Scilab Textbook Companion for Basic Electrical Engineering by D. P. Kothari And I. J. Nagrath[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Elementary Concepts and Definitions

Scilab code Exa 1.A.1 Additional Solved Problem 1

```
t=0.1
R=800
i=50*exp(-10*t)/1000
v=50*cos(25*t)
v_i=10*t^(2.5)

P1=i*i*R
P2=v*v/R
P3=v_i

disp(P3,P2,P1)
```

Scilab code Exa 1.A.2 Additional Solved Problem 2

```
v2=5
i2=v2/1000
```

```
v1=-i2/5
vs=v1

disp(vs)
```

Scilab code Exa 1.A.3 Additional Solved Problem 3

```
L=20/1000

//////////////////////////////
disp("Part1")
function i = i(t)
    i = 8*exp(-100*t);
endfunction

t=10/1000
v= L*(derivative(i,t))
disp(v,"V=")

//////////////////////////////Part2
disp("Part2")
t=0.1

function v=v(t)
    v=6*exp(-12*t)
endfunction

i0=8

i2=1/L*intg(0,t,v)+i0
disp(i2)

//////////////////////////////Part3
disp("Part3")
function i3 = i3(t)
```

```
29      i3 = 10-10*exp(-50*t);
30  endfunction
31
32  t=40/1000
33  v3=L*(derivative(i3,t))
34  P40=v3*i3(t)
35  disp(P40)
36
37  t=50/1000
38  P50=1/2*L*(i3(50)^2)
39  disp(P50)
```

Scilab code Exa 1.A.4 Additional Solved Problem 4

```
1  function i = i(t)
2      i = 9*sin(%pi*t)/1000;
3  endfunction
4
5  t=200/1000
6  CV=intg(0,t,i)
7  Wc=300E-6
8  C=(CV^2)/(2*Wc)
9  disp(C)
```

Scilab code Exa 1.A.5 Additional Solved Problem 5

```
1  L=25E-3
2
3  T=5/1000
4  I=1/L*integrate('25*cos(500*t)','t',0,T)
5  P=25*cos(500*T)*I
6
7  t1=%pi/2/500          /////power absorbed zero
```

```
8  t2=%pi/500          /////energy stored zero
9
10 disp(I,P,t1,t2)
```

Scilab code Exa 1.A.6 Additional Solved Problem 6

```
1  e0=8.85E-12
2  er=1
3  A=%pi*(1/200)^2
4  d=150/1000000
5  C=er*e0*A/d
6
7  E=1/1000
8  v=sqrt(2*E/C)
9  disp(v)
10
11 E=2/1000000
12 v=100
13 er=2*E/(v^2)/C
14 disp(er)
```

Scilab code Exa 1.A.7 Additional Solved Problem 7

```
1  t=10/1000
2  v3=8*exp(-50*t)
3  p3=v3*(-3.6)
4  P=[230/1000*4.8; (-3.2)*1.45;p3]
5
6  disp("Power absorbed are respectively")
7  disp(P)
```

Scilab code Exa 1.A.9 Additional Solved Problem 9

```
Im=250/1000
w=100
r=4
L=50/1000
t=25/1000

i=Im*sin(w*t)
Vr=i*r
Vl=Im*L*w*cos(w*t)

Pr=i*i*r
Pl=Vl*i
wl=1/2*L*i*i
wl_min=0 //min current =0
wl_max=1/2*L*Im*Im //Im is the max current

disp("All values in Joules")
disp(wl_max,wl_min,wl,Pl,Pr)
```

Scilab code Exa 1.1 Problem1

```
disp("v1=A cos(w t+p)")
disp("i1=B cos(w1 t+p1)")
disp("i2=C sin(w2 t+p2)")
disp("All values in degrees")
w=input("w=")
p=input("p=")
w1=input("w1=")
p1=input("p1=")
w2=input("w2=")
p2=input("p2=")

if(w==w1)
```

```
13      lag1=p-p1;
14      disp(lag1, "i1 lags v1 by ")
15  else
16      disp("Lag undefined for i1")
17  end
18
19
20  if(w==w2)
21      lag2=p-p2+90;
22      disp(lag2, "i2 lags v1 by ")
23  else
24      disp("Lag undefined for i2")
25  end
```

Scilab code Exa 1.2 Problem2

```
1  // X cos(w t+p)+Y sin(w t+q)
2
3  X=50
4  Y=-30
5  w=120
6  p=-45
7  p=p/180*%pi;
8  q=160
9  q=q/180*%pi;
10
11 //Part1
12
13 A=X*cos(p)+ Y*sin(q);
14 B=-X*sin(p)+ Y*cos(q);
15
16 disp(B,"B=",A,"A=")
```

Scilab code Exa 1.3 Problem3

```
G1=input("G1=")
G2=input("G2=")
G3=input("G3=")
Is1=input("Is1=")
Is2=input("Is2=")

A=[G1+G3,-G3;-G3,G2+G3];
I=[Is1;Is2];
V=inv(A)*I;

disp(V)
```

Scilab code Exa 1.5 Problem5

```


R1=input("R1=")
R2=input("R2=")
R3=input("R3=")
Vs1=input("Vs1=")
Vs2=input("Vs2=")

R=[R1+R3,-R3;-R3,R2+R3];
V=[Vs1;-Vs2];
I=inv(R)*V;

disp(I)
```

