

Scilab Textbook Companion for
Principles Of Electric Machines And Power
Electronics
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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

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

```
1 A=4*%pi*10^-7;lc=360;
2 N=500;i=4;lg=2*10^-3;
3
4 m=-A*(lc/lg)
5
6 c=(N*i*A)/(lg)
7
8 Hc=(N*i)/(lc)
```

Scilab code Exa 3 airgapflux

```
1 N1=500;I1=10;N2=500;I2=10;
2 Ibafe=3*52*10^-2;A=4*%pi*10^-7;
3 b=1200;Ag=4*10^-4;Ac=4*10^-4;
4 lg=5*10^-3;Ibecore=51.5*10^-2;c=2.067*10^-4;
5 d=4.134*10^-4;
6
7 F1=N1*I1
8
9 F2=N2*I2
10
11 Pre=1200*A
12
13 Rbafe=(Ibafe)/(Pre*Ac)
14
15 Rg=lg/(A*Ag)
16
17 Rbecore=Ibecore/(Pre*Ac)
18
19 Bg=d/(Ag)
```

20
21 $H_g = B_g / A$

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

```
1 resimp=9; inte=1; V=10; A=1/3;
2
3 I=V/(inte+resimp)
4
5 P=I^2*resimp
6
7 R=(A^2)*(resimp)
8
9 I1=V/(inte+I)
10
11 P1=I1^2*inte
```

Scilab code Exa 2 parameters

```
1 Vh=220; Ih=4.55; Wl=100;
2 Vl=150; Il=2.5; Wh=215;
3 Vhrated=2200; Vlrated=220;
4 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=(I1^2-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 Xeq1=Xeqh/A^2
33
34 P=(Poc/(Vlrated*I1))
35
36 Psh=(Psc/(Vl*Ihrated))

```

Scilab code Exa 3 voltageregulation

```

1 Fullload=75; Ia=4.55; V1=2200;
2
3 Fullload=Fullload/100
4
5 Ih=Fullload*Ia
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
12 [x1,y1]=polar2rect(V1,0)
13
14 [x2,y2]=polar2rect(35.46,-53.13)
15
16 [x3,y3]=polar2rect(106.73,36.87)
17
18 X1=x1+%i*y1
19
20 X2=x2+%i*y2
21
22 X3=x3+%i*y3
23
24 X=X1+X2+X3
25
26 function [r,theta]=rect2polar(x,y)
27 r=sqrt(x^2+y^2);
28 theta=atan(y/x)*180/%pi;
29 endfunction
30
31 [V,Angle]=rect2polar(2306.5,35.67)
32
33 VolReg=(V-V1)/V1*100
34
35 function [x,y]=polar2rect(r,theta)
36 x=r*cos(theta*pi/180);
37 y=r*sin(theta*pi/180);
38 endfunction

```

```

39 [x1,y1]=polar2rect(V1,0)
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-V1)/V1*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

```
1 P=100000; Vs=2000; Vp=200; Ih=500;
2 Vl=2000;
3
4 Iab=P/Vp
5
6 Ibc=P/Vs
7
8 Il=Ih+50
9
10 Vh=Vl+200
11
12 Kva1=(Vl*Il)/(1000)
13
14 Kva2=(Vh*Ih)/(1000)
```

Scilab code Exa 7 volcurregulation

```
1 Power=120000;; Phase=3;
2 V=230; Pri=2300; Sec=230; Z=0.012+%i*0.016; Pf=0.85;
3
4 Is=Power/(sqrt(Phase)*V)
5
6 I2=Is/sqrt(Phase)
7
8 a=Pri/V
9
10 I1=I2/a
11
12 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

```

1 Pri=1330;Sec=230;Zl=0.12+%i*0.25;Phase=3;V=230;
2 Z=0.8+%i*5;Power=27;
3 Zz=0.003+%i*0.015;Pf=0.9
4
5 A=(Pri/Sec)^2*(Zl)
6
7 Req=4.01;
8
9 Xeqh=8.36;
10
11 a=(sqrt(Phase)*Pri)/V
12
13 Reql=0.8;
14
15 Xeq1=5;
16 Rr=0.003;
17
18 Xx=0.015;
19
20 R=(Reql+Req)*(1/10^2)+Rr
21
22 X=(Xeq1+Xeqh)*(1/10^2)+Xx
23
24 Vl=V/sqrt(Phase)
25
26 Il=(Power*10^3)/(Phase*133)
27
28 Angle=-acos(%pi*Pf/180)

