

```

Scilab code Exa 2.7.13 design the triggering circuit

```
1 //Example 2.7.13; // design
2 clc;
3 clear;
4 close;
5 format('v',6)
6 vs=30; //in volts
7 n=0.51; //
8 vd=0.7; //in volts
9 vp=(n*vs+vd); //in volts
10 c=0.1; //in micro farads
11 vv=3.5; //in volts
12 x=log(vv/(vp-vd)); //
13 t2=50; //in micro seconds
14 r3=-((t2*10^-6)/(x*c*10^-6)); //in ohms
15 f=50; //in Hz
16 t=(1/f)*10^3; //in ms
17 t1=(t-(t2*10^-6)); //inms
18 x1=log(1-((vp-vv)/(vs))); //
19 y1=(-t1*10^-3)/(c*10^-6); //
20 r1=y1/x1; //in ohms
21 r2=(10^4)/(n*vs); //in ohms
22 disp(r1*10^-3,"R1 in ohm is")
23 disp(r2,"R2 in ohm is")
24 disp(round(r3),"R3 in ohm is")
25 disp(c,"capaictance in micro Farad is")
26 //R3 is wrong in the textbook
```

Chapter 3

Single phase controlled rectifiers

Scilab code Exa 3.3.1 form factor ripple factor transformation utilization factor and peak inverse voltage

```
1 // Example 3.3.1: form factor , ripple factor ,
   transformation utilization factor and peak
   inverse voltage
2 clc;
3 clear;
4 close;
5 Vm=1; //assume
6 R=1; //assume
7 t=%pi/3:%pi;
8 Vldc= ((Vm/(2*%pi))*intsplin(t, sin(t))); //
9 Vlms=sqrt((Vm^2/(2*%pi))*intsplin(t, (sin(t))^2)); //
10 ff=Vlms/Vldc;
11 disp(" part (a)")
12 disp("form factor is "+string(ff)+" or "+string(ff
   *100)+" percentage")
13 //form factor is calculated wrong in the textbook
14 disp(" part (b)")
15 rf=sqrt(ff^2-1); //
```

```

16 disp("ripple factor is "+string(rf)+ " or "+string(
    rf*100)+" percentage")
17 //ripple factor is calculated wrong in the textbook
18 Vs=Vm/(sqrt(2)); //rms secondary voltage
19 Is=Vlms/R; //
20 TUF=((Vldc^2)/R)/(Vs*Is); //
21 disp(" part (c)")
22 disp("transformation utilization factor is "+string(
    TUF)+ " or "+string(TUF*100)+" percentage")
23 //transformation utilization factor is calculated
    wrong in the textbook
24 R=1; //assume
25 Vm=1; //assume
26 disp(" part (d)")
27 disp("PIV=Vm")

```

Scilab code Exa 3.4.1 plot the variation

```

1 // Example 3.4.1: plot the variation
2 clc;
3 clear;
4 close;
5 vsrms=230; //volts
6 vm=sqrt(2)*vsrms; //volts
7 alpha=[0;30;60;90;120;150;180]; //degree
8 x=[0;(30*(%pi/180));(60*(%pi/180));(90*(%pi/180))
    ;(120*(%pi/180));(150*(%pi/180));(180*(%pi/180))]
9 for i=1:7
10     vldc(i)=(vm/%pi)*(1+cosd(alpha(i))); //
11     vlms(i)=vsrms*((1/%pi)*(%pi-x(i)+(sin(2*x(i)))
        /2))^(1/2); //
12 end
13 subplot(1,2,1)
14 xlabel("alpha"); //
15 ylabel("Vldc"); //

```

```

16 xtitle('(a) Variation of average load voltage')
17 plot(alpha,vldc);//
18
19 subplot(1,2,2)
20 xlabel("alpha");//
21 ylabel("Vrms");//
22 xtitle('(b) Variation of RMS load voltage')
23 plot(alpha,vlms);//

```

Scilab code Exa 3.4.5 delay angle average output current average and rms thyristor current

```

1 // Example 3.4.5: delay angle ,rms , averae output
   current ,average and rms thyristor current
2 clc;
3 clear;
4 close;
5 format('v',5)
6 Vrms=120; //RMS VOLTAGE
7 R=10; //in ohms
8 Vldc= (0.25*(2*sqrt(2)*Vrms))/pi; //in volts
9 csd= (Vldc*pi)/(sqrt(2)*Vrms); //
10 alpha= acosd(csd-1); //
11 disp("part (a)")
12 disp(alpha,"delay angle in degree is")
13 Vrms=120; //RMS VOLTAGE
14 Vm=sqrt(2)*Vrms; //assume
15 t=2*pi/3:pi;
16 Vlms=((Vm/(sqrt(2)))*(((1/pi)*((pi-(2*pi)/3)+sind
   ((4*pi)/6))))^(1/2));
17 Vldc= (0.25*(2*sqrt(2)*Vrms))/pi; //in volts
18 Ildc=Vldc/R; //average load current in ampere
19 Ilms=Vlms/R; // rms load current in ampere
20 disp("part (b)")
21 disp(Ilms,"rms load current in amperes")

```



```

22 disp(Ildc," average load current in amperes")
23 //rms load current is calculated wrong in the
    textbook
24 Im=Vm/R; //
25 Ith=((Im/(2*%pi))*intsplin(t, sin(t))); //in amperes
26 Ithrms=sqrt((Im^2/(2*%pi))*intsplin(t, (sin(t))^2));
    //in amperes
27 disp(" part (c)")
28 disp(Ith," average thyristor current in amperes is")
29 disp(Ithrms," rms thyristor current in amperes is")
30 //average and rms thyrister current is calculated
    wrong in the textbook

```

Scilab code Exa 3.6.1 average load voltage rms load voltage average and rms load currents form factor and ripple factor

```

1 // Example 3.6.1: average load voltage ,rms load
    voltage ,average and rms load currents ,form
    factor and ripple factor
2 clc;
3 clear;
4 close;
5 format('v',7)
6 R=10; //IN OHMS
7 r=10; //IN OHMS
8 Vi=230; //in volts
9 alpha=60; //firng angle in degree
10 Vm=Vi*sqrt(2); //in voltas
11 Vldc=((Vm)/%pi)*(1+cosd(alpha)); //average load
    voltgae
12 disp(" part (a)")
13 disp(Vldc," average load voltage in volts")
14 disp(" part (b)")
15 r=10; //IN OHMS
16 Vi=230; //in volts

```

```

17 alpha=60; // firing angle in degree
18 Vm=Vi*sqrt(2); // in volts
19 Vlms=((Vm/(sqrt(2)))*(((%pi-%pi/3)+(sind(2*%pi/3))
    /2)/%pi)^(1/2)); //
20 disp(Vlms,"rms load voltage in volts")
21 //rms voltage is calculated wrong in the textbook
22 disp(" part (c)")
23 Ildc=Vldc/R; // in amperes
24 Irms=Vlms/R; // in amperes
25 disp(Irms,"rms load current in ampere")
26 disp(Ildc,"average load current in ampere")
27 //rms load current is wrong in the textbook
28 disp(" part (d)")
29 ff=Vlms/Vldc;
30 disp("form factor is "+string(ff)+" or "+string(ff
    *100)+" %")
31 rf=sqrt(ff^2-1); //
32 disp("ripple factor is "+string(rf)+" or "+string(
    rf*100)+" %")
33 //form factor and ripple factor is calculated wrong
    in the textbook

```

Scilab code Exa 3.7.1 device rating

```

1 // Example 3.7.1: device ratings
2 clc;
3 clear;
4 close;
5 Io=25; // in amperes
6 Vsrms=120; // in volts
7 Vm=sqrt(2)*Vsrms; // in volts
8 for i= 1:5
9     alpha=[0;60;90;135;180]
10    Vldc(i)=((Vm)/%pi)*(1+cosd(alpha(i,1))); //
11    disp(round(Vldc(i)),"mean voltage in volts is

```

```

        at angle "+string(alpha(i,1))+ " degree")
12 end
13 PIV=Vm; //peak inverse voltage
14 Iascr=Io/2; //scr average current in ampere
15 Iadod=Io; //average diode current in amperes
16 Ipscr=Iascr; //peak current rating for SCR in amperes
17 Ipdod=Iadod; //peak current rating for diode in
    amperes
18 disp(Iascr,"scr average current in amperes")
19 disp(Iadod,"average diode current in amperes")
20 disp(Ipscr,"peak current rating for SCR in amperes")
21 disp(Ipdod,"peak current rating for diode in amperes
    ")

```

Scilab code Exa 3.7.2 Vldc Vn Vlrms HF DF and PF

