Scilab Textbook Companion for Principles Of Electric Machines And Power Electronics by P. C. Sen[1]

Created by
giridharan
electrical engineering
Electrical Engineering
IIT Bombay
College Teacher
Dr.Madhu.N.Belur
Cross-Checked by

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Book Description

Title: Principles Of Electric Machines And Power Electronics

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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

magnetic circuit

Scilab code Exa 1 current

```
1  Bc=0.8;Hc=510;Bg=0.8;
2  A=4*%pi*10^-7;lg=1.5*10^-3;
3  lc=0.36;N=500;
4
5  Fg=Bg/A*(2*lg)
6
7  Fc=Hc*lc
8
9  F=Fc+Fg
10
11 i=F/N
12
13 Pre=Bc/Hc
14
15 RelPre=Pre/A
16
17 F=Hc*lc
18
19 i=F /N
```

Scilab code Exa 2 fluxdensity

```
A=4*%pi*10^-7;lc=360;
N=500;i=4;lg=2*10^-3;

m=-A*(lc/lg)

c=(N*i*A)/(lg)

Hc=(N*i)/(lc)
```

Scilab code Exa 3 airgapflux

```
N1=500;I1=10;N2=500;I2=10;
Ibafe=3*52*10^-2;A=4*%pi*10^-7;
b=1200;Ag=4*10^-4;Ac=4*10^-4;
lg=5*10^-3;Ibecore=51.5*10^-2;c=2.067*10^-4;
d=4.134*10^-4;

F1=N1*I1

F2=N2*I2

Pre=1200*A

Rbafe=(Ibafe)/(Pre*Ac)

Rg=lg/(A*Ag)

Rbecore=Ibecore/(Pre*Ac)

Bg=d/(Ag)
```

```
20
21 Hg=Bg/A
```

Scilab code Exa 4 magneticflux

```
1  Irad=20;Orad=25;Dia=22.5
2  N=250;i=2.5;
3  l=2*%pi*Dia*10^-2;
4  B=1.225;
5
6  radius=1/2*(Irad+Orad)
7
8  H=(N*i)/l
9
10 A=%pi*((Orad-Irad)/2)^2*10^-4
11
12 z=(1.225)*(%pi*6.25*10^-4)
13
14 y=(N*z)
15
16 L=(y/i)
17
18 core=(B/H)
19
20 l=(2*%pi*22.5*10^-2)
21
22 Rcore=(l)/(core*A)
23
24 L=(N^2)/(Rcore)
```

Scilab code Exa 5 fluxvoltage

```
1  n=500;E=100;A=0.001;b=1/120;
```

```
2 f=1.2;
3
4 max1=(E/1000)*(b)
5
6 max2=(f*A)
7
8 E=(120*n*max2*2)
```

Scilab code Exa 6 dimensions

```
1 lg=0.4*10^-2;Bg=0.8;
2 Hm=42*10^3;A=4*%pi*10^-7;Ag=2.5*10^-4;
3 Bm=0.95;
4
5 Hg=Bg/A
6
7 lm=(lg/Hm)*Hg
8
9 Am=(Bg*Ag)/(Bm)
```

Chapter 2

TRANSFORMERS

Scilab code Exa 1 powertaken

```
resimp=9;inte=1;V=10;A=1/3;

I=V/(inte+resimp)

P=I^2*resimp

R=(A^2)*(resimp)

I1=V/(inte+I)

P1=I1^2*inte
```

Scilab code Exa 2 parameters

```
Vh=220;Ih=4.55;Wl=100;
Vl=150;Il=2.5;Wh=215;
Vhrated=2200;Vlrated=220;
Ihrated=4.55;Ilrated=45.5;
```

```
5
6  Rcl=Vlrated^2/Wl
7
8  Poc=(Vlrated^2/Rcl)
9
10 Icl=Vlrated/Rcl
11
12 Iml=(Il^2-Icl^2)^(1/2)
13
14 Xml=Vlrated/Iml
15
16 A=Vhrated/Vlrated
17
18 Rch=A^2*Rcl
19
20 Xmh=A^2*Xml
21
22 Reqh=215/Ihrated^2
23
24 Psc=Ihrated^2*Reqh
25
26 Zeqh=Vl/Ihrated
27
28 Xeqh=(Zeqh^2-Reqh^2)^(1/2)
29
30 Reql=Reqh/A^2
31
32 Xeql=Xeqh/A^2
33
34 P=(Poc/(Vlrated*Il))
35
36 Psh=(Psc/(Vl*Ihrated))
```

Scilab code Exa 3 voltageregulation

```
Fullload=75;Ia=4.55;Vl=2200;

Fulload=Fullload/100

Ih=Fullload*Ia

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[x1,y1]=polar2rect(Vl,0)

[x2,y2]=polar2rect(35.46,-53.13)

[x3,y3]=polar2rect(106.73,36.87)

X1=x1+%i*y1

X2=x2+%i*y2

X3=x3+%i*y3

X=X1+X2+X3

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[V,Angle]=rect2polar(2306.5,35.67)

VolReg=(V-Vl)/Vl*100

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction
```

```
39 [x1,y1]=polar2rect(Vl,0)
40
41 [x2,y2]=polar2rect(35.46,53.13)
42
43 [x3,y3]=polar2rect(106.73,143.13)
44
45 X1=x1+%i*y1
46
47 X2=x2+%i*y2
48
49 X3=x3+%i*y3
50
51 X=X1+X2+X3
52
53 function[r,theta]=rect2polar(x,y)
54 r=sqrt(x^2+y^2);
55 theta=atan(y/x)*180/%pi;
56 endfunction
57
58 [V1,Angle1]=rect2polar(2135.89,92.4)
59
60 VolReg=(V1-Vl)/Vl*100
```

Scilab code Exa 4 efficiency

```
1 V=0.75;I=10000;A=0.6;
2 Pc=100;Reqh=10.4;Ih=(0.75*4.55)^2;
3 Reql=0.104;V2=220;B=1;
4
5 Pout=V*I*A
6
7 Pcu=(Ih*Reqh)
8
9 Eff=Pout/(Pout+Pc+Pcu)
10
```

```
11 Eff=Pout/(Pout+Pc+Pcu)*100
12
13 I2=(100/0.104)^(1/2)
14
15 Pout1=V2*I2*B
16
17 Eff1=Pout1/(Pout1+Pc+Pcu)
18
19 Eff1=Pout1/(Pout1+Pc+Pcu)*100
```