```

Scilab code Exa 9 impedances

```

1 Vh=2200;Vl=220;Pb=10000;
2 I=0.25;a=10;Z=10.4+%i*31.3;
3
4 Ib=Pb/Vh

```

```
5
6  I1=Pb/V1
7
8  Zb=Vh/Ib
9
10 Z1=V1/I1
11
12 Ih=I/Ib
13
14 Zeq=Z/Zb
15
16 Zeq1=Z*(1/100)
17
18 Zpu=Zeq1/Z1
19
20 Pcu=Ib^2*10.4
21
22 Ppu=Pcu/Pb
```

Chapter 3

ELECTROMECHANICAL 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

```

1 Ia=40;Ra=0.25;La=10;
2 ACv=265;Angle=30;
3 Ka=0.18;
4
5 A=cos(%pi*Angle/180)
6
7 Vt=(2*sqrt(2)*ACv*A)/(%pi)
8
9 Ea=Vt-(Ia*Ra)
10
11 N=Ea/Ka
12
13 Sec=(Ka*60)/(2*%pi)
14
15 T=Sec*Ia
16
17 P=Vt*Ia
18
19 P=(Ia^2*Ra)+Ea*Ia

```

Scilab code Exa 11 firingangle

```

1 V=480;RPM=1800;
2 Ia=16.5;Ra=0.0874;
3 Ka=0.33;
4 Angle=30;N=1800;
5
6 Vp=(V/sqrt(3))
7
8 Vt=(3*sqrt(6)*Vp)/(%pi)
9
10 Ea=Vt-(Ia*Ra)
11
12 No=(Ea/Ka)
13

```

```

14 A=cos(%pi*Angle/180)
15
16 Vt1=Vt*A
17
18 Ea1=Vt1-(Ia*Ra)
19
20 No1=Ea1/Ka
21
22 Eaf=Ka*N
23
24 Vtf=Eaf+(Ia*Ra)
25
26 Angle=Vtf/Vt
27
28 a=acos(Angle)
29
30 Alfa=a*180/%pi
31
32 Eas=Vtf-(Ia*Ra)
33
34 Nos=Eas/Ka
35
36 SpeedReg=(Nos-N)/N*100

```

Scilab code Exa 12 speedcontrol

```

1 Supv=120;Ia=20;Ra=0.5;
2 Ka=0.05;
3
4 Vt=Ia*Ra
5
6 A=(Vt/Supv)
7
8 Ea=Supv-(Ia*Ra)
9

```

10 $N=E_a/K_a$

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 serieturns

```
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  Ea = Eanl;
7  Ifar = 0.16;
8  Rf=Vt/If
9
10 Rfc=Rf-Rfw
11
12 Prot=Ea*5
13
14 Eanl=Vt-(Ia*Ra)
15
16 Eafl=Vt-(Iarated*Ra)
17
18 Wfl=(Eafl/Eanl)*N
19
20 Wm=(Wfl/60)*2*%pi
21
22 T=(Eafl*Iarated)/Wm
23
24 Pout=(Eafl*Iarated)-(Prot)
25
26 Pin=(Vt)*(Iarated+If)
27
28 Eff=(Pout/Pin)*100
29
30 Wfl1=(Eafl/Eanl)*(1/Afl)*N
31
32 Wm1=(Wfl1/60)*(2*%pi)
33
34 T=(Eafl*Iarated)/(Wm1)
35
36 Eff1=(Pout/Pin)*100
37
38 Wm=(1000/60)*(2*%pi)
39
40 Ka=Eanl/Wm

```

```

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

```

Scilab code Exa 7 ampereturns

```

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