```

1 // Example 3.7.2: Vldc ,Vn, Vlrms ,HF,DF and PF
2 clc;
3 clear;
4 close;
5 format('v',7)
6 Vsrms=120; //in volts
7 alpha=%pi/2; //
8 vm=sqrt(2)*Vsrms; //
9 vldc=((sqrt(2)*Vsrms)/(%pi))*(1+cos(alpha)); //in
    volts
10 vldcm=(2*vm)/(%pi); //in volts
11 vn=vldc/vldcm; //normalised average output voltage in
    volts
12 x=((1/%pi)*((%pi-alpha)+(sin((2*alpha)))/2))^(1/2);
    //
13 vlrms=((vm/sqrt(2))*x); //RMS load voltage in volts
14 Io=1; //assume
15 Isrms=Io*(1-(alpha/%pi))^(1/2); //in amperes
16 Is1rms=((2*sqrt(2))*Io*cos(alpha/2))/(%pi); //in

```

```

    amperes
17 HF=((Isrms/Is1rms)^2-1)^(1/2); //Harmonic Fator is
18 DF=cos(alpha/2); //Displacement factor
19 PF=(Is1rms/Isrms)*(DF); //power factor
20 disp(round(vldc), "average output voltage (Vldc) in
    volts is")
21 disp(vn, "Normalised average output voltage (Vn) in
    volts is")
22 disp(vlrms, "RMS load voltage (Vlrms) in volts is")
23 disp(HF*100, "Harmonic factor (HF) in percentage is")
24 disp(DF*100, "Displacement factor (DF) in percentage
    is")
25 disp(PF, "power factor (PF) lagging is")

```

Scilab code Exa 3.7.3 amlitude of first four harmonic components

```

1 // Example 3.7.3:amlitude of first four harmonic
    components
2 clc;
3 clear;
4 close;
5 format('v',7)
6 io=1; //assume
7 alpha=%pi/2; //
8 n=[0;0;(1/(%pi*3));0;(1/(%pi*5));0;(1/(%pi*7))
    ;0;(1/(%pi*9))]; //
9 for i= [3;5;7;9]
10     m(i)=((2*sqrt(2))*cos(((i)*alpha)/2));
11 end
12 x=[0;0;m(3)*n(3);0;m(5)*n(5);0;m(7)*n(7);0;m(9)*n(9)
    ]; //
13 for i=[3;5;7;9]
14     disp("RMS value of "+string(i)+" harmonic is I"+
        string((i))+ " = "+string(x(i))+ "Io ")
15 end

```

Scilab code Exa 3.7.4 Vldc FPF and PF

```
1 // Example 3.7.4: Vldc, FPF and PF
2 clc;
3 clear;
4 close;
5 format('v',4)
6 disp("part (a)")
7 vm=1; //assume
8 alpha=[0;30;60;90;120;150;180]; //in degree
9 for i=1:7
10     vldc(i)=(vm/%pi)*(1+cosd(alpha(i))); //
11     disp("average load voltage (Vldc) for angle "+
12         string(alpha(i))+ " degree is Vm*"+string(vldc
13         (i))+ " ")
14 end
15 subplot (2,2,1)
16 plot2d(alpha,vldc); //
17 xlabel("alpha (degrees)")
18 ylabel("average voltage (Vldc)")
19 xtitle("(a) Variation of Vldc Vs alpha")
20 disp("part (b)")
21 format('v',6)
22 vm=1; //assume
23 alpha=[0;30;60;90;120;150;180]; //in degree
24 for i=1:7
25     FPF(i)=cosd((alpha(i))/2)
26     disp("displavefactor or fundamental power
27         factor (FPF) for fringle angle "+string(
28         alpha(i))+ " degree is "+string(FPF(i))+ " ")
29 end
30 subplot (2,2,2)
31 plot2d(alpha,FPF); //
32 xlabel("alpha (degrees)")
```

```

29 ylabel("FPF")
30 xtitle("(b) Variation of FPF Vs alpha")
31 disp("part (c)")
32 vm=1; //assume
33 alpha1=[0;30;60;90;120;150;180]; //
34 alpha=[0;%pi/6;%pi/3;%pi/2;(2*%pi)/3;(5*%pi)/6;%pi];
    //in degree
35 for i=1:6
36
37     PF(i)=(sqrt(2)*(1+cos(alpha(i))))/sqrt((%pi)*(
        %pi-alpha(i))) );
38     PF(7)=0; //
39     disp("displavefactor or fundamental power
        factor (FPF) for fringle angle "+string(
        alpha1(i))+ " degree is "+string(PF(i))+ " ")
40 end
41 subplot (2,2,3)
42 plot2d(alpha1,PF); //
43 xlabel("alpha (degrees)")
44 ylabel("FPF")
45 xtitle("(c) Variation of PF Vs alpha")

```

Scilab code Exa 3.7.5 alpha

```

1 // Example 3.7.5; alpha
2 clc;
3 clear;
4 close;
5 format('v',4)
6 disp("part (a)")
7 vc=135; //in volts
8 vs=220; //in vlts
9 rl=0.5; //in ohms
10 io=10; //in ampeerres
11 vm=sqrt(2)*vs; //

```

```

12 vldc=io*r1+vc; //
13 alpha=acosd((vldc*%pi)/(2*vm)); //
14 disp("alpha is in degree "+string(alpha)+" ")
15 disp(" part (b)")
16 vc=145; //in volts
17 vs=220; //in vlts
18 r1=0.5; //in ohms
19 io=10; //in ampeeres
20 vm=sqrt(2)*vs; //
21 vldc=io*r1-vc; //
22 alpha=acosd((vldc*%pi)/(2*vm)); //
23 disp("alpha in degree "+string(alpha)+" ")

```

Scilab code Exa 3.7.6 average output voltage supply rms current supply fundamental current current displacement factor supply factor and supply harmonic factor

```

1 // Example 3.7.6: average output voltage ,supply rms
  current ,supply fundamental current ,
  displacement factor ,supply factor and supply
  harmonic factor
2 clc;
3 clear;
4 close;
5 format('v',6)
6 Vsrms=220; //in volts
7 alpha=%pi/3; //
8 vm=sqrt(2)*Vsrms; //
9 vldc=((2*vm)/(%pi))*(cos(alpha)); //in volts
10 vldcm=(2*vm)/(%pi); //in volts
11 vn=vldc/vldcm; //normalised average output voltage in
  volts
12 x=((1/%pi)*((%pi-alpha)+(sin((2*alpha)))/2))^(1/2);
  //
13 vlrms=((vm/sqrt(2))*x); //RMS load voltage in volts

```

```

14 Io=1; //assume
15 Isrms=Io*(1-(alpha/%pi))^(1/2); //in amperes
16 Is1rms=((2*sqrt(2))*Io*cos(alpha/2))/(%pi); //in
    amperes
17 HF=((Isrms/Is1rms)^2-1)^(1/2); //Harmonic Fator is
18 DF=cos(alpha/2); //Displacement factor
19 PF=(Is1rms/Isrms)*(DF); //power factor
20 disp(" part (a)")
21 disp(round(vldc)," average output voltage (Vldc)in
    volts is")
22 disp(" part (b)")
23 disp("due to exact 50% duty cycle the rms value of
    supply current Isrms=Io")
24 Io=1; //assume
25 Isrms=Io; //in amperes
26 Is1rms=((2*sqrt(2))*Io)/(%pi); //in amperes
27 disp(" part (c)")
28 disp("supply fundamental current is "+string(Is1rms)
    +" Io ")
29 disp(" part (d)")
30 DF=cos(alpha); //
31 disp(DF," displacement factor is")
32 disp(" part (a)")
33 SPF=Is1rms*DF; //
34 disp(SPF," supply power factor is (lagging)")
35 disp(" part (f)")
36 HF=((Isrms/Is1rms)^2-1)^(1/2); //
37 disp(HF*100," supply harmonic factor in percentage is
    ")

```

Scilab code Exa 3.7.7 amplitude of the first three lower order harmonics