Scilab code Exa 5 efficiency

```
1  Power=50;Lo1=0.5;
2  Lo2=0.75;Lo3=1;Lo4=1.1;
3  Pf1=1;Pf2=0.8;Pf3=0.9;
4  Pf4=1;Ho1=6;Ho2=6;Ho3=3;Ho4=3;Ho=6;Pc=200;
5  Pcu=500;
6
7  EngOut=(Lo1*Power*Ho1*Pf1)+(Lo2*Power*Ho2*Pf2)+(Lo3*
      Power*Ho3*Pf3)+(Lo4*Power*Ho4*Pf4)
8
9  A=Pc/1000
10
11 TotalHour=Ho+Ho1+Ho2+Ho3+Ho4
12
13 Coreloss=A*TotalHour
14
15 B=Pcu/1000
16
17 Copperloss=(Lo1^2*B*Ho1)+(Lo2^2*B*Ho2)+(Lo3^2*B*Ho3)
      +(Lo4^2*B*Ho4)
18
19 Totalloss=Coreloss+Copperloss
20
21 Eff=EngOut/(EngOut+Totalloss)*100
```

Scilab code Exa 6 kvarating

```
P=100000;Vs=2000;Vp=200;Ih=500;
Vl=2000;

Iab=P/Vp

Ibc=P/Vs

Il=Ih+50

Vh=Vl+200

Kva1=(Vl*Il)/(1000)

Kva2=(Vh*Ih)/(1000)
```

Scilab code Exa 7 volcurregulation

```
Power=120000;;Phase=3;
V=230;Pri=2300;Sec=230;Z=0.012+%i*0.016;Pf=0.85;

Is=Power/(sqrt(Phase)*V)

I2=Is/sqrt(Phase)

a=Pri/V

I1=I2/a

 Zeq=(Z)*10^2
```

```
13
14  a=acos(Pf)
15
16  Deg=(a*180)/%pi
17
18 function[x,y]=polar2rect(r,theta)
19 x=r*cos(theta*%pi/180);
20 y=r*sin(theta*%pi/180);
21 endfunction
22
23 [a,b]=polar2rect(Pri,0)
24
25 A=a+%i*b
26
27 function[x,y]=polar2rect(r,theta)
28 x=r*cos(theta*%pi/180);
29 y=r*sin(theta*%pi/180);
30 endfunction
31
32 [c,d]=polar2rect(I1,-Deg)
33
34 A1=c+%i*d
35
36 A2=A1*(Zeq)
37
38 A3=A2+A
39
40 V1=2332.4;
41
42 PriVol=sqrt(Phase)*V1
43
44 VR=(V1-Pri)/Pri*100
```

Scilab code Exa 8 supplyvoltage

```
Pri=1330;Sec=230;Zl=0.12+%i*0.25;Phase=3;V=230;
Z=0.8+%i*5;Power=27;
Zz=0.003+%i*0.015;Pf=0.9

A=(Pri/Sec)^2*(Zl)

Req=4.01;

Xeqh=8.36;

a=(sqrt(Phase)*Pri)/V

Reql=0.8;

Xeql=5;
Rr=0.003;

Xx=0.015;

R=(Reql+Req)*(1/10^2)+Rr

X=(Xeql+Xeqh)*(1/10^2)+Xx

Vl=V/sqrt(Phase)

Il=(Power*10^3)/(Phase*133)

Angle=-acos(%pi*Pf/180)
```

Scilab code Exa 9 impedances

```
Vh=2200;Vl=220;Pb=10000;
I=0.25;a=10;Z=10.4+%i*31.3;

Ib=Pb/Vh
```

```
5
6  Il=Pb/Vl
7
8  Zb=Vh/Ib
9
10 Zl=Vl/Il
11
12 Ih=I/Ib
13
14 Zeq=Z/Zb
15
16 Zeql=Z*(1/100)
17
18 Zpu=Zeql/Zl
19
20 Pcu=Ib^2*10.4
21
22 Ppu=Pcu/Pb
```

Chapter 3

ELECTROMECHNICAL ENERGY CONVERSION

Scilab code Exa 1 fieldenergy

```
1  Hc=670;G=5;D=10;A=5;B=10;Bg=1;Z=4*%pi*10^-7;N=250;
      Area=700;
2
3  Lc=2*(A+B)+2*(G+D)
4
5  Hg=Bg/Z
6
7  Lc=60/100
8
9  Hg=Bg/Z
10
11 Ni=(Hc*Lc)+(Hg*2*G*10^-3)
12
13 I=Ni/N
14
15 Vdc=I*G
16
17 Wfc=Area/2
18
```

```
19 Vc=2*(G*10^-2*D*10^-2*0.20)+2*(A*10^-2*B*10^-2*0.10)
20
21 Wfc=Wfc*Vc
22
23 Wfg=1.0/(2*Z)
24
25 Vg=2*(G*10^-2*10*10^-2*0.005)
26
27 Wfg=(Wfg*G*10^-2*10^-3)
28
29 Wf=Wfc+Wfg
```

Scilab code Exa 2 mechanicalforce

```
1 I=3;G=0.05;
2
3 Lam=(0.09*I^(.5)/G)
4
5 t1=0:0.1:3;
6
7 t0=0;
8
9 a=integrate('((0.09*2)/(G*I))*I^(0.5)','i',t0,t1)
10
11 Wf=((0.09*2)/(G*I))*I^(1.5)
12
13 Fm=-0.09*(2/3)*I^(1.5)*(1/G^2)
14
15 Wf1=(G^2*Lam^3)/(0.09^2*I)
16
17 Lam1=(0.09*I^(.5)/G)
18
19 Fm=-((Lam1^3)*2*G)/(I*0.09^2)
```

Scilab code Exa 3 liftingforce

```
1  A=4*%pi*10^-7;N=300;V=120;
2  R=6;G=5*10^-3;Ag=6*6*10^-4;
3  Lg=2*5*10^-3;
4  Vo=2*6*6*5*10^-7;
5
6  I=V/R
7
8  Bg=(A*N*I)/(2*G)
9
10 Wf=(Bg^2)/(2*A)*(Vo)
11
12 Fm=(Bg^2)/(2*A)*(2*Ag)
13
14 L=(N^2*A*Ag)/(Lg)
15
16 Irms=V/(sqrt(6^2+15.34^2))
17
18 Brms=(A*N*Irms)/(2*G)
19
20 Fm=(Brms^2)/(2*A)*(2*Ag)
```

Chapter 4

DC MACHINES

Scilab code Exa 1.b torque

```
1  P=4;A=2;Z=462;Wn=(1000/60)*(2*%pi);z=0.0276;
2  Icoil=100;
3
4  Ka=(Z*P)/(2*2*%pi)
5
6  Wn
7
8  Ea=(Ka*z*Wn)
9
10 Icoil
11
12 Ia=2*Icoil
13
14 T=(Ka*z*Ia)
15
16 Pa=Ea*Ia
```

Scilab code Exa 10 speedtorque

```
Ia=40;Ra=0.25;La=10;
ACv=265;Angle=30;
Ka=0.18;

A=cos(%pi*Angle/180)

Vt=(2*sqrt(2)*ACv*A)/(%pi)

Ea=Vt-(Ia*Ra)

N=Ea/Ka

Sec=(Ka*60)/(2*%pi)

T=Sec*Ia

P=Vt*Ia

P=(Ia^2*Ra)+Ea*Ia
```