```

1  Iarated=100;Vt=100;
2  Ra=0.1;
3  Ia1=200;
4  Ia = 25;
5  Iastart=Vt/Ra
6
7  Rae=(Vt-20)/(200)
8
9  Ea2=Vt-Iarated*(Ra+Rae)
10
11 Rae2=(Vt-Ea2-20)/(200)
12
13 Ea3=Vt-Ia*(Ra+Rae2)
14
15 Ea3=Vt-Iarated*(Ra+Rae2)
16
17 Rae3=(Vt-Ea3-20)/200
18
19 Ea4=Vt-Iarated*(Ra+Rae3)
20
21 Rae4=(Vt-Ea4-20)/200
22
23 Ia=(Vt-Ea4)/Ra
24
25 R1=Rae-Rae2
26
27 R2=Rae2-Rae3
28
29 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;
```

```

2  R2=0.5;X1=1;X2=1;Xm=35;
3  I=1.1;Peak=10;H=5;H1=7;
4  Phase=3;
5
6  Ns=120*F/P
7
8  S1=(Ns-N)/Ns
9
10 A=R2/S1
11
12 Z1=(Xm*%i)*(A+X1*%i)/(A+X2*%i+Xm*%i)
13
14 Rth=12.08;
15
16 Pg1=Phase*((I*Peak)/sqrt(2))^2*Rth
17
18 Wsyn=(Ns/60)*2*%pi
19
20 T1=Pg1/Wsyn
21
22 Ns1=-(120*H*F)/P
23
24 S2=(Ns1-N)/Ns1
25
26 B=R2/S2
27
28 Xm1=H*Xm
29
30 hX2=H*X2
31
32 Z2=Xm1*%i*(B+hX2*%i)/(B+hX2*%i+Xm1*%i)
33
34 Rth2=0.39;
35
36 Pg2=Phase*((0.22*Peak)/sqrt(2))^2*Rth2
37
38 Wsyn2=(Ns1/60)*2*%pi
39

```

```

40 T2=Pg2/Wsyn2
41
42 Ns3=(120*H1*F)/P
43
44 S3=(Ns3-N)/Ns3
45
46 C=R2/S3
47
48 Xm3=H1*Xm
49
50 hX3=H1*X2
51
52 Z3=Xm3*%i*(C+hX3*%i)/(C+hX3*%i+Xm3*%i)
53
54 Rth3=0.54;
55
56 Pg3=Phase*((0.16*Peak)/sqrt(2))^2*Rth3
57
58 Wsyn3=(Ns3/60)*2*%pi
59
60 T3=Pg3/Wsyn3

```

Scilab code Exa 11 voltage

```

1 S=2;Pole=50;F=50;
2 Slip=0.25;
3
4 Pole=Pole*10^-2
5
6 Vs=S*Pole*F
7
8 Vs=Vs*3600/1000
9
10 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 Zn1=(Vt/NoI)
15
```

```

16 Rn1=(Pn1)/(3*NoI^2)
17
18 Xn1=(Zn1^2-Rn1^2)^(1/2)
19
20 Rb1=BP/(3*BI^2)
21
22 Zb1=(BV)/(sqrt(3)*BI)
23
24 Xb1=(Zb1^2-Rb1^2)^(1/2)
25
26 Xb1=Xb1*(F/BF)
27
28 X1=Xb1/2
29
30 Xm=(Xn1-X1)
31
32 R=Rb1-R1
33
34 R2=((X1+Xm)/(Xm))^2*2
35
36 Vth=(Xm)/(X1+Xm)
37
38 Rth=(Vth^2)*R1

```

Scilab code Exa 4 sliptorque

```

1 R1=0.25;X1=0.5;X2=0.5;
2 R2=0.2;Xm=30;V=460;
3 N=1740;F=60;P=4;Phase=3;No=1800;
4
5 V1=V/sqrt(Phase)
6
7 Z1=(R1+%i*X1)+(%i*Xm*(R2+%i*X2)/(R2+%i*30.5))
8
9 function[r,theta]=rect2polar(x,y)

```