```

1 // Example 3.7.7:amlitude of first three harmonic
    components
2 clc;

```



```
3 clear;
4 close;
5 format('v',6)
6 io=1; //assume
7 n=[0;0;3*pi;0;5*pi;0;%pi*7]
8 for i= [3;5;7]
9     m(i)=((2*sqrt(2))*io);
10 end
11 x=[0;0;m(3)/n(3);0;m(5)/n(5);0;m(7)/n(7);]; //
12 for i=[3;5;7]
13     disp("RMS value of "+string(i)+" harmonic is I"+
14         string((i))+ " = "+string(x(i))+ "Io ")
14 end
```

Chapter 4

Three phase controlled rectifiers

Scilab code Exa 4.8.2 current

```
1 //Example 4.8.2: current
2 clc;
3 clear;
4 close;
5 io=1; //assume
6 t0=0; //
7 t1=(2*%pi)/3; //
8 th=integrate('1','t',t0,t1); //
9 th1=(1/(2*%pi))*th; //
10 x=th1^(1/2); //
11 disp("Ithrms is "+string(x)+"*Io")
```

Chapter 5

Inverters

Scilab code Exa 5.3.1 frequency

```
1 //Example 5.3.1: Maximum frequency
2 clc;
3 clear;
4 close;
5 //given data :
6 T_off=100; // in micro-sec
7 L=40; // in micro-H
8 C=5; // in micro-farad
9 R=4; //in ohm
10 Tr=((2*%pi)/sqrt((1/(C*10^-6*L*10^-6))-(R^2/(4*(L
    *10^-6)^2))))*10^6;
11 f=(1/(Tr+T_off))*10^3;
12 disp(f,"maximum frequency , f(kHz) = ")
```

Scilab code Exa 5.12.1 rms output voltage output power average and peak currents peak reverse blocking voltage THD DF harmonic factor and distortion factor of the lowest order harmonic

```

1 //Example 5.12.1: rms output voltage ,output power ,
   average and peak currents ,peak reverse blocking
   voltage ,THD,DF,harmonic factor and distortion
   factor of the lowest order harmonic
2 clc;
3 clear;
4 close;
5 disp(" part (a)")
6 format('v',5)
7 v=24;//in volts
8 V=v;//
9 r=3;//in ohms
10 v1rms=(2*v)/(sqrt(2)*%pi);//in volts
11 disp(v1rms,"rms output voltage at fundamental
   frequency in volts is")
12 disp(" part (b)")
13 po=((v/2)^2)/r;//in watts
14 disp(po,"output power in Watt is")
15 disp(" part (c)")
16 itav=(v/(4*r));//in amperes
17 itp=((v/2)/r);//in amperes
18 disp(itav,"average transistor current in amperes is"
   )
19 disp(itp,"transistor peak current in amperes is")
20 disp(" part (d)")
21 vbr=2*(v/2);//in volts
22 disp(vbr,"peak reverse bloacking voltage in volts is
   ")
23 disp(" part (e)")
24 vo=v/2;//
25 THD1=((vo)^2-(v1rms)^2)^(1/2);//in volts
26 THD=THD1/v1rms;//
27 disp(THD*100,"Total Hramonic distortion in
   percentage is")
28 disp(" part (f)")
29 n=[0;0;(1/3);0;(1/5);0;(1/7);0;(1/9);0;(1/11)
   ;0;(1/13)];//
30 for i=[3;5;7;9;11;13]

```

```

31     v(i)=(2*V)*((n(i)))/(%pi*sqrt(2));//
32 end
33 x=sqrt((((v(3))/(3^2))^2)+(((v(5))/(5^2))^2)+(((v(7)
    )/(7^2))^2)+(((v(9))/(9^2))^2)+(((v(11))/(11^2))
    ^2)+(((v(13))/(13^2))^2));//
34 DF=x/v1rms;//
35 disp(DF*100,"distortion factor in percentage is")
36 //distortion factor is calculated wrong in the
    textbook
37 disp("part (g)")
38 HF3=v(3)/v1rms;//
39 DF3=((v(3))/(3^2))/v1rms
40 disp(HF3*100,"HF for the third harmonic in
    percentage is")
41 disp(DF3*100,"DF the third harmonic in percentage is
    ")

```

Scilab code Exa 5.12.2 rms output voltage output power average and peak currents peak reverse blocking voltage THD DF harmonic factor and distortion factor of the lowest order harmonic

```

1 //Example 5.12.2: rms output voltage ,output power ,
    average and peak currents ,peak reverse blocking
    voltage ,THD,DF,harmonic factor and distortion
    factor of the lowest order harmonic
2 clc;
3 clear;
4 close;
5 format('v',5)
6 v=48;//in volts
7 V=v;//
8 r=2.4;//in ohms
9 v1rms=(4*v)/(sqrt(2)*%pi);//in volts
10 disp("part (a)")
11 disp(v1rms,"rms output voltage at fundamental

```

```

    frequency in volts is")
12 disp(" part (b)")
13 po=((v)^2)/r;//in watts
14 disp(po,"output power in Watt is")
15 disp(" part (c)")
16 itav=(v/(r));//in amperes
17 itp=((v/2)/r);//in amperes
18 disp(itp,"average transistor current in amperes is")
19 disp(itav,"transistor peak current in amperes is")
20 disp(" part (d)")
21 vbr=2*(v/2);//in volts
22 disp(vbr,"peak reverse bloacking voltage in volts is
    ")
23 disp(" part (e)")
24 vo=v;//
25 THD1=((vo)^2-(v1rms)^2)^(1/2);//in volts
26 THD=THD1/v1rms;//
27 disp(THD*100,"Total Hramonic distortion in
    percentage is")
28 disp(" part (f)")
29 n=[0;0;(1/3);0;(1/5);0;(1/7);0;(1/9);0;(1/11)
    ;0;(1/13)];//
30 for i=[3;5;7;9;11;13]
31     v(i)=(2*V)*((n(i)))/(pi*sqrt(2));//
32 end
33 x=sqrt((((v(3))/(3^2))^2)+(((v(5))/(5^2))^2)+(((v(7)
    )/(7^2))^2)+(((v(9))/(9^2))^2)+(((v(11))/(11^2))
    ^2)+(((v(13))/(13^2))^2));//
34 vorms=0.9
35 DF=x/vorms;//
36 disp(DF*100,"distor factor in percentage is")
37 //distortion factor is calculated wrong in the
    textbook
38 disp(" part (g)")
39 HF3=2*v(3)/v1rms;//
40 DF3=2*((v(3))/(3^2))/v1rms
41 disp(HF3*100,"HF for the third harmonic in
    percentage is")

```

```
42 disp(DF3*100,"DF the third harmonic in percentage is  
    ")
```

Scilab code Exa 5.12.3 amplitude of the first three lower order harmonics

```
1 //Example 5.12.3: amplitude of the first three lower  
  order harmonis  
2 clc;  
3 clear;  
4 close;  
5 //given data :  
6 v=200;//in volts  
7 n=[(1/3);(1/5);(1/7)];//  
8 for i=1:3  
9     vn(i)=((4*v*n(i))/(sqrt(2)*%pi));//  
10 end  
11 disp(round(vn(1)),"Rms value of third harmonic  
    component of output voltage in volts is")  
12 disp(round(vn(2)),"Rms value of fifth harmonic  
    component of output voltage in volts is")  
13 disp((vn(3)),"Rms value of seventh harmonic  
    component of output voltage in volts is")
```

Scilab code Exa 5.12.4 compare performance

```
1 //Example 5.12.4: amplitude of the first three lower  
  order harmonis  
2 clc;  
3 clear;  
4 close;  
5 //given data :  
6 v=200;//in volts  
7 n=[(1/3);(1/5);(1/7)];//
```

```

8 vo1rms=(2*v)/(sqrt(2)*%pi); //in volts
9 for i=1:3
10     vn(i)=((2*v*n(i))/(sqrt(2)*%pi)); //
11 end
12 disp(round(vo1rms),"Volrms for half bridge circuit
    in volts is")
13 disp(round(vn(1)),"Rms value of third harmonic
    component for half bridge circuit in volts is")
14 disp(round(vn(2)),"Rms value of fifth harmonic
    component for half bridge circuit in volts is")
15 disp((vn(3)),"Rms value of seventh harmonic
    component for half bridge circuite in volts is")
16 disp("for bridge inverter")
17 vo1rms1=(4*v)/(sqrt(2)*%pi); //in volts
18 for i=1:3
19     vn1(i)=((4*v*n(i))/(sqrt(2)*%pi)); //
20 end
21 disp(round(vo1rms1),"Volrms for half bridge circuit
    in volts is")
22 disp(round(vn1(1)),"Rms value of third harmonic
    component for bridge inverter circuit in volts
    is")
23 disp(round(vn1(2)),"Rms value of fifth harmonic
    component for half bridge inverter circuit in
    volts is")
24 disp((vn1(3)),"Rms value of seventh harmonic
    component for half bridge inverter circuite in
    volts is")

```

Chapter 6

Choppers

Scilab code Exa 6.5.1 average load voltage RMS load voltage Form factor and Ripple factor