Scilab code Exa 11 firingangle

```
V=480;RPM=1800;
Ia=16.5;Ra=0.0874;
Ka=0.33;
Angle=30;N=1800;

Vp=(V/sqrt(3))

Vt=(3*sqrt(6)*Vp)/(%pi)

Ea=Vt-(Ia*Ra)

No=(Ea/Ka)

```

```
A=cos(%pi*Angle/180)

Vt1=Vt*A

Ea1=Vt1-(Ia*Ra)

No1=Ea1/Ka

Eaf=Ka*N

Vtf=Eaf+(Ia*Ra)

 Angle=Vtf/Vt

 a=acos(Angle)

 Alfa=a*180/%pi

Eas=Vtf-(Ia*Ra)

Nos=Eas/Ka

SpeedReg=(Nos-N)/N*100
```

Scilab code Exa 12 speedcontrol

```
Supv=120;Ia=20;Ra=0.5;
Ka=0.05;

Vt=Ia*Ra

A=(Vt/Supv)

Ea=Supv-(Ia*Ra)

```

```
10 N=Ea/Ka
```

Scilab code Exa 2 terminalvoltage

```
1  Ia=120;Vt=100;Ea=100;
2  Ra=0.1;Ar=0.06;EA=98;
3  Ifeff=1.4;
4
5  Vt1=Ea-(Ia*Ra)
6
7  Ifeff1=1-Ar
8
9  V=EA-(Ia*Ra)
10
11 Ea=(Vt)+(Ia*Ra)
12
13 Ifactual=Ifeff+Ar
```

Scilab code Exa 3 fieldcurrent

```
1  Eaa=111;Ia=120;Ra=0.1;
2  Rfw=80;Eac=85;If=0.5;
3  v=100;
4
5  Vt=Eaa-(Ia*Ra)
6
7  Rf=v/1
8
9  Rfc=Rf-Rfw
10
11 Rfcrit=Eac/If
12
13 Rfc=Rfcrit-Rfw
```

Scilab code Exa 4 fullloadvoltage

```
1 Ia=120;Ra=0.1;Vt=80;Vt1=75;AB=17;Ea=6;
2
3 V=Ia*Ra
4
5 Ia=AB/Ra
6
7 Ia1=Ea/Ra
```

Scilab code Exa 5 seriesturns

```
1 Ia=120;Vt=100;Rsr=0.01;
2 Ra=0.1;Ia=120;Rf=100;
3 Ifeff=1.45;If=1.01;
4 Nf=1200;Ifar=0.06;
5
6 It=Ia-If
7
8 If=(Vt+It*Rsr)/Rf
9
10 Ea=Vt+(It*Rsr)+(Ia*Ra)
11
12 Nsr=(Ifeff-If+Ifar)*(1200)/(It)
```

Scilab code Exa 6 resistance

```
1 Vt=100;Ra=0.1;Ia=6;If=0.99;Rfw=80;
2 Ia1=5;Iarated=120;N=1000;
```

```
3  Afl=0.95;Prot=497.5;
4
5  Eanl=Vt-(Ia*Ra)
6
7  Rf=Vt/If
8
9  Rfc=Rf-Rfw
10
11 Prot=Ea*5
12
13 Eanl=Vt-(Ia*Ra)
14
15 Eafl=Vt-(Iarated*Ra)
16
17 Wfl=(Eafl/Eanl)*N
18
19 Wm=(Wfl/60)*2*%pi
20
21 T=(Eafl*Iarated)/Wm
22
23 Pout=(Eafl*Iarated)-(Prot)
24
25 Pin=(Vt)*(Iarated+If)
26
27 Eff=(Pout/Pin)*100
28
29 Wfl1=(Eafl/Eanl)*(1/Afl)*N
30
31 Wm1=(Wfl1/60)*(2*%pi)
32
33 T=(Eafl*Iarated)/(Wm1)
34
35 Eff1=(Pout/Pin)*100
36
37 Wm=(1000/60)*(2*%pi)
38
39 Ka=Eanl/Wm
40
```

```
41 Ia=1.5*120
42
43 Tstart=(Ka*Ia)
44
45 Ifeff=If-Ifar
46
47 Ea1=93.5
48
49 Ka1=(Ea1/Wm)
50
51 Tstart1=(Ka1*Ia)
```

Scilab code Exa 7 amperetturns

```
1  If=0.99;Vt=100;Ia=120;Ra=0.1;
2  Rpm1=932;Rpm2=1000;
3  Ifeff=0.86;Nf=1200;
4  rpm1=1000;
5  Ifeff1=1.32;Rpm3=800;
6  EA=65;
7
8  Ea=Vt-(Ia*Ra)
9
10 Ea1=Rpm2/Rpm1*Ea
11
12 Ifar=If-Ifeff
13
14 At=Nf*Ifar
15
16 Ea2=Rpm2/Rpm3*Ea
17
18 Nsr=(Ifeff1-If+Ifar)*(Nf)/(Ia+If)
19
20 Ifeff2=If-(Nsr*(Ia+If))/Nf-Ifar
21
```

```
22 N=(Ea/EA)*Rpm2
```

Scilab code Exa 8 powerresistance

```
1  Vt=220;Ia=25;Ra=0.6;
2  Rsr=0.4;Rae=0;N=300;
3  N1=200;Wm=(2*%pi/60);
4  Hp=746;
5
6  Ea=Vt-Ia*(Ra+Rsr+Rae)
7
8  P=Ea*Ia
9
10 a=P/Hp
11
12 T=(Ea*Ia)/(N*Wm)
13
14 Ksr=T/Ia^2
15
16 T1=(N1/N)^2*T
17
18 P=(T1*N1*Wm)
19
20 a=T1/Ksr
21
22 a=sqrt(Ia)
23
24 Rae=(Vt-Ea-(Ia*Ra)+(Ia*Rsr))/Ia
25
26 P=Ea*Ia
```

Scilab code Exa 9 startingcurrent

```
Iarated=100;Vt=100;
Ra=0.1;
Ia1=200;

Iastart=Vt/Ra

Rae=(Vt-20)/(200)

Ea2=Vt-Iarated*(Ra+Rae)

Rae2=(Vt-Ea2-20)/(200)

Ea3=Vt-Ia*(Ra+Rae2)

Ea3=Vt-Iarated*(Ra+Rae2)

Rae3=(Vt-Ea3-20)/200

Ea4=Vt-Iarated*(Ra+Rae3)

Rae4=(Vt-Ea4-20)/200

Ia=(Vt-Ea4)/Ra

R1=Rae-Rae2

R2=Rae2-Rae3

R3=Rae3-Rae4
```