```

10 r=sqrt(x^2+y^2);
11 theta=atan(y/x)*180/%pi;
12 endfunction
13
14 [Rth,Angle]=rect2polar(0.44,0.99)
15
16 function[x,y]=polar2rect(r,theta)
17 x=r*cos(theta*%pi/180);
18 y=r*sin(theta*%pi/180);
19 endfunction
20
21 [a,b]=polar2rect(Rth,Angle)
22
23 X=a+%i*b
24
25 Ist=(V1/X)
26
27 function[r,theta]=rect2polar(x,y)
28 r=sqrt(x^2+y^2);
29 theta=atan(y/x)*180/%pi;
30 endfunction
31
32 [Ist,Angle]=rect2polar(99.56,-224.0)
33
34 Wsy=(1800/F)*2*%pi
35
36 Vth=(V1*%i*Xm)/(R1+%i*30.5)
37
38 Vth=265.3;
39
40 Zth=%i*Xm*(%i*R1+%i*X1)/(R1+%i*30.5)
41
42 Zth=(%i*Xm*(R1+%i*X1))/(R1+%i*30.5)
43
44 Rth=0.24;
45
46 Xth=0.49;
47

```

```

48 a=Vth^2/((Rth+R2)^2+(Xth+X1)^2)
49
50 Tst=((Phase/Wsy)*a*R2)
51
52 S=(No-N)/No
53
54 FL=R2/S
55
56 Z1=(R2+%i*X2)+((%i*Xm)*(FL+%i*X2))/(FL+%i*30.5)
57
58 function[r,theta]=rect2polar(x,y)
59 r=sqrt(x^2+y^2);
60 theta=atan(y/x)*180/%pi;
61 endfunction
62
63 [c,d]=rect2polar(5.78,2.09)
64
65 function[x,y]=polar2rect(r,theta)
66 x=r*cos(theta*%pi/180);
67 y=r*sin(theta*%pi/180);
68 endfunction
69
70 [z,y]=polar2rect(c,d)
71
72 X=z+%i*y
73
74 Ifl=V1/X
75
76 function[r,theta]=rect2polar(x,y)
77 r=sqrt(x^2+y^2);
78 theta=atan(y/x)*180/%pi;
79 endfunction
80
81 [If1,Ang]=rect2polar(40.63,-14.6)
82
83
84 Ratio=Ist/If1
85

```

```

86 Pf=cos(%pi*19.8/180)
87
88 z=Vth^2/((Rth+FL)^2+(Xth+X2)^2)
89
90 T=(Phase/Wsy)*z*FL
91
92 Pag=T*Wsy
93
94 P2=S*Pag
95
96 Pmech=(1-S)*Pag
97
98 Pout=Pmech-1700
99
100 Pinp=Phase*V1*Ifl*Pf
101
102 EFFMotor=Pout/Pinp*100
103
104     EFFint=(1-S)*100
105
106     Stmax=R2/(Rth^2+(Xth+X2)^2)^0.5
107
108     X=Rth+(Rth^2+(Xth+X2)^2)^0.5
109
110
111     Tmax=(Phase/2*Wsy)*X
112
113     T=Tmax/T

```

Scilab code Exa 5 resistance

```

1 F=60;P=6;RPM=1140;
2 RPM1=1000;R=0.2;
3
4 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 Sf1=(Ns-N)/Ns
6
7 Tst=RI^2*Sf1
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; V1=18000;
3
4 Vb=V/sqrt(Phase)
5
6 Ib=(V1*10^6)/(sqrt(Phase)*V)
7
8 Zb=Vb/Ib
9
10 Zsun=(V1/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
```

```

37 Newvol=1.2*Ef
38
39 function [x,y]=polar2rect(r,theta)
40 x=r*cos(theta*pi/180);
41 y=r*sin(theta*pi/180);
42 endfunction
43
44 [x1,y1]=polar2rect(Newvol,21)
45
46 [x2,y2]=polar2rect(Vt,0)
47
48 [x3,y3]=polar2rect(Xs,90)
49
50 X1=x1+i*y1
51
52 X1=x2+i*y2
53
54 X1=x3+i*y3
55
56 X=(X1-X2)/X3
57
58 function [r,theta]=rect2polar(x,y)
59 r=sqrt(x^2+y^2);
60 theta=atan(y/x)*180/pi;
61 endfunction
62
63 [Ia,Angle1]=rect2polar(11.11,-13.93)
64
65 Pf=cos(pi*51.5/180)
66
67 a=sin(pi*51.5/180)
68
69 ReactiveKva=(Phase*Vt*Ia*a*10^-3)
70
71 Pmax=(Phase*Ef*Vt)/Xs
72
73 function [x,y]=polar2rect(r,theta)
74 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

```