```
1 //Example 6.5.1: average load voltage ,RMS load
   voltage ,Form factor and Ripple factor
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data
7 f=1; //in kHz
8 t=1/f; //in ms
9 d=0.3; //
10 v=200; //
11 vch=2; //in volts
12 vldc=(v-vch)*d; //average load voltage in volts
13 disp(" part (a)")
14 disp(vldc," average load voltage in volts is")
15 disp(" part (b)")
16 vlrms=(v-vch)*sqrt(d); //RMS load voltage in volts
17 disp(vlrms,"RMS load voltage in volts is")
18 disp(" part (c)")
19 FF=vlrms/vldc; //
```

```

20 disp(" ripple factor is "+string(FF)+" or "+string(FF
    *100)+"%")
21 disp(" part (d)")
22 rf=sqrt(FF^2-1);//
23 disp(" ripple factor is "+string(rf)+" or "+string(rf
    *100)+"%")

```

Scilab code Exa 6.5.2 chooper efficiency input resistance and average load current

```

1 //Example 6.5.2: chooper efficiency ,input resistance
  and average load current
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data
7 r=10; //in ohms
8 f=1; //in kHz
9 t=1/f; //in ms
10 d=0.3; //
11 v=200; //
12 vch=2; //in volts
13 Po=((v-vch)^2)*(d/r); //in watts
14 Pi=((d*v*(v-vch))/r); //in watts
15 cn=Po/Pi; //chopper efficiency
16 disp(" part (a)")
17 disp(" chopper efficiency is "+string(cn)+" or "+
    string(cn*100)+"%")
18 disp(" part (b)")
19 R1=r/d; //
20 disp(R1,"input resistance in ohm is")
21 disp(" part (c)")
22 vldc=59.4; //V
23 r=10; //ohm

```

```
24 Ildc=vldc/r;//amp
25 disp(Ildc,"average load current is ,(A)=")
```

Scilab code Exa 6.5.3 Duty Cycle Average Load voltage and RMS Load Voltage

```
1 //Example 6.5.3: Duty Cycle ,Average Load voltage and
  RMS Load Voltage
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data
7 V=200;// in volts
8 T_on=500*10^-6;
9 f=1*10^3;// in Hz
10 D=T_on*f;
11 disp("part (a)")
12 disp("duty cycle is "+string(D)+" or "+string(D*100)
  +"%")
13 disp("part (b)")
14 VL_dc=D*V;
15 disp(VL_dc,"Average Load Voltage ,(volts) = ")
16 disp("part (c)")
17 VL_rms=sqrt(D)*V;
18 disp(VL_rms,"RMS Load Voltage ,VL_rms(volts) = ")
19 //part c answer is calculated wrong in book
```

Scilab code Exa 6.5.4 plot the variation

```
1 //Example 6.5.4: average load voltage and rms load
  voltage
2 clc;
```

```

3 clear;
4 close;
5 //given data
6 for i=1:10
7     sr(i)=i;//
8     d(1)=0;
9     d(i+1)=d(i)+0.1;//
10 end
11 for i=1:11
12     v=1;//
13     vldc(i)=d(i)*v;//
14     vlrms(i)=sqrt(d(i))*v;//
15 end
16 X = [sr];
17 Y = [d];
18 Z = [vldc];
19 U= [vlrms];
20 disp(Z,"Vldc different values of average load
        voltage are in volts")
21 disp(U,"Vlrms diffent values of RMS load voltage are
        in volts")
22 plot(d,[vlrms vldc]);
23 xlabel("DUTY CYCLE D")
24 ylabel("Vldc & Vlrms Volts")
25 xtitle("Variation of Vldc and Vlrms with duty cycle
        D")

```

Scilab code Exa 6.5.5 plot the variation

```

1 //Example 6.5.5: average load voltage and rms load
  voltage
2 clc;
3 clear;
4 close;
5 //given data

```

```

6 d=[0.1;0.2;0.3;0.4;0.5;0.6;0.7;0.8;0.9;1.0]
7 for i=1:10
8     FF(i)=(1/sqrt(d(i)))*100; //
9     RF(i)=((((FF(i))/100)^2)-1)^(1/2))*100; //
10 end
11
12 disp(FF,"FF different values of form factor in
    percentage is")
13 disp(RF,"RF different values of ripple factor in
    percentage is")
14 plot(d,[FF RF]);
15 xlabel("DUTY CYCLE D")
16 ylabel("FF & RF (%)")
17 xtitle("Variation of FF and RF with duty cycle D")
18 hl=legend(['FF %'; 'RF %']);

```

Scilab code Exa 6.5.6 Average output voltage RMS output voltage chopper efficiency and Effective input resistance

```

1 //Example 6.5.6: Average output voltage ,RMS output
    voltage ,chopper efficiency and Effective input
    resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',6)
7 r=10; //in ohms
8 d=0.3; //
9 v=230; //
10 vch=1.5; //in volts
11 D=80/100; // duty cycle
12 V=220; // in volts
13 Vch=1.5; //in volts
14 VL_dc=D*(V-Vch);

```

```

15 disp(" part (a)")
16 disp(VL_dc," Average output voltage ,VL_dc(V) = ")
17 disp(" part (b)")
18 VL_rms=sqrt(D)*(V-Vch);
19 disp(VL_rms,"RMS output voltage ,VL_rms(V) = ")
20 disp(" part (c)")
21 Po=((v-vch)^2)*(d/r); //in watts
22 Pi=((d*v*(v-vch))/r); //in watts
23 cn=Po/Pi; //chopper efficiency
24 disp(" chopper efficiency is "+string(cn)+" or "+
      string(cn*100)+"%")
25 disp(" part (d)")
26 D=80/100; // duty cycle
27 R=20; //in ohm
28 Ri=R/D;
29 disp(Ri," Effective input resistance ,Ri(ohm) = ")

```

Scilab code Exa 6.5.7 average output voltage and average load current

```

1 //Example 6.5.7.a; average output voltage and current
2 clc;
3 clear;
4 close;
5 //given data :
6 vs=120; //in volts
7 vb=1; //in volts
8 d=0.33; //
9 r1=10; //in ohms
10 f=200; //in Hz
11 Vldc=d*vs; //
12 Ildc=round(Vldc)/r1; //in amperes
13 disp(round(Vldc)," average/DC output voltage in volts
      is")
14 disp(Ildc," average load current in amperes is")

```

Scilab code Exa 6.6.5 average armature current

```
1 //Example 6.6.5 : Average armature current
2 clc;
3 clear;
4 close;
5 //given data :
6 V=200; // in volts
7 D=50/100; // duty cycle
8 VL_dc=V*D;
9 Eb=75; // in volts
10 Ra=1; // in ohm
11 Ia=(VL_dc-Eb)/Ra;
12 disp(Ia,"Average armature current ,Ia(A) = ")
```

Scilab code Exa 6.6.6 minimum instantaneous load current peak instantaneous current and maximum peak to peak ripple

```
1 //Example 6.6.6 :minimum instantaneous load current ,
   peak instantaneous current and maximum peak to
   peak ripple
2 clc;
3 clear;
4 close;
5 format('v',6)
6 v=220; //volts
7 r=10; //in ohms
8 l=15.5; //in mH
9 f=5; //in kHz
10 Eb=20; //in volts
11 d=0.5; //
12 x=exp((- (1-d)*r)/(f*10^3*l*10^-3)); //
```

```

13 y=(1-x)*(Eb/r); //
14 y1=(1-x)*((v-Eb)/r); //
15 A=[0.94 -0.94*0.94;0.94 -1];
16 B=[-0.94*0.125;-1.25];
17 X=A\B; //
18 disp(" part (a)")
19 disp(X(1,1),"minimum instantaneous current in
    amperes is")
20 disp(" part (b)")
21 disp(X(2,1),"peak instantaneous current in amperes
    is")
22 disp(" part (c)")
23 PP=X(2,1)-X(1,1); //
24 disp(PP,"maximum peak to peak ripple in the load
    current in amperes is")

```

Scilab code Exa 6.6.7 load inductance