Chapter 5

INDUCTION(ASYNCHRONOUS) MACHINES

Scilab code Exa 1 frequency

```
1  F=60;P=4;S=0.05;
2  Ns=1800;V=460;Tr=0.5;
3
4  Ns=(120*F)/(P)
5
6  N=(1-S)*Ns
7
8  F2=S*F
9
10 Sliprpm=S*Ns
11
12 A=S*Tr*V/sqrt(3)
```

Scilab code Exa 10 parasitictorque

```
1  F=60;P=4;N=1740;R1=0.5;
```

```
R2=0.5;X1=1;X2=1;Xm=35;
I=1.1;Peak=10;H=5;H1=7;
Phase=3;

Ns=120*F/P

S1=(Ns-N)/Ns

A=R2/S1

Z1=(Xm*%i)*(A+X1*%i)/(A+X2*%i+Xm*%i)

Rth=12.08;

Pg1=Phase*((I*Peak)/sqrt(2))^2*Rth

Wsyn=(Ns/60)*2*%pi

T1=Pg1/Wsyn

Ns1=-(120*H*F)/P

S2=(Ns1-N)/Ns1

B=R2/S2

Xm1=H*Xm

hX2=H*X2

Z2=Xm1*%i*(B+hX2*%i)/(B+hX2*%i+Xm1*%i)

Rth2=0.39;

Pg2=Phase*((0.22*Peak)/sqrt(2))^2*Rth2

Wsyn2=(Ns1/60)*2*%pi

```

```
T2=Pg2/Wsyn2

Ns3=(120*H1*F)/P

S3=(Ns3-N)/Ns3

C=R2/S3

Xm3=H1*Xm

hX3=H1*X2

Z3=Xm3*%i*(C+hX3*%i)/(C+hX3*%i+Xm3*%i)

Rth3=0.54;

Pg3=Phase*((0.16*Peak)/sqrt(2))^2*Rth3

Wsyn3=(Ns3/60)*2*%pi

T3=Pg3/Wsyn3
```

Scilab code Exa 11 voltage

```
S=2;Pole=50;F=50;
Slip=0.25;

Pole=Pole*10^-2

Vs=S*Pole*F

Vs=Vs*3600/1000

V=(1-Slip)*(Vs)
```

Scilab code Exa 2 powerloss

```
1  Hp=15;Loss=750;
2  F=60;P=4;N=1728;
3
4  Mecp=P+Loss
5
6  Ns=120*F/P
7
8  S=(Ns-N)/Ns
9
10 Pag=Mecp/(1-S)
11
12 P2=S*Pag
```

Scilab code Exa 3 parameters

```
1  Nof=60;NoV=2200;
2  NoI=4.5;NoP=1600;
3  BF=15;BV=270;BI=25;
4  BP=9000;
5  R1=2.8;V=2200;F=60;
6  Rbl=4.8;
7
8  Pnl=1600
9
10 Prot=Pnl-(3*NoI^2*R1)
11
12 Vt=V/sqrt(3)
13
14 Znl=(Vt/NoI)
15
```

```
Rnl=(Pnl)/(3*NoI^2)

Xnl=(Znl^2-Rnl^2)^(1/2)

Rbl=BP/(3*BI^2)

Zbl=(BV)/(sqrt(3)*BI)

Xbl=(Zbl^2-Rbl^2)^(1/2)

Xbl=Xbl*(F/BF)

X1=Xbl/2

Xm=(Xnl-X1)

R=Rbl-R1

R2=((X1+Xm)/(Xm))^2*2

Vth=(Xm)/(X1+Xm)

Rth=(Vth^2)*R1
```

Scilab code Exa 4 sliptorque

```
R1=0.25;X1=0.5;X2=0.5;
R2=0.2;Xm=30;V=460;
N=1740;F=60;P=4;Phase=3;No=1800;

V1=V/sqrt(Phase)

Z1=(R1+%i*X1)+(%i*Xm*(R2+%i*X2)/(R2+%i*30.5))

function[r,theta]=rect2polar(x,y)
```

```
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Rth,Angle]=rect2polar(0.44,0.99)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[a,b]=polar2rect(Rth,Angle)

X=a+%i*b

Ist=(V1/X)

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Ist,Angle]=rect2polar(99.56,-224.0)

Wsy=(1800/F)*2*%pi

Vth=(V1*%i*Xm)/(R1+%i*30.5)

Vth=265.3;

Zth=%i*Xm*(%i*R1+%i*X1)/(R1+%i*30.5)

Zth=(%i*Xm*(R1+%i*X1))/(R1+%i*30.5)

Rth=0.24;

Xth=0.49;

```

```
a=Vth^2/((Rth+R2)^2+(Xth+X1)^2)

Tst=((Phase/Wsy)*a*R2)

S=(No-N)/No

FL=R2/S

Z1=(R2+%i*X2)+((%i*Xm)*(FL+%i*X2))/(FL+%i*30.5)

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[c,d]=rect2polar(5.78,2.09)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[z,y]=polar2rect(c,d)

X=z+%i*y

Ifl=V1/X

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Ifl,Ang]=rect2polar(40.63,-14.6)


Ratio=Ist/Ifl

```

```
Pf=cos(%pi*19.8/180)

z=Vth^2/((Rth+FL)^2+(Xth+X2)^2)

T=(Phase/Wsy)*z*FL

Pag=T*Wsy

P2=S*Pag

Pmech=(1-S)*Pag

Pout=Pmech-1700

Pinp=Phase*V1*Ifl*Pf

EFFMotor=Pout/Pinp*100

  EFFint=(1-S)*100

  Stmax=R2/(Rth^2+(Xth+X2)^2)^0.5

  X=Rth+(Rth^2+(Xth+X2)^2)^0.5


  Tmax=(Phase/2*Wsy)*X

  T=Tmax/T
```

Scilab code Exa 5 resistance

```
F=60;P=6;RPM=1140;
RPM1=1000;R=0.2;

Ns=(120*F/P)
```

```
5
6  S1=(Ns-RPM)/(Ns)
7
8  S2=(Ns-RPM1)/(Ns)
9
10 Rext=(R/S1)*S2-(R)
```

Scilab code Exa 6 startingtorque

```
1  F=60;P=4;N=1710;RI=6;
2
3  Ns=(120*F)/P
4
5  Sfl=(Ns-N)/Ns
6
7  Tst=RI^2*Sfl
8
9  Stmax=(0.0875/0.91)^(1/2)
10
11 NMaxT=(1-Stmax)*Ns
12
13 Tmax=(1+Stmax^2)/(2*Stmax)*Tst
```

Scilab code Exa 7 speedpower

```
1  F1=60;F2=15;F3=120;F=60;P=6;
2  V=240;A=2;
3
4  S=F2/F1
5
6  Ns=(120*F)/P
7
8  N=(1+S)*Ns
```

```
 9
10 N1=(1-S)*Ns
11
12 S1=F3/F1
13
14 n=(1+S1)*Ns
15
16 n1=(1-S1)*Ns
17
18 Pac=1/S
19
20 Pac1=-1/S
21
22 Pdc=-(1-(S))/S
23
24 Pdc=-(1+(S))/-S
25
26 Pac1=1/S1
27
28 Pac1=1/-S1
29
30 Pdc=-(1-S1)/S1
31
32 Pdc=-(1+S1)/-S1
```