```

6 Ia=121.4
7
8 Vt=V/sqrt(Phase)
9
10 Ea=Vt-(Ia*Ra)
11
12 Xs=Xal+Xar
13
14 function [x,y]=polar2rect(r,theta)
15 x=r*cos(theta*pi/180);
16 y=r*sin(theta*pi/180);
17 endfunction
18
19 [x1,y1]=polar2rect(Ea,0)
20
21 [x2,y2]=polar2rect(Xs,90)
22
23 X1=x1+%i*y1
24
25 X2=x2+%i*y2
26
27 Im=X1/X2
28
29 function [r,theta]=rect2polar(x,y)
30 r=sqrt(x^2+y^2);
31 theta=atan(y/x)*180/%pi;
32 endfunction
33
34 [Im,Angle1]=rect2polar(7.84D-15,-128.0)
35
36 function [x,y]=polar2rect(r,theta)
37 x=r*cos(theta*pi/180);
38 y=r*sin(theta*pi/180);
39 endfunction
40
41 [x1,y1]=polar2rect(Im,Angle1)
42
43 [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

```

```

16 Ia1=(Vt-(Ef1*Vt))/(Xs)
17
18 Pf1=cos(90/90*%pi/2)
19
20 Ia=Power/(Phase*Vt)
21
22 function [x,y]=polar2rect(r,theta)
23 x=r*cos(theta*%pi/180);
24 y=r*sin(theta*%pi/180);
25 endfunction
26
27 [x1,y1]=polar2rect(4.2,0)
28
29 [x2,y2]=polar2rect(10,90)
30
31 X1=x1+%i*y1
32
33 X2=x2+%i*y2
34
35 X=X1*X2
36
37 function [r,theta]=rect2polar(x,y)
38 r=sqrt(x^2+y^2);
39 theta=atan(y/x)*180/%pi;
40 endfunction
41
42 [a,b]=rect2polar(Vt,42)

```

Scilab code Exa 7 powercurrent

```

1 Vt=1;Ia=1;Xd=0.8;Xq=0.4;Loss=0.15;Angle=36.9;
2
3 a=cos(%pi*Angle/180)
4
5 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 $P2 = S * P_{gf} + (2 - S) * P_{gb}$

Scilab code Exa 4 externalresistance

```
1 V=120;F=60;Pole=4;Zm=1.5+4.0j;Za=3+6j;
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+1j*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+1j*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
```

```

32 Ts=Is*sin(%pi*6.01/180)
33
34 function [x,y]=polar2rect(r,theta)
35 x=r*cos(theta*%pi/180);
36 y=r*sin(theta*%pi/180);
37 endfunction
38
39 [a,b]=polar2rect(Is1,Angle1)
40
41 X=a+%i*b
42
43 C=1/C*10^6
44
45 a=((-Xm*Ra)+(sqrt(18.25)*sqrt(13.2)))
46
47 Xc=Xa+(a/Rm)
48
49 C=10^6/(2*%pi*F*Xc)
50
51 Ia=V/(3+%i*6)
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 [Is,Angle]=rect2polar(8,-16)
59
60 Im=V/(1.5+%i*4)
61
62 [Is1,Angle1]=rect2polar(9.86,-26.3)
63
64 Alfa=Angle1-Angle
65
66 Ts=Is*sin(%pi*6.01/180)
67
68 function [x,y]=polar2rect(r,theta)
69 x=r*cos(theta*%pi/180);

```

```

70 y=r*sin(theta*pi/180);
71 endfunction
72
73 [a,b]=polar2rect(Is1,Angle1)
74
75 X=a+%i*b
76
77 [c,d]=polar2rect(Is,Angle)
78
79 X1=c+%i*d
80
81 X2=X+X1
82
83 function[r,theta]=rect2polar(x,y)
84 r=sqrt(x^2+y^2);
85 theta=atan(y/x)*180/%pi;
86 endfunction
87
88 [I,Angle]=rect2polar(17.86,-42.3)
89
90 Ia=V/(Ra+%i*Xa)
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,Angle]=rect2polar(9.3,-6.4)
98
99 Alfa=69.33-34.53
100
101 Ts=Ia*sin(%pi*Alfa/180)
102
103 function[x,y]=polar2rect(r,theta)
104 x=r*cos(theta*pi/180);
105 y=r*sin(theta*pi/180);
106 endfunction
107