```

1 //Example 6.6.7; inductance
2 clc;
3 clear;
4 close;
5 v=220; //in volts
6 r=0.2; //in ohms
7 ia=200; //in amperes
8 f=200; //in hz
9 di=0.05*ia; //in amperes
10 e=0; //in volts
11 d=0.5; //
12 l=((1-d)*v*d*(1/f))/di; //
13 disp(l*10^3,"inductance in mH is")

```

Scilab code Exa 6.6.9 load current is continuous or not Average output current maximum and minimum steady state output current and RMS values of first and second harmonics of the load current

```

1 //Example 6.6.9: load current is continuous or not ,
  Average output current , maximum and minimum
  steady state output current and RMS values of
  first and second harmonics of the load current
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',6)
7 V=220;//in volts
8 La=5;// in mH
9 Eb=24;//in volts
10 Ra=1;// in ohm
11 T=2;//in m-sec
12 D=0.6/2;
13 D_dash=(La/(T*Ra))*log(1-((Eb/V)*(1-exp((T*Ra)/La)))
  );
14 disp(" part (c)")
15 disp("As D = "+string(D)+"% is greater then D_dash =
  "+string(D_dash)+"% so load current is continous
  ")
16 disp(" part (d)")
17 Io=((D*V)-Eb)/Ra;
18 disp(Io,"Average output current ,Io(A) = ")
19 I_max=(V/Ra)*((1-exp(-(D*T*Ra)/La))/(1-exp(-(T*Ra)/
  La)))-(Eb/Ra);
20 disp(I_max,"Maximum steady state putput current ,
  I_max(A) = ")
21 I_min=(V/Ra)*((1-exp((D*T*Ra)/La))/(1-exp((T*Ra)/La)
  ))-(Eb/Ra);
22 disp(round(I_min),"Minimum steady state output
  current ,I_min(A) = ")
23 disp(" part (e)")
24 C1_rms=((2*V)/(%pi*sqrt(2)))*sin(%pi*D);// in volts

```

```

25 C2_rms=((2*V)/(2*%pi*sqrt(2)))*sin(2*%pi*D); // in
    volts
26 Z1=((Ra^2+(2*%pi*La*10^-3*(1/(T*10^-3)))^2)^(1/2));
    //
27 Z2=((Ra^2+(2*2*%pi*La*10^-3*(1/(T*10^-3)))^2)^(1/2))
    ;//
28 If1=C1_rms/Z1; //in amperes
29 If11=C2_rms/Z2; //in amperes
30 disp(If1,"fundamental component of load current in
    amperes is")
31 disp(If11,"second harmonic component of load current
    in amperes is")

```

Scilab code Exa 6.6.11 value of current limiting resistor maximum and minimum duty cycle

```

1 //Example 6.6.11: value of current limiting resistor
    ,maximum and minimum duty cycle
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 v=325; //in volts
8 eb=120; //in volts
9 r=0.2; //in ohms
10 ra=0.3; //in ohms
11 e=120; //in volts
12 rb=0.2; //in ohms
13 rl=0.3; //in ohms
14 d=60; //in percentage
15 i=20; //in amperes
16 vo=(d/100)*v; //
17 R=((i*rl)-(v-eb)+(i*rb))/(-i); //
18 disp(" part (a)")

```

```

19 disp(R,"value of current limiting resistor in ohm is
    ")
20 //value of current limiting resistor is calculated
    wrong in the textbook
21 disp("part (b)")
22 p=15; //
23 R=9.45; //
24 vmax=v+(v*(p/100)); //
25 vmin=v-(v*(p/100)); //
26 Dmax=((i*R)/vmin)*100; //
27 Dmin=((i*R)/vmax)*100; //
28 disp(Dmax,"maximum duty cycle in percentage is")
29 disp(Dmin,"minimum duty cycle in percentage is")

```

Scilab code Exa 6.9.1 output voltage

```

1 //Example 6.9.1 : pulse width and output voltage
2 clc;
3 clear;
4 close;
5 //given data :
6 v=220; //in volts
7 vo=660; //in volts
8 toff=100; //in micro seconds
9 ton=((vo*toff)/v)-toff; //in micro seconds T=ton+toff
    ; //in micro seconds
10 T=ton+toff;
11 f=(1/T); //in Hz
12 Vo=((v)/(1-(f*(ton/2)))); //in volts
13 disp(ton,"pulse width (ton) in micro seconds is")
14 disp(Vo,"new output voltage in volts is")

```

Scilab code Exa 6.9.2 chopping frequency and output voltage

```
1 //Example 6.9.2 :chopping frequency and new output
   voltage
2 clc;
3 clear;
4 close;
5 format('v',8)
6 //given data :
7 v=200;//in volts
8 vo=600;//in volts
9 ton=200;//in micro seconds
10 x=-((v/vo)-1);//
11 f=x/(ton*10^-6);//
12 ton1=ton/2;//
13 Vo=((v)/(1-(f*ton1*10^-6)));//in volts
14 disp(f,"chopping frequency in Hz is")
15 disp(Vo,"new output voltage in volts is")
```

Chapter 8

Control of DC drivers

Scilab code Exa 8.12.1 back emf Required armature voltage and Rated armature current

```
1 //Example 8.12.1: back emf ,Required armature
   voltage and Rated armature current
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 TL=45; // in N-M
8 N=1200; //in rpm
9 Rf=147; //in ohm
10 Ra=25; // in ohm
11 Kv=0.7032;
12 w=(2*pi*N)/60;
13 Vf=220; //in volts
14 Kt=Kv;
15 If=Vf/Rf;
16 T=TL;
17 Ia=T/(Kt*If);
18 Eg=Kv*w*Ia;
19 disp(" part (a)")
```

```

20 disp(Eg,"Back emf ,Eg( Volts) = ")
21 disp(" part (b)")
22 Ea=(Ia*(Ra/100))+Eg;
23 disp(Ea,"Required armature voltage ,Ea(volts) = ")
24 disp(" part (c)")
25 rac=11191.4/Vf; //
26 disp(rac,"rated armature current in amperes is")

```

Scilab code Exa 8.12.2 the field current Evaluation of alfa Evaluation of power factor

```

1 //Example 8.12.2: the field current ,Evaluation of
  alfa ,Evaluation of power factor
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 TL=50; // in N-M
8 N=1000; //in rpm
9 Rf=150; //in ohm
10 Ra=.25; // in ohm
11 Kv=0.7032;
12 alfa=0;
13 Vm=230; // in volts
14 Ef=((Vm*sqrt(2))/%pi)*(1+cosd(alfa));
15 If=Ef/Rf;
16 disp(" part (a)")
17 disp(If," Field current , If(A) = ")
18 disp(" part (b)")
19 w=(2*%pi*N)/60;
20 Ia=TL/(Kv*If);
21 Eg=Kv*w*If;
22 Ea=Eg+(Ra*Ia);
23 alfa_a=acosd(((Ea*%pi)/(Vm*sqrt(2)))-1);

```

```

24 disp(alfa_a,"angle in degree")
25 disp(" part (c)")
26 Ismax=Ia*((180-alfa_a)/180)^(1/2); //in amperes
27 PF=((Ea*Ia)/(Vm*Ismax)); //lagging
28 disp(PF,"power factor (lagging) is")

```

Scilab code Exa 8.12.3 torque

```

1 //Example 8.12.3: torque
2 clc;
3 clear;
4 close;
5 format('v',7)
6 //given data :
7 Ia=50; // in A
8 Rf=150; //in ohm
9 Ra=.25; // in ohm
10 Kv=1.4; // in V/A-rad/sec
11 alfa_f=0;
12 alfa_a=45; // in degree
13 Vm=230*sqrt(2); // in volts
14 Vs=230; // in volts
15 Ef=((2*Vm)/%pi)*(cosd(alfa_f));
16 If=Ef/Rf;
17 T=Kv*Ia*If;
18 disp(" part (a)")
19 disp(T,"Torque developed by the motor ,T(N/m) = ")
20 Ea=((2*Vm)/%pi)*(cosd(alfa_a));
21 Eg=Ea-(Ia*Ra);
22 w=Eg/(Kv*If);
23 N=(w/(2*%pi))*60;
24 disp(" part (b)")
25 disp(N,"Speed ,N(rpm) = ")
26 disp(" part (c)")
27 Ea=Eg+(Ra*Ia);

```