Chapter 6

SYNCHRONOUS MACHINES

Scilab code Exa 1 powerfactor

```
1  IMp=500;Pf=0.8;Pf1=0.6;
2  SMp=300;Pfs=1;P1=400;
3  P2=4;
4
5  Power=IMp*Pf
6
7  RecPower=IMp*Pf1
8
9  SyPower=SMp*Pfs
10
11 TotalPower=Power+SyPower
12
13 RecPower
14
15 ComplesPower=sqrt(TotalPower^2+RecPower^2)
16
17 PowerFactor=(TotalPower/ComplesPower)
18
19 Power1=sqrt(Power^2-RecPower^2)
20
21 KVAR=RecPower-Power1
```

```
22
23 NewKVA=sqrt(TotalPower^2+KVAR)
24
25 PowerFactor1=(TotalPower/NewKVA)
26
27 Ism=P1/(sqrt(3)*P2)
28
29 PowerfactorSYS=SyPower/P1
```

Scilab code Exa 2 unsaturatedvalues

```
1 V=14000;Phase=3;Ra=0.07;V1=10;Is=490;Pf=0.8;
2 If=200;Vl=18000;
3
4 Vb=V/sqrt(Phase)
5
6 Ib=(V1*10^6)/(sqrt(Phase)*V)
7
8 Zb=Vb/Ib
9
10 Zsun=(Vl/sqrt(3))/Is
11
12 Xsun=sqrt(Zsun^2-Ra^2)
13
14 Xsun=Xsun/Zb
15
16 Zssa=(V/sqrt(3))/Is
17
18 Xssa=Zssa/Zb
19
20 a=cos(0.8)
21
22 Deg=a*180/%pi
23
24 Zs=Zssa/Ra
```

```
25
26 Zs=atan(Zs)
27
28 Angle=Zs*180/%pi
29
30 function[x,y]=polar2rect(r,theta)
31 x=r*cos(theta*%pi/180);
32 y=r*sin(theta*%pi/180);
33 endfunction
34
35 [a,b]=polar2rect(1,0)
36
37 X1=a+%i*b
38
39 [c,d]=polar2rect(1,-Deg)
40
41 X2=c+%i*d
42
43 [e,f]=polar2rect(0.84,Angle)
44
45 X3=e+%i*f
46
47 X=X1+(X2*X3)
48
49 function[r,theta]=rect2polar(x,y)
50 r=sqrt(x^2+y^2);
51 theta=atan(y/x)*180/%pi;
52 endfunction
53
54 [I,Angle]=rect2polar(1.54,0.64)
55
56 Ef=I*V
57
58 If=I*If
```

Scilab code Exa 3 excitationvoltage

```
1  function[r,theta]=rect2polar(x,y)
2  r=sqrt(x^2+y^2);
3  theta=atan(y/x)*180/%pi;
4  endfunction
5  V=208;Poles=4;F=60;Phase=3;Vol=5000;Xs=8;
6
7  Vt=V/sqrt(Phase)
8
9  Ia=Vol/(sqrt(Phase)*V)
10 function[x,y]=polar2rect(r,theta)
11 x=r*cos(theta*%pi/180);
12 y=r*sin(theta*%pi/180);
13 endfunction
14 [x1,y1]=polar2rect(Vt,0)
15
16 [x2,y2]=polar2rect(Ia,-36.9)
17
18 [x3,y3]=polar2rect(8,90)
19
20 X1=x1+%i*0
21
22 X2=x2+%i*0
23
24 X2=x2+%i*y2
25
26 X3=x3+%i*y3
27
28 X=X1+(X2*X3)
29
30 function[r,theta]=rect2polar(x,y)
31 r=sqrt(x^2+y^2);
32 theta=atan(y/x)*180/%pi;
33 endfunction
34
35 [Ef,Angle]=rect2polar(186.7,88.7)
36
```

```
Newvol=1.2*Ef

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[x1,y1]=polar2rect(Newvol,21)

[x2,y2]=polar2rect(Vt,0)

[x3,y3]=polar2rect(Xs,90)

X1=x1+%i*y1

X1=x2+%i*y2

X1=x3+%i*y3

X=(X1-X2)/X3

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Ia,Angle1]=rect2polar(11.11,-13.93)

Pf=cos(%pi*51.5/180)

a=sin(%pi*51.5/180)

ReactiveKva=(Phase*Vt*Ia*a*10^-3)

Pmax=(Phase*Ef*Vt)/Xs

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
```

```
75 y=r*sin(theta*%pi/180);
76 endfunction
77
78 [x1,y1]=polar2rect(206.9,90)
79
80 [x2,y2]=polar2rect(120,0)
81
82 [x3,y3]=polar2rect(8,90)
83
84 X1=x1+%i*y1
85
86 X2=x2+%i*y2
87
88 X3=x3+%i*y3
89
90 X=(X1-X2)/X3
91
92 function[r,theta]=rect2polar(x,y)
93 r=sqrt(x^2+y^2);
94 theta=atan(y/x)*180/%pi;
95 endfunction
96
97 [Ia,Angle2]=rect2polar(25.8,15)
98
99 tan=Vt/Ef
100
101 Ang=tan*180/%pi
102
103 Pf=cos(%pi*Ang/180)
```

Scilab code Exa 4 powerangle

```
1 V=208;F=60;Phase=3;Power=3000;Xs=8;
2
3 Vt=V/sqrt(Phase)
```

```
4
5  Ia=Power/(Phase*Vt)
6
7  function[x,y]=polar2rect(r,theta)
8  x=r*cos(theta*%pi/180);
9  y=r*sin(theta*%pi/180);
10 endfunction
11 [x1,y1]=polar2rect(120,0)
12
13 [x2,y2]=polar2rect(8.33,0)
14
15 [x3,y3]=polar2rect(8,90)
16
17 X=X1-(X2*X3)
18
19 function[r,theta]=rect2polar(x,y)
20 r=sqrt(x^2+y^2);
21 theta=atan(y/x)*180/%pi;
22 endfunction
23
24 [Ef,Angle]=rect2polar(120,-66.64)
25
26 Pmax=(Phase*Ef*Vt)/Xs
27
28 Ws=(1800/F)*2*%pi
29
30 Tmax=Pmax/Ws
```