```

```

108 [Is, Angle]=polar2rect(Ia, Angle)
109
110 [Is1, Angle1]=polar2rect(28.1, -69.44)
111
112 X=Is+%i*Angle
113
114 X1=Is1+%i*Angle1
115
116 X2=Is+%i*Angle
117
118 X=X1+X2
119
120 function[r, theta]=rect2polar(x, y)
121 r=sqrt(x^2+y^2);
122 theta=atan(y/x)*180/%pi;
123 endfunction
124
125 [Is, Angle]=rect2polar(19.1, -32.7)
126
127 Xc=10^6/(2*%pi*F*405)
128
129 Ia=V/(Ra+(%i*6+%i*6.55))
130
131 function[r, theta]=rect2polar(x, y)
132 r=sqrt(x^2+y^2);
133 theta=atan(y/x)*180/%pi;
134 endfunction
135
136 [Is, Angle]=rect2polar(2.16, -9.04)
137
138
139 Ia=V/(Ra+(%i*6-%i*6.55))
140
141 [Is, Angle]=rect2polar(38.6, 7.09)
142
143 Alfa=69.44+Angle
144
145 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);

```

```

184 y=r*sin(theta*%pi/180);
185 endfunction
186
187 [Is,Angle]=polar2rect(28.1,-69.44)
188
189 [Is1,Angle1]=polar2rect(I,39.35)
190
191 X=Is+%i*Angle
192
193 X1=Is1+%i*Angle1
194
195 X2=X+X1
196
197 function[r,theta]=rect2polar(x,y)
198 r=sqrt(x^2+y^2);
199 theta=atan(y/x)*180/%pi;
200 endfunction
201
202 [I,Angle]=rect2polar(33.7,-6.7)

```

Scilab code Exa 5 maximumtorque

```

1 V=120;F=60;X1m=2;R1m=1.5;R2=1.5;
2 X1a=2;R1a=1.5;X2=2;Xmag=48;C=30;a=1;
3 Z1m=1.5;Zb=0.69+%i*0.98;Z1a=2.5;
4 Xc=%i*2-%i*88.4;Ra=2.5;
5
6 Xc=10^6/(2*%pi*F*C)
7
8 Zb
9
10 function[r,theta]=rect2polar(x,y)
11 r=sqrt(x^2+y^2);
12 theta=atan(y/x)*180/%pi;
13 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

```

```

52 Zm=Z1m+%i*2+2*(Zb)
53
54 function[r,theta]=rect2polar(x,y)
55 r=sqrt(x^2+y^2);
56 theta=atan(y/x)*180/%pi;
57 endfunction
58
59 [Ip1,Angle1]=rect2polar(2.88,3.96)
60
61 Za=Ra+%i*2+2*(Zb)
62
63 R=3.88; Im=3.96;
64 Xc=Im-((Im*R-4.9*sqrt(26.22))/2.88)
65
66 c=10^6/(2767.34)
67
68 Cs=c-C
69
70 function[x,y]=polar2rect(r,theta)
71 x=r*cos(theta*%pi/180);
72 y=r*sin(theta*%pi/180);
73 endfunction
74
75 [v,a]=polar2rect(V,0)
76
77 X=v+%i*a
78
79 R=3.88; Im=3.96; Xc=7.34;
80
81 a=R+(%i*Im-%i*Xc)
82
83 z=X/a
84
85 function[r,theta]=rect2polar(x,y)
86 r=sqrt(x^2+y^2);
87 theta=atan(y/x)*180/%pi;
88 endfunction
89

```

```

90 [Is1,Angle1]=rect2polar(17.5,15.3)
91
92 Is=24.4;Angle=-53.4;
93 function [x,y]=polar2rect(r,theta)
94 x=r*cos(theta*pi/180);
95 y=r*sin(theta*pi/180);
96 endfunction
97
98 [a,b]=polar2rect(Is,Angle)
99
100 X1=a+%i*b
101
102 [c,d]=polar2rect(Is1,Angle1)
103
104 X2=c+%i*d
105
106 X=X1+X2
107
108 function [r,theta]=rect2polar(x,y)
109 r=sqrt(x^2+y^2);
110 theta=atan(y/x)*180/%pi;
111 endfunction
112
113 [z,y]=rect2polar(32.04,-4.28)
114
115 a=sin(%pi*95/180)
116
117 Ts=2*(Is1)*(Is)*2*0.69*a/Wsy
118
119 T=Ts/z