```

28 alfa_a=acosd(((Ea*%pi)/(Vm*sqrt(2)))-1);
29 Ismax=Ia*((180-alfa_a)/180)^(1/2); //in amperes
30 PF=((Ea*Ia)/(Vm*Ismax)); //lagging
31 disp(PF,"power factor (lagging) is")
32 //supply power factor is calculated wrong in the
    textbook

```

Scilab code Exa 8.12.4 Motor torque

```

1 //Example 8.12.4: Motor torque
2 clc;
3 clear;
4 close;
5 format('v',7)
6 //given data :
7 Vs_rms=230; // in volts
8 N=1200; // in rpm
9 Ia=40; // in A
10 Ra=0.25; //in ohm
11 Ka_fi1=0.182; // in V/rpm
12 Ka_fi=(0.182*60)/(2*%pi);
13 alfa_a=30;
14 T=Ka_fi*Ia;
15 disp("part (a)")
16 disp(T,"Motor torque ,T(N-m) = ")
17 disp("part (b)")
18 Ea=((2*sqrt(2)*Vs_rms)/%pi)*(cosd(alfa_a));
19 N=(Ea-(Ra*Ia))/Ka_fi1;
20 disp(N,"Speed of the motor ,N(rpm) = ")
21 disp("part (c)")
22 Is_rms=Ia;
23 PF=(Ea*Ia)/(Vs_rms*Is_rms);
24 disp(PF,"Power factor ,PF(lagging) = ")

```

Scilab code Exa 8.12.6 draw characteristics

```
1 //Example 8.12.6;Torque speed charaterstics
2 clc;
3 clear;
4 close;
5 format('v',7)
6 //given data :
7 v=230;//in volts
8 vm=sqrt(2)*v;//in clts
9 Ka=1;
10 QR=1;//
11 ra=0.05;//
12 alpha=30;//in degree
13 y=(60/(2*pi));//
14 z=((vm/pi)*(1+cosd(alpha)));//
15 x=(ra/(0.5)^2)
16 for i=1:8
17     wm(i)= (z-(i)*x)*y;//
18 end
19 wm=[(y*z);wm(1);wm(2);wm(3);wm(4);wm(5);wm(6);wm(7);
     wm(8)]
20 disp(wm,"varoius values of speed in RPM is")
21 T=[0;1;2;3;4;5;6;7;8];
22 plot2d(T,wm)
23 xlabel("Torque ,N-m")
24 ylabel("Speed (rpm) for alpha=30 degree")
```

Scilab code Exa 8.18.1 No load speed firing angle Power Factor and speed regulation

```

1 //Example 8.18.1: No load speed ,firing angle ,Power
  Factor and speed regulation
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 Ra=0.075;//in ohm
8 alfa1=0;// in degree
9 alfa2=30;// in degree
10 VL_rms=480;// in volts
11 Ka_fi=0.3;// in V/rms
12 Vs_rms=round(VL_rms/sqrt(3));
13 Vm=sqrt(2)*Vs_rms;
14 Ea=round((3*sqrt(3)*Vm*cosd(alfa1))/%pi);
15 Ea1=((3*sqrt(3)*Vm*cosd(alfa2))/%pi);
16 Ia=(10/100)*160;// in A
17 N_0=(Ea-Ia*Ra)/Ka_fi;
18 N_30=(Ea1-Ia*Ra)/Ka_fi;
19 disp("part (a)")
20 disp(N_0,"No load speed at alfa=0 degree ,(rpm) = ")
21 disp(N_30,"No load speed at alfa=30 degree ,(rpm) = "
  )
22 disp("part (b)")
23 Ia=160;// in A
24 N=1800;// in rpm
25 Eg=540;// in volts
26 Ea=(Eg+(Ia*Ra));
27 alfa=(acosd((Ea*%pi)/(3*sqrt(3)*Vm)));
28 disp(alfa,"the firng angel , alfa (degree) = ")
29 disp("part (c)")
30 Is_rms=sqrt(2/3)*Ia;
31 Sva=3*Vs_rms*Is_rms;
32 PF=(Ea*Ia)/(Sva);
33 disp(PF,"Power Factor ,PF(lagging) = ")
34 disp("part (d)")
35 Ra=0.075;//in ohm
36 Ia=160;// in A

```

```

37 Ia1=16; // in A
38 Eg=540; // in volts
39 Ka_fi=0.3; // in V/rms
40 N=1800; // in rpm
41 Ea=(Eg+(Ia*Ra));
42 Eg1=Ea-(Ia1*Ra);
43 N_0=Eg1/Ka_fi;
44 SR=((N_0-N)/N)*100;
45 disp(SR,"Speed Regulation ,SR(%) = ")

```

Scilab code Exa 8.18.2 Delay Angel of Armature No load speed and speed regulation

```

1 //Example 8.18.2: Delay Angel of Armature ,No load
  speed and speed regulation
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',5)
7 VL_rms=208; // in volts
8 Kv=1.2; // in V/A-rad/sec
9 Vs_rms=round(VL_rms/sqrt(3));
10 Vm=sqrt(2)*Vs_rms;
11 Rf=240; // in ohm
12 Ra=0.25; // in ohm
13 alfa_f=0; // in degree
14 V=280; // in volts
15 Twenty_HP=20*746; //in watt
16 Ia=Twenty_HP/V
17 Ef=round((3*sqrt(3)*Vm*cosd(alfa_f))/%pi);
18 N=1800;
19 w=(N*2*%pi)/60;
20 If=Ef/Rf;
21 Eg=Kv*w*If;

```

```

22 Ea=round(Eg+(Ia*Ra));
23 alfa_a=(acosd((Ea*%pi)/(3*sqrt(3)*Vm)));
24 disp("part (a)")
25 disp(alfa_a,"Delay Angel Of Armature , alfa_a (degree)
    = ")
26 disp("part (b)")
27 Ia1=(Ia*10)/100
28 Eg_noL=Ea-(Ia1*Ra);
29 w_0=(Eg_noL/(1.2*1.17)); // rad/sec
30 N_0=(w_0*60)/(2*%pi);
31 disp(N_0,"NO load speed at alfa |_a ,(rpm) = ")
32 // no load speed is calculated wrong in textbook
33 disp("part (c)")
34 SR=((N_0-N)/N)*100;
35 disp(SR,"Speed Regulation ,SR(%) = ")
36 // speed regulation is calculated wrong in the
    textbook

```

Scilab code Exa 8.18.3 alphas speed and delay angle

```

1 //Example 8.18.3: alphas ,speed and delay angle
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 v1=208; //
8 vsrms=v1/sqrt(3); //
9 n=1000; //rpm
10 w=n*(%pi/30); //in rad/s
11 ang=0; //
12 ef=((3*sqrt(3)*sqrt(2)*vsrms*cosd(ang))/%pi); //in
    volts
13 rf=140; //in ohms
14 If=ef/rf; //in amperes

```

```

15 t=120; //N-m
16 kv=1.2; //
17 ia=(t)/(kv*If); //in amperes
18 eg=kv*If*w; //in volts
19 ra=0.25; //in ohms
20 ea=eg+(ia*ra); //
21 alpha=acosd((ea*%pi)/(3*sqrt(3)*sqrt(2)*vsrms))
22 disp(" part (a)")
23 disp(round(alpha)," alpha in degree is")
24 disp(" part (b)")
25 rf=140; //in ohms
26 If=ea/rf; //in amperes
27 t=120; //N-m
28 kv=1.2; //
29 ia=(t)/(kv*If); //in amperes
30 ra=0.25; //in ohms
31 eg=ea-(ia*ra); //
32 w=(eg/(kv*If)); //in rad/s
33 N=w*(30/%pi); //rpm
34 disp(N," speed in rpm is")
35 //speed is calculated wrong in the textbook
36 disp(" part (c)")
37 n1=1000; //rpm
38 w=n1*(%pi/30); //in rad/s
39 v1=208; //
40 vsrms=v1/sqrt(3); //
41 w1=(1800*(%pi/30)); //
42 n=1800; //rpm
43 ang=0; //
44 T=120; //n-m
45 alphas=0; //
46 ang=0; //
47 ea=((3*sqrt(3)*sqrt(2)*vsrms*cosd(ang))/%pi); //in
    volts
48 rf=140; //in ohms
49 If=ea/rf; //in amperes
50 t=120; //N-m
51 kv=1.2; //

```