Scilab code Exa 5 fieldcurrent

```
1  V=460;Phase=3;N=1200;Hp=125;
2  Ra=0.078;Xal=0.15;Xar=1.85;Nre=28.2;Nse=28.2;
3
4  Ia=sqrt(Phase)*V
5
```

```
Ia=121.4

Vt=V/sqrt(Phase)

Ea=Vt-(Ia*Ra)

Xs=Xal+Xar

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[x1,y1]=polar2rect(Ea,0)

[x2,y2]=polar2rect(Xs,90)

X1=x1+%i*y1

X2=x2+%i*y2

Im=X1/X2

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Im,Angle1]=rect2polar(7.84D-15,-128.0)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[x1,y1]=polar2rect(Im,Angle1)

[x2,y2]=polar2rect(Ia,0)
```

```
44
45 X1=x1+%i*y1
46
47 X2=x2+%i*y2
48
49 X=X1-X2
50
51 function[r,theta]=rect2polar(x,y)
52 r=sqrt(x^2+y^2);
53 theta=atan(y/x)*180/%pi;
54 endfunction
55
56 [a,b]=rect2polar(-121.4,-128)
57
58 n=sqrt(2)/Phase*Nre
59
60 If=(a/n)*(Xs/Xar)
```

Scilab code Exa 6 statorcurrent

```
1 V=11;Phase=3;F=60;IncExe=150;DecExe=50;Xs=10;
2 Power=80000;
3
4 Vt=V/sqrt(Phase)
5
6 Vt=Vt*1000
7
8 Ef=IncExe/100
9
10 Ef1=DecExe/100
11
12 Ia=(Vt-(Ef*Vt))/(Xs)
13
14 Pf=cos(90/90*%pi/2)
15
```

```
Ia1=(Vt-(Ef1*Vt))/(Xs)

Pf1=cos(90/90*%pi/2)

Ia=Power/(Phase*Vt)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[x1,y1]=polar2rect(4.2,0)

[x2,y2]=polar2rect(10,90)

X1=x1+%i*y1

X2=x2+%i*y2

X=X1*X2

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[a,b]=rect2polar(Vt,42)
```

Scilab code Exa 7 powercurrent

```
Vt=1;Ia=1;Xd=0.8;Xq=0.4;Loss=0.15;Angle=36.9;

a=cos(%pi*Angle/180)

b=sin(%pi*Angle/180)
```

```
6
7  TanDeg=(Vt*Xq*a)/(Vt+(Ia*Xq*b))
8
9  z=atan(TanDeg)
10
11 Deg=(z*%pi/180)
12
13 Deg=(z*180/%pi)
14
15 Angl=Angle-Deg
16
17 Id=Ia*sin(%pi*Angl/180)
18
19 Iq=Ia*cos(%pi*Angl/180)
20
21 Ef=(Vt*cos(%pi*Deg/180))-(Id*Xq)
22
23 Pf=((Vt*Ef)/Xd)*sin(%pi*Deg/180)
24
25 Pr=(Vt^2*(Xd-Xq)/(2*Xd*Xq))*sin(%pi*45.6/180)
26
27 Pout=Vt*Ia*a
28
29 Prmax=(Vt^2*(Xd-Xq))/(2*Xd*Xq)
30
31 v=asin(Loss/Prmax)/2
32
33 Deg1=(v*180/%pi)
34
35 Id=Vt*cos(%pi*Deg1/180)/Xd
36
37 Iq=Vt*sin(%pi*Deg1/180)/Xq
38
39 Ia=(Id^2+Iq^2)^(1/2)
40
41  Ang=atan(Id/Iq)
42
43  Ang=(Ang*180/%pi)
```

```
44
45 Phi=Ang+Deg1
46
47 Pf=cos(%pi*Phi/180)
```

Chapter 7

SINGLE PHASE MOTORS

Scilab code Exa 2 ouputpower

```
1  F=60;P=4;N=1730;Zb=27.86;
2  R=1.35;X=1.63;R1=2.9;X1=3.26;
3  V=120;Prot=81.2;
4
5  Ns=(120*F)/P
6
7  S=(Ns-N)/N
8
9  a=%i*Zb*((R/S)+%i*X)
10
11 b=(R/S)+%i*(Zb+X)
12
13 Zf=a/b
14
15 Rf=13.06;
16
17 Xf=16.31;
18
19 a=%i*Zb*(R/(2-S)+%i*X)
20
21 b=R/(2-S)+%i*(Zb+X)
```

```
22
23 Zb=a/b
24
25 Rb=0.61;
26
27 Xb=1.55;
28
29 Zinput=(R1+Rf+Rb)+%i*(X1+Xf+Xb)
30
31 function[r,theta]=rect2polar(x,y)
32 r=sqrt(x^2+y^2);
33 theta=atan(y/x)*180/%pi;
34 endfunction
35
36 [a,b]=rect2polar(16.57,21.12)
37
38 Iinput=V/a
39
40 cos(%pi*b/180)
41
42 Pinput=V*Iinput*ans
43
44 Wsy=Ns*2*(%pi/F)
45
46 T=Iinput^2*(Rf-Rb)/Wsy
47
48 Pmech=T*Wsy*(1-S)
49
50 OutputPower=Pmech-Prot
51
52 Eff=OutputPower/Pinput*100
53
54 Pgf=Iinput^2*Rf
55
56 Pgb=Iinput^2*Rb
57
58 airgap=Pgf+Pgb
59
```

```
60 P2=S*Pgf+(2-S)*Pgb
```

Scilab code Exa 4 externalresistance

```
1  V=120;F=60;Pole=4;Zm=1.5+4.0;Za=3+6;
2  Xa=6;Xm=4;Rm=1.5;Ra=3;
3
4  Ra=(Xa/Xm)*(Rm+sqrt(18.25))
5
6  C=(2*%pi*F)*(Xa+(Ra*Rm)/(Xm+sqrt(18.25)))
7
8  a=((-Xm*Ra)+(sqrt(18.25)*sqrt(13.2)))
9
10 Xc=Xa+(a/Rm)
11
12 Ia=V/(3+%i*6)
13
14 function[r,theta]=rect2polar(x,y)
15 r=sqrt(x^2+y^2);
16 theta=atan(y/x)*180/%pi;
17 endfunction
18
19 [Is,Angle]=rect2polar(8,-16)
20
21 Im=V/(1.5+%i*4)
22
23 function[r,theta]=rect2polar(x,y)
24 r=sqrt(x^2+y^2);
25 theta=atan(y/x)*180/%pi;
26 endfunction
27
28 [Is1,Angle1]=rect2polar(9.86,-26.3)
29
30 Alfa=Angle1-Angle
31
```

```
Ts=Is*sin(%pi*6.01/180)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[a,b]=polar2rect(Is1,Angle1)

X=a+%i*b

C=1/C*10^6

a=((-Xm*Ra)+(sqrt(18.25)*sqrt(13.2)))

Xc=Xa+(a/Rm)

C=10^6/(2*%pi*F*Xc)

Ia=V/(3+%i*6)

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Is,Angle]=rect2polar(8,-16)

Im=V/(1.5+%i*4)

[Is1,Angle1]=rect2polar(9.86,-26.3)

Alfa=Angle1-Angle

Ts=Is*sin(%pi*6.01/180)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
```

```
y=r*sin(theta*%pi/180);
endfunction

[a,b]=polar2rect(Is1,Angle1)

X=a+%i*b

[c,d]=polar2rect(Is,Angle)

X1=c+%i*d

X2=X+X1

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[I,Angle]=rect2polar(17.86,-42.3)

Ia=V/(Ra+%i*Xa)

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Ia,Angle]=rect2polar(9.3,-6.4)

Alfa=69.33-34.53

Ts=Ia*sin(%pi*Alfa/180)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