```

Scilab code Exa 6 torquedev

```

1 V=120;F=60;N=2000;A=0.6;
2 Ra=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

```

1  Rw=1;Lw=30;I=3;TimeOn=2;RF=0.0675;
2  StepRate=300;Turns=100;TimeOff=1;
3  PeakI=3;
4
5  R=Lw/TimeOn
6
7  Rext=R-TimeOff
8
9  Prext=(I^2*Rext)
10
11 Vs=I*R
12
13 Rext=R-Rw
14
15 R1=Lw/TimeOff
16
17 Rf=R1-R
18
19 Energy=(1/2*Lw*I^2)
20
21 Power=Turns*Rf
22
23 Power=Turns*RF
24
25 Vc=Vs+(PeakI*R)

```

Scilab code Exa 4 inductionenergy

```

1  Lw=30;R=15;Ia=3;V=45;
2
3  Tow=Lw/R
4
5  t1=0.7*Tow
6
7  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
```

```

4  function [x,y]=polar2rect(r,theta)
5  x=r*cos(theta*pi/180);
6  y=r*sin(theta*pi/180);
7  endfunction
8
9  [x,y]=polar2rect(Ia,-25.8)
10
11  X=x+%i*y
12
13  [x1,y1]=polar2rect(Xd,90)
14
15  X1=x1+%i*y1
16
17  A=Vt+(X*X1)
18
19  function [x,y]=polar2rect(r,theta)
20  x=r*cos(theta*pi/180);
21  y=r*sin(theta*pi/180);
22  endfunction
23
24  [Ei,Angle]=rect2polar(1.39,0.81)
25
26  [x,y]=polar2rect(Ia,-25.8)
27
28  X=x+%i*y
29
30  [x2,y2]=polar2rect(Xd1,90)
31
32  X2=x2+%i*y2
33
34  [Ei2,Angle1]=rect2polar(1.17,0.36)
35
36  [x,y]=polar2rect(Ia,-25.8)
37
38  X=x+%i*y
39
40  [x3,y3]=polar2rect(Xd2,90)
41

```

```

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

```

1  V=480;Ka=0.3;N=1500;
2  Ia=130;Ra=0.1;No=1000;
3
4  Vp=V/sqrt(3)
5
6  Ea=Ka*N
7
8  Vo=Ea+(Ia*Ra)
9
10 a=Vo*%pi
11
12 b=3*sqrt(6)*Vp
13
14 c=a/b
15
16 Angle=acosd(c)
17
18 IA=sqrt(2/3)*Ia
19
20 S=3*Vp*IA
21
22 Ps=Vo*Ia
23
24 Pf=Ps/S
25
26 Ea1=Ka*No
27
28 Vo1=-300+(Ia*Ra)
29
30 a=Vo1*%pi
31
32 b=3*sqrt(6)*Vp
33
34 c=a/b
35
36 Angle=acosd(c)
37
38 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 Ea1 = Ka*N1;
16
17 Vo=Ea1+(Ia*Ra)
18
19 Vo=Ea1+(Io*Ra)
20
21 Pmotor1=Ea1*Io
22
23 Pr1=Ia^2*Ra
24
25 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*I/sqrt(2)*cos(%pi*Angle/180)

```

Scilab code Exa 7 phasevoltage

```
1 V=600;Phase=3;
2
3 V1=sqrt(2/3)*V
4
5 Vp=V*sqrt(2)/Phase
```

Scilab code Exa 8 angleshift

```
1 V=120;Vo=50;Vo1=100;
2
3 Angleshift=(Vo^2/V^2)*180
4
5 Angleshift=(Vo1^2/V^2)*180
```

Scilab code Exa 9 outputcurrent

```
1 I=100;
2 PulseScr=sqrt(1/3);
3 PulseOut=sqrt(2/3);
4
5 a=PulseScr
6
7 msScr=a*I
8
9 b=PulseOut
10
11 RmsOut=b*I
```