```

52 ia=(t)/(kv*If); //in amperes
53 ra=0.25; //in ohms
54 eg=ea-(ia*ra); //
55 if1=eg/(kv*w1); //in amperese
56 ef1=if1*rf; //in volts
57 alphaf=acosd((ef1*%pi)/(3*sqrt(3)*120*sqrt(2)));
58 disp(alphaf,"delay angle in degree is")

```

Scilab code Exa 8.19.1 Firing angle to keep the motor current and Power fed back

```

1 //Example 8.19.1: Firing angle to keep the motor
  current and Power fed back
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 Vs_rms=260; // in volts
8 Ia=40; // in A
9 Eg=192; //in volts
10 kv=0.182; // in V/rpm
11 Ra=0.3; // in ohm
12 Ea=Eg+(Ia*Ra);
13 alfa_a=acosd((Ea*%pi)/(2*Vs_rms*sqrt(2)));
14 disp("part (a)")
15 disp(alfa_a,"Firing angle to keep motor current ,
  alfa_a(degree) = ")
16 Ea1=-Eg+(Ia*Ra);
17 alfa_b=acosd((Ea1*%pi)/(2*Vs_rms*sqrt(2)));
18 disp(alfa_b,"Firing angle , alfa_a(degree) =")
19 disp("part (b)")
20 Ia=40; // in A
21 Eg=192; //in volts
22 Ra=0.3; // in ohm

```

```

23 Ea=-Eg+(Ia*Ra);
24 P=abs(Ea)*Ia;
25 disp(P,"Power fed back ,P(Watt) = ")

```

Scilab code Exa 8.19.2 Average armature voltage back emf speed of the motor motor torque and supply power factor

```

1 //Example 8.19.2 Average armature voltage ,back emf
  ,speed of the motor , motor torque and supply
  power factor
2 clc;
3 clear;
4 close;
5 format('v',5)
6 //given data :
7 Vm=230;// in volts
8 Ia=40;// in A
9 Ra=0.5;// in ohm
10 Ka_fi=0.2;// in V/rpm
11 alfa=30;
12 Ea=(Vm*sqrt(2)*(1+cosd(alfa)))/%pi;
13 disp(" part (a)")
14 disp(Ea," Average armature current ,Ea(volts) = ")
15 disp(" part (b)")
16 Eb=Ea-(Ia*Ra);
17 disp(Eb," Back emf ,Eb(volts) = ")
18 disp(" part (c)")
19 N=Eb/Ka_fi;
20 disp(round(N)," Speed of the motor ,N(rpm) = ")
21 disp(" part (d)")
22 Ka_fi1=(Ka_fi*60)/(2*%pi);
23 T=Ka_fi1*Ia;
24 disp(T," Torque ,T(N/m) = ")
25 disp(" part (e)")
26 alfa=%pi/6;

```

```

27 PF=(2*sqrt(2)*cos(alfa/2)^2)/(sqrt(%pi*(%pi-alfa)));
28 disp(PF,"power factor (lagging) is")

```

Scilab code Exa 8.19.3 torque developed speed and input power factor

```

1 //Example 8.19.3: torque developed ,speed and input
  power factor
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',7)
7 v=208;//in volts
8 f=50;//in Hz
9 ra=0.5;//in ohms
10 rf=345;//in ohms
11 kv=0.71;//in V/A-rad/sec
12 alpha=45;//in degree
13 ia=55;//in amperes
14 If=((2*sqrt(2)*v*cosd(0))/(%pi*rf));//in amperes
15 t=kv*If*ia;//in N/m
16 disp("part (a)")
17 disp(t,"torque in N/m is")
18 disp("part (b)")
19 eb=((2*sqrt(2)*v*cosd(alpha))/%pi)-(ia*ra);//in
  volts
20 w=eb/(kv*If);//in rad/sec
21 N=w/(2*%pi);//rps
22 disp(N*60,"speed in rpm")
23 //speed is calculated wrong in the textbook
24 disp("part (c)")
25 ea=132.4;//in volts
26 ef=187.3;//in volts
27 pi=(ea*ia)+(ef*If);//in watts
28 Isrms=sqrt((ia)^2+(If)^2);//in amperes

```



```

29 va1=Isrms*v;//in VA
30 Pf=pi/va1;//
31 disp(Pf,"power factor (lagging) is")

```

Scilab code Exa 8.19.4 developed back emf required armature voltage and firing angle and rated armature current

```

1 //Example 8.19.4:developed back emf,required
   armature voltage and firing angle and rated
   armature current
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',6)
7 hp=20;//
8 v=230;//volts
9 n=1000;//rpm
10 lt=50;//load torque in N-m
11 s=1000;//speed in rpm
12 ra=0.2;//in ohms
13 rf=150;//in ohms
14 la=10;//in mH
15 kv=0.7;//
16 vf=(2*sqrt(2)*v)/(pi);//
17 If=vf/rf;//in amperes
18 ia=(lt/(kv*If));//in amperes
19 eg=((kv*2*pi*n*If))/(60);//in volts
20 disp("part (a)")
21 disp(eg,"back emf in volts is")
22 disp("part (b)")
23 ea=eg+(ia*ra);//in volts
24 alpha=acosd((ea*pi)/(2*sqrt(2)*v));//
25 disp(ea,"armature voltage in volts is")
26 disp(alpha,"firing angle in degree is")

```

```
27 disp(" part (c)")
28 ea1=220;//in volts
29 ha20=746*20;//
30 iar=(ha20/ea1);//in amperes
31 disp(iar,"rated armature current in amperes is")
```

Scilab code Exa 8.21.1 average armature current

```
1 //Example 8.21.1 : Average armature current
2 clc;
3 clear;
4 close;
5 //given data :
6 V=200;// in volts
7 D=50/100;// duty cycle
8 VL_dc=V*D;
9 Eb=75;// in volts
10 Ra=1;// in ohm
11 Ia=(VL_dc-Eb)/Ra;
12 disp(Ia,"Average armature current ,Ia(A) = ")
```

Chapter 9

Power factor improvement

Scilab code Exa 9.4.3 plot the variation

```
1 //Example 9.4.3:plot the variation of average load
   voltage with firing angle
2 clc;
3 clear;
4 close;
5 alpha=[0;30;60;90]; //firing angle in degree
6 for i=1:4
7     ea(i)=(2/%pi)*cosd(alpha(i)); //V
8 end
9 plot2d(alpha,ea); //
10 ylabel("Average load voltage(in terms of Vm)")
11 xlabel("Firing angle (alpha)")
12 xtitle("Variation of Ea Vs alpha for SAC")
```

Scilab code Exa 9.5.1 ISrms I1rms FPF PF and HF

```
1 //Example 9.5.1; IS_rms , I1_rms , FPF, PF and HF
2 clc;
```

```

3 clear;
4 close;
5 format('v',7)
6 //given data :
7 Vm=230; // in volts
8 Ia=12; // in A
9 pi=180;
10 Av=200; // average load voltage in volts
11 alfa=acosd(((Av*%pi)/(Vm*sqrt(2)))-1);
12 Is_rms=Ia*sqrt((pi-alfa)/pi);
13 disp( "(a) for PAC")
14 disp(Is_rms,"(1) Is_rms(A) = ")
15 I1_rms=((2*sqrt(2))/%pi)*Ia*cosd(alfa/2);
16 disp(I1_rms,"(2) I1_rms(A) = ")
17 fi=alfa/2;
18 FPF=cosd(fi);
19 disp(FPF,"(3) FPF(lag) = ")
20 CDF=I1_rms/Is_rms;
21 disp(CDF,"(4) CDF = ")
22 PF=CDF*FPF;
23 disp(PF,"(4) PF (lag)= ")
24 HF=sqrt((1/CDF^2)-1);
25 disp(HF,"(5) HF = ")
26 Vm=230; // in volts
27 Ia=12; // in A
28 pi=180;
29 Av=200; // average load voltage in volts
30 alfa=acosd(((Av*%pi)/(2*Vm*sqrt(2))));
31 Is_rms=Ia*sqrt((pi-(2*alfa))/pi);
32 disp( "(b) for SAC")
33 disp(Is_rms,"(1) Is_rms(A) = ")
34 I1_rms=((2*sqrt(2))/%pi)*Ia*cosd(alfa);
35 disp(I1_rms,"(2) I1_rms(A) = ")
36 fi=0;
37 FPF=cosd(fi);
38 disp(FPF,"(3) FPF = ")
39 CDF=I1_rms/Is_rms;
40 disp(CDF,"(4) CDF = ")

```