```

```
[Is,Angle]=polar2rect(Ia,Angle)

[Is1,Angle1]=polar2rect(28.1,-69.44)

X=Is+%i*angle

X1=Is1+%i*Angle1

X2=Is+%i*Angle

X=X1+X2

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Is,Angle]=rect2polar(19.1,-32.7)

Xc=10^6/(2*%pi*F*405)

Ia=V/(Ra+(%i*6+%i*6.55))

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Is,Angle]=rect2polar(2.16,-9.04)


Ia=V/(Ra+(%i*6-%i*6.55))

[Is,Angle]=rect2polar(38.6,7.09)

Alfa=69.44+Angle

Ts=Is*sin(%pi*Alfa/180)
```

```
146
147 function[x,y]=polar2rect(r,theta)
148 x=r*cos(theta*%pi/180);
149 y=r*sin(theta*%pi/180);
150 endfunction
151
152 [Is,Angle]=polar2rect(28.1,-69.44)
153
154 [Is1,Angle1]=polar2rect(39.34,10.4)
155
156 X1=Is+%i*Angle
157
158 X2=Is1+%i*Angle1
159
160 X=X1+X2
161
162 function[r,theta]=rect2polar(x,y)
163 r=sqrt(x^2+y^2);
164 theta=atan(y/x)*180/%pi;
165 endfunction
166
167 [Is,Angle]=rect2polar(48.56,-19.20)
168
169 Ia=V/(Ra+(%i*Xa-%i*Xc))
170
171 function[r,theta]=rect2polar(x,y)
172 r=sqrt(x^2+y^2);
173 theta=atan(y/x)*180/%pi;
174 endfunction
175
176 [I,Angle]=rect2polar(23.9,19.6)
177
178 Alfa=69.44+39.5
179
180 Ts=I*sin(%pi*Alfa/180)
181
182 function[x,y]=polar2rect(r,theta)
183 x=r*cos(theta*%pi/180);
```

```
y=r*sin(theta*%pi/180);
endfunction

[Is,Angle]=polar2rect(28.1,-69.44)

[Is1,Angle1]=polar2rect(I,39.35)

X=Is+%i*Angle

X1=Is1+%i*Angle1

X2=X+X1

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[I,Angle]=rect2polar(33.7,-6.7)
```

Scilab code Exa 5 maximumtorque

```
V=120;F=60;X1m=2;R1m=1.5;R2=1.5;
X1a=2;R1a=1.5;X2=2;Xmag=48;C=30;a=1;
Z1m=1.5;Zb=0.69+%i*0.98;Z1a=2.5;
Xc=%i*2-%i*88.4;Ra=2.5;

Xc=10^6/(2*%pi*F*C)

Zb

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction
```

```
14
15 [x,y]=rect2polar(0.69,0.98)
16
17 function[x,y]=polar2rect(r,theta)
18 x=r*cos(theta*%pi/180);
19 y=r*sin(theta*%pi/180);
20 endfunction
21
22 [a,b]=polar2rect(V,0)
23
24 X=a+%i*b
25
26 z=(Z1m+%i*2+2*(Zb))
27
28 Im=X/z
29
30 function[r,theta]=rect2polar(x,y)
31 r=sqrt(x^2+y^2);
32 theta=atan(y/x)*180/%pi;
33 endfunction
34
35 [Is,Angle]=rect2polar(14.41,-19.81)
36
37 y=(Z1a+Xc+2*(Zb))
38
39 Ia=X/y
40
41 function[r,theta]=rect2polar(x,y)
42 r=sqrt(x^2+y^2);
43 theta=atan(y/x)*180/%pi;
44 endfunction
45
46 [Is1,Angle1]=rect2polar(0.065,1.41)
47
48 Wsy=(1800*2*%pi)/F
49
50 Ts=2*(Is)*(Is1)*2*0.69*sin(%pi*141.1/180)/Wsy
51
```

```
Zm=Z1m+%i*2+2*(Zb)

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[Ip1,Angle1]=rect2polar(2.88,3.96)

Za=Ra+%i*2+2*(Zb)

R=3.88;Im=3.96;
Xc=Im-((Im*R-4.9*sqrt(26.22))/2.88)

c=10^6/(2767.34)

Cs=c-C

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[v,a]=polar2rect(V,0)

X=v+%i*a

R=3.88;Im=3.96;Xc=7.34;

a=R+(%i*Im-%i*Xc)

z=X/a

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

```

```
[Is1,Angle1]=rect2polar(17.5,15.3)

Is=24.4;Angle=-53.4;
function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[a,b]=polar2rect(Is,Angle)

X1=a+%i*b

[c,d]=polar2rect(Is1,Angle1)

X2=c+%i*d

X=X1+X2

function[r,theta]=rect2polar(x,y)
r=sqrt(x^2+y^2);
theta=atan(y/x)*180/%pi;
endfunction

[z,y]=rect2polar(32.04,-4.28)

a=sin(%pi*95/180)

Ts=2*(Is1)*(Is)*2*0.69*a/Wsy

T=Ts/z
```

Scilab code Exa 6 torquedev

```
V=120;F=60;N=2000;A=0.6;
Ohm=20;L=0.25;
```

```
3  V=120;F=60;N=2000;Ia=0.6;
4  a=20;L=0.25;
5
6  Edc=V-(Ia*Ra)
7
8  X=2*%pi*F*L
9
10 Eac=(-Ia*Ra)+sqrt(V^2-(Ia*X)^2)
11
12 Nac=N*(Eac/Edc)
13
14 Pf=(Eac+(Ia*Ra))/V
15
16 Pmech=Eac*Ia
17
18 Wm=(Nac*2*%pi)/F
19
20 T=Pmech/Wm
```

Chapter 8

SPECIAL MACHINES

Scilab code Exa 1 shaftposition

```
1  T=0.2;V=115;N=3000;F=60;
2  J=10^-5;
3
4  Km=T/V
5
6  Wm=(N*2*%pi/F)
7
8  Fm=T/Wm
9
10 Tm=J/Fm
11
12 A=Km/Fm
13
14 Kmv=A*V
15
16 KmvT=A*Tm
```