```

41 //in book CDF is mentioned as DF which is wrongly
    mentioned
42 PF=CDF*FPF;
43 disp(PF," (4) PF (lagging)= ")
44 HF=(sqrt((1/CDF^2)-1))*100;
45 disp(HF," (5) HF (%) = ")

```

Scilab code Exa 9.5.2 parameters and average voltage

```

1 //Example 9.5.2; average voltage
2 clc;
3 clear;
4 close;
5 format('v',7)
6 a1=30;//in degree
7 a2=75;//in degree
8 b1=60;//in degree
9 ia=10;//in amperes
10 vsrms=230;//in volts
11 b3=180-a1;//
12 a3=180-b1;//
13 b2=180-a2;//
14 alfa=0;//
15 vldc=((vsrms*sqrt(2))/%pi)*(cosd(a1)-cosd(b1)+cosd(
    a2)-cosd(b2)+cosd(a3)-cosd(b3));//
16 disp(vldc," average voltage in volts is")
17 Is_rms=ia*((1/180)*(b1-a1+b2-a2+b3-a3))^(1/2);//
18 disp(Is_rms," Is_rms(A) = ")
19 I1_rms=((sqrt(2)*ia)/(%pi))*(cosd(a1)-cosd(b1)+cosd(
    a2)-cosd(b2)+cosd(a3)-cosd(b3));//
20 disp(I1_rms," I1_rms(A) = ")
21 fi=alfa;
22 FPF=cosd(fi);
23 disp(FPF," FPF = ")
24 DF=I1_rms/Is_rms;

```

```

25 disp(DF," DF = ")
26 PF=DF*FPF;
27 disp(PF," PF(lag)= ")
28 HF=sqrt((1/DF^2)-1);
29 disp(HF*100," HF(%) = ")

```

Scilab code Exa 9.5.3 parameters

```

1 //Example 9.5.3: IS_rms , I1_rms , PF and HF
2 clc;
3 clear;
4 close;
5 //given data :
6 Vm=230; // in volts
7 Ia=10; // in A
8 alpha=%pi/6; //degree
9 ea=((2*Vm*sqrt(2))/%pi)*cos(alpha); //
10 disp(ea,"average output voltage is ,(V)=")
11 isrms=Ia*(1-(2*alpha)/%pi)^(1/2); //
12 disp(isrms,"rms value of supply current is ,(A)=")
13 I1rms=((2*sqrt(2)*Ia*cos(alpha))/%pi); //
14 disp(I1rms,"rms value of fundamental component of
    supply current is ,(A)=")
15 hf=((isrms/I1rms)^2-1)^(1/2); //
16 disp(hf*100,"HF of supply current is ,(%)=")
17 PF=((sqrt(2))*(1+cos(alpha)))/((%pi*(%pi-alpha))
    ^(1/2)); //
18 disp(PF,"PF (lagging) of supply current is ,(%)=")

```

Chapter 10

Control of AC drivers

Scilab code Exa 10.15.1 slip the air gap power and efficiency

```
1 //Example 10.15.1: slip ,the air gap power and
  efficiency
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 w=100;// in rad/sec
8 F1=50;//in Hz
9 P=4;
10 Ns=(120*F1)/P;
11 ws=2*pi*(Ns/60);
12 s=((ws-w)/ws);
13 disp(" part (1)")
14 disp(" slip is "+string(s)+" or "+string(s*100)+" % "
  )
15 disp(" part (2)")
16 T=100;// in N-M
17 w=100;// in rad/sec
18 Pag=ws*T;
19 P_slip=s*Pag;
```

```

20 P_mech=(1-s)*Pag;
21 disp(Pag,"(a) the air gap power, pag (W) = ")
22 disp(P_slip,"(b) slip power (W) =")
23 disp(P_mech,"(c) Mech o/p power, P_mech (W) = ")
24 //air gap power is calculated wrong in the textbook
25 disp(" part (3)")
26 eta=(P_mech/Pag);
27 disp("efficiency of the rotor circuit is "+string(
    eta)+" or "+string(eta*100)+" % ")

```

Scilab code Exa 10.15.2 Supply voltage per phase slip slip frequency slip and rotor los

```

1 //Example 10.15.2 :Supply voltage per phase , slip ,
  slip frequency , slip and rotor loss
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',6)
7 V_rms=240;// in volts
8 F1=50;//in Hz
9 Vs_rms=240/2;
10 disp(" part (1)")
11 disp(Vs_rms,"supply voltage (V) = ")
12 disp(" part (2)")
13 N=1440;// in rpm
14 P=4;// pole
15 Ns=(120*F1)/4;
16 S=((Ns-N)/Ns);
17 disp(" slip is "+string(S)+" or "+string(S*100)+" % "
    )
18 disp(" part (3)")
19 S_frequency=S*F1;
20 disp(S_frequency," slip frequency (Hz) = ")

```



```

21 disp(" part (4)")
22 f=2; //Hz
23 f1=25; //Hz
24 s=(f/f1); //
25 disp(" slip is "+string(s)+" or "+string(s*100)+" % "
    )
26 disp(" part (5)")
27 F2=25; //in Hz
28 S1=(S_frequency/F2);
29 rotor_loss=S1/(1-S1);
30 disp(rotor_loss ," Rotor loss (%) = ")

```

Scilab code Exa 10.15.6 supply voltage slip slip frequency and percentage rotor loss

```

1 //Example 10.15.6: supply voltage per phase , slip ,
    slip frequency and percentage rotor loss
2 clc;
3 clear;
4 close;
5 Ns1=750; //
6 V_rms=240; // in volts
7 f2=25; //Hz
8 F1=50; //in Hz
9 Vs_rms=240/2;
10 N=1440; // in rpm
11 P=4; // pole
12 Ns=(120*F1)/4;
13 S=((Ns-N)/Ns);
14 S_frequency=S*F1;
15 fs12=S_frequency/4; //
16 S1=fs12/f2;
17 rotor_loss=S1/(1-S1);
18 n=Ns1-((S1*Ns1)); //
19 disp(Vs_rms ," supply voltage (V) = ")

```

```
20 disp(S1*100,"slip ,S(%) = ")
21 disp(S_frequency,"slip frequency at 50Hz (Hz) = ")
22 disp(fs12,"slip frequency at 25Hz (Hz) = ")
23 disp(rotor_loss ,"Rotor loss(%) = ")
24 disp(n,"speed in rpm is")
```

Chapter 11

Appendix B

Scilab code Exa 2.b power absorbed

```
1 // Example 2(b): power absorbed
2 clc;
3 clear;
4 close;
5 vsrms=230; // volts
6 vm=(sqrt(2)*vsrms)/2; // volts
7 alpha=[45:90]; // degree
8 x=[(45*(%pi/180));(90*(%pi/180))]
9 for i=1:2
10     vldc(i)=(vm/%pi)*(1+cosd(alpha(i))); //
11     vlms(i)=vm*((1/%pi)*(%pi-x(i)+(sin(2*x(i))))/2))
12     r1=100; //ohm
13 end
14 r1=100; //OHM
15 p11=((vlms(1))^2)/r1 //W
16 p12=((vlms(2))^2)/r1; //W
17 disp(p11," power aborbed is ,(W)=")
18 disp(p12," power aborbed is ,(W)=")
```

Scilab code Exa 5.b speed slip and torque

```
1 // Example 5(b): power absorbed
2 clc;
3 clear;
4 close;
5 v=400; //V
6 po=15; //kW
7 nfx=1440; //rpm
8 f=50; //Hz
9 z2=0.4+%i*1.6; //ohm
10 p=4; //
11 x=120; //Hz
12 ns=((x*f)/p); //rpm
13 s=((ns-nfx)/ns); // slip
14 ns1=(x*x)/p; //rpm
15 nfl1=(1-s)*ns1; //rpm
16 disp(nfl1,"full load speed is ,(rpm)=")
17 sm=real(z2)/imag(z2); // slip
18 disp(sm,"slip is,=")
19 tfy=((po*10^3)/(2*pi*(nfl1/60))); //N-m
20 a=sm; //
21 tm=((a^2+s^2)/(2*a*s))*tfy; //N-m
22 disp(tm,"maximum torque is ,(N-m)=")
```