Scilab code Exa 3 maximumvoltage

```
Rw=1;Lw=30;I=3;TimeOn=2;RF=0.0675;
StepRate=300;Turns=100;TimeOff=1;
PeakI=3;

R=Lw/TimeOn

Rext=R-TimeOff

Prext=(I^2*Rext)

Vs=I*R

Rext=R-Rw

R1=Lw/TimeOff

Rf=R1-R

Energy=(1/2*Lw*I^2)

Power=Turns*Rf

Power=Turns*RF

Vc=V+(PeakI*R)
```

Scilab code Exa 4 inductionenergy

```
Lw=30;R=15;Ia=3;V=45;

Tow=Lw/R

t1=0.7*Tow

t0=0:0.1:t1;
```

```
8
9  t=0;
10
11 a=integrate('45*(-3+6*%e^(-x/2))','x',t,t0)
12
13  Energy=(1/2)*Lw*Ia^2
14
15  ProEnergy=(a/Energy)*100
```

Chapter 9

TRANSIENTS AND DYNAMICS

Scilab code Exa 1 armaturevoltage

```
1  Rf=100;Lf=25;Ra=0.25;Laq=0.02;
2  Kg=100;Ll=0.15;V=200;Rl=1;
3
4  tow=Lf/Kg
5
6  log(0.1)
7
8  t=2.30/4
9
10 Towat=(Ll+Laq)/(Rl+Ra)
```

Scilab code Exa 3 maximumcurrent

```
1  Xd=0.9;Vt=1;Ia=1;Xd1=0.4;Xd2=0.2;Ta=0.2;
2  Td1=4;Td2=0.6;t=0.1;
3
```

```
function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[x,y]=polar2rect(Ia,-25.8)

X=x+%i*y

[x1,y1]=polar2rect(Xd,90)

X1=x1+%i*y1

A=Vt+(X*X1)

function[x,y]=polar2rect(r,theta)
x=r*cos(theta*%pi/180);
y=r*sin(theta*%pi/180);
endfunction

[Ei,Angle]=rect2polar(1.39,0.81)

[x,y]=polar2rect(Ia,-25.8)

X=x+%i*y

[x2,y2]=polar2rect(Xd1,90)

X2=x2+%i*y2

[Ei2,Angle1]=rect2polar(1.17,0.36)

[x,y]=polar2rect(Ia,-25.8)

X=x+%i*y

[x3,y3]=polar2rect(Xd2,90)

```

```
42 X3=x3+%i*y3
43
44 [Ei2,Angle2]=rect2polar(1.08,0.10)
45
46 Idc=sqrt(2)*(Ei2/Xd2)
47
48 Td1=(Xd1/Xd)*Td1
49
50 Td2=(Xd2/Xd1)*Td2
51
52 Isc=sqrt(2)*(Td1+1.29*%e^(-0.562*0.1)+2.42*%e
      ^(-3.3*0.1))+7.78*%e^(-5*0.1)
```

Chapter 10

POWER SEMICONDUCTOR CONVERTERS

Scilab code Exa 1 firingangle

```
1  Ka=0.09;N=1000;
2  Ia=30;Ra=0.4;V=120;
3  RevEa=-90;
4
5  Ea=Ka*N
6
7  Vo=Ea+(Ia*Ra)
8
9  a=Vo*%pi
10
11 b=2*sqrt(2)*V
12
13 c=a/b
14
15 angle=acosd(c)
16
17 P=Vo*Ia
18
19 S=V*Ia
```

```
20
21 Pf=P/S
22
23 Vo1=RevEa+(Ia*Ra)
24
25 a=Vo1*%pi
26
27 b=2*sqrt(2)*V
28
29 c=a/b
30
31 Angle=acosd(c)
32
33 Pdc=Ea*Ia
34
35 Pr=Ia^2*Ra
36
37 Ps=Pdc-Pr
```

Scilab code Exa 2 ouputvoltage

```
1 Vp=120;Angle=60;
2
3 t0=%pi/2
4
5 t1=t0:0.01:(210/360*2*%pi);
6
7 integrate('2^.5*120*sin(t)','t',t0,t1)
8
9 Vo=((3*sqrt(6))/(2*%pi))*120*cos(%pi*Angle/180)
```

Scilab code Exa 3 powerfactor

```
V=480;Ka=0.3;N=1500;
Ia=130;Ra=0.1;No=1000;

Vp=V/sqrt(3)

Ea=Ka*N

Vo=Ea+(Ia*Ra)

a=Vo*%pi

b=3*sqrt(6)*Vp

c=a/b

Angle=acosd(c)

IA=sqrt(2/3)*Ia

S=3*Vp*IA

Ps=Vo*Ia

Pf=Ps/S

Ea1=Ka*No

Vo1=-300+(Ia*Ra)

a=Vo1*%pi

b=3*sqrt(6)*Vp

c=a/b

Angle=acosd(c)

Pdc=Ea1*Ia
```

```
39
40 Pr=Ia^2*Ra
41
42 Ps=Pdc-Pr
```

Scilab code Exa 4 controlfiringangle

```
1  OutP=100*0.746;Eff=0.8;
2  Pf=0.85;V=460;
3
4  S=OutP/(Eff*Pf)
5
6  Il=S/(sqrt(3)*V)
7
8  Ip=Il/sqrt(3)
9
10 Is=Ip/sqrt(2)
11
12 Vs=sqrt(2)*V
13
14 Angle=acosd(Pf)
```

Scilab code Exa 5 supplypower

```
1  Ka=0.1;Ra=0.2;N=400;
2  Ia=100;V=120;N1=350;
3  Io=-100;
4
5  Ea=Ka*N
6
7  Vo=Ea+(Ia*Ra)
8
9  Pmotor=Ea*Ia
```

```
10
11 Pr=Ia^2*Ra
12
13 Ps=V*Ia*0.5
14
15 Vo=Ea1+(Ia*Ra)
16
17 Vo=Ea1+(Io*Ra)
18
19 Pmotor1=Ea1*Io
20
21 Pr1=Ia^2*Ra
22
23 Ps=V*Io*1/8
```

Scilab code Exa 6 outputpower

```
1 V=300;I=540;Angle=45;
2
3 t0=0:0.1:%pi;
4
5 t=0;
6 integrate('540*sin((x-45*%pi/180))','x',t,t0)/%pi
7
8  Is=242.89;
9
10 Ps=V*I
11
12 Vo1=(4*V)/(%pi*sqrt(2))
13
14 Pout=Vo1*Io/sqrt(2)*cos(%pi*Angle/180)
```

Scilab code Exa 7 phasevoltage

```
V=600;Phase=3;

Vl=sqrt(2/3)*V

Vp=V*sqrt(2)/Phase
```

Scilab code Exa 8 angleshift

```
V=120;Vo=50;Vo1=100;

Angleshift=(Vo^2/V^2)*180

Angleshift=(Vo1^2/V^2)*180
```

Scilab code Exa 9 outputcurrent

```
I=100;
PulseScr=sqrt(1/3);
PulseOut=sqrt(2/3);

a=PulseScr

msScr=a*I

b=PulseOut

RmsOut=b*I
```