Scilab code Exa 1.7 Problem7

```
R1=1
```

```
2  R2=6
3  R3=12
4  R4=4
5  I4=3/4
6  V6=6
7
8  V4=3/4*4
9  I12=3/12
10 IR=3/4+I12
11
12 R=-12*I12+V6  //KVL
13 disp(R,"R(Ohm)=")
14
15 I6=V6/6
16 I1=I6+IR
17
18 Vs=1*I1+V6  //KVL
19 disp(Vs, "Vs(V)=")
20
21 disp(Vs*I1,"Power(W)=")
```

Scilab code Exa 1.9 Problem9

```
1  i1=4
2  v3=3
3  v4=8
4
5  i3=v3/3
6  i4=v4/4
7
8  i2=(i1-i3-i4)/2  //KCL
9  v2=2*i2
10
11 disp(v2,"v2=")
```

Scilab code Exa 1.10 Problem10

```
v1=6
i2=2
i3=4

v2=2*i2
v3=2*i3

v4=-v1+4*i2+v3-v2 //KVL
i4=v4/3
disp(i4)
```

Scilab code Exa 1.11 Problem11

```
i1=4-1 // KCL at node 1
disp(i1,"i1=")

v1=i1*1
v12=1*1
v2=v1-v12
i2=v2/1

i3=1-i2 //KCL at node 2

Vs=v2-1*i3 //KVL
disp(Vs,"Vs=")
```

Scilab code Exa 1.12 Problem12

```
i34=10-8 //KCL at node 4
v34=5*i34
v23=40-10 //KVL
vx=v23
disp(vx,"vx=")
ix=4-8 //KCL at node 1
disp(ix,"ix=")
i23=ix+10 //KCL at node 2
R2=vx/i23
disp(R2,"R2=")
v14=40+6*ix //KVL
R1=v14/8
disp(R1,"R1=")
```

Scilab code Exa 1.13 Problem13

```
vs=0.01 // *cos(1000*t)

vpi=vs
i0=-vpi/1000
vo=i0*1000;
printf("v0 = %f *cos(1000*t)",vo)
```

Scilab code Exa 1.15 Problem15

```
t=0.1
R=800
i=50*exp(-10*t)/1000
v=50*cos(25*t)
v_i=10*t^(2.5)

P1=i*i*R
P2=v*v/R
```

```
P3=v_i

disp(P3,P2,P1)
```

Chapter 2

Fundamentals of Resistive Circuits

Scilab code Exa 2.1 Problem1

```
1  function s=series(r1,r2)
2      s=r1+r2
3  endfunction
4
5  function p=parallel(r1,r2)
6      p=r1*r2/(r1+r2)
7  endfunction
8
9  r1=series(12,8)
10 r2=parallel(20,r1)
11 r3=series(r2,50)
12 r4=parallel(30,r3)
13 r5=series(10,r4)
14 r6=series(r5,20)
15 Req_ab=parallel(r5,40)
16 disp(Req_ab)
17
18 r7=40+20+10  //series
19 Req_bc=parallel(r4,r7)
```

```
20 disp(Req_bc)
```

Scilab code Exa 2.2 Problem2

```
1 I=(14-4)/(8+5+5+7) //KVL
2 disp(I)
```

Scilab code Exa 2.3 Problem3

```
1 r1=100
2 v=3/4
3
4 r2=r1*v/(1-v)
5
6
7 function p=parallel(r1,r2)
8     p=r1*r2/(r1+r2)
9 endfunction
10
11 //////Part1
12 R2_eq=parallel(r2,10000)
13 k=R2_eq/(R2_eq+r1)
14 change1=(3/4-k)/(3/4)*100
15 disp(change1)
16 //////Part2
17
18 R2_eq=parallel(r2,1000)
19 k=R2_eq/(R2_eq+r1)
20 change2=(3/4-k)/(3/4)*100
21 disp(change2)
```

Scilab code Exa 2.4 Problem4

```
function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction


v=150

Req=1000*parallel(parallel(10,5),4)
i1=v/(2000+0.2*1000+Req)
v1=i1*0.2*1000
VReq=Req*i1
i2=VReq/4000

disp(v1)
disp(i2)
```

Scilab code Exa 2.5 Problem5

```
function [Rab,Rbc,Rca]=star_to_delta(Ra,Rb,Rc)
    X=Ra*Rb+Rb*Rc+Rc*Ra
    Rab=X/Rc
    Rbc=X/Ra
    Rca=X/Rb
endfunction

function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

[Rx,Ry,Rz]=star_to_delta(8,4,2)

Req_ad=parallel(parallel(4,Rx)+parallel(12,Rz),
   parallel(3,Ry))
```

```
15 disp(Req_ad)
```

Scilab code Exa 2.6 Problem6

```
1 //Converting Voltage source with series resistance
     to current source
2 I=1/(1/4)
3
4 //KCL at nodes 1,2,3 using conductances
5 A=[11,-3,-4;-3,6,-2;-4,-2,11]
6 V=inv(A)*[5;-7;6]
7
8 disp(V)
```

Scilab code Exa 2.7 Problem7

```
1 function p=parallel(r1,r2)
2     p=r1*r2/(r1+r2)
3 endfunction
4
5 Req=parallel(15,30)
6
7 //KCL at nodes 1 and 2
8 A=[3,-1;-3,5]
9 V=inv(A)*[80;-360]
10
11 disp(V(1))
```

Scilab code Exa 2.8 Problem8

```
1 //Converting practical voltage source to current
     source
2 I=12/6
3
4 //KCLs
5 A=[0.7,-0.5;-0.5,0.767]
6 V=inv(A)*[7;2]
7 disp(V)
8
9 I12=(V(1)-V(2))/2
10 disp(I12)
```

Scilab code Exa 2.9 Problem9

```
1 //KCLs
2
3 A=[2,-1;-4,19]
4 V=inv(A)*[10;25]
5
6 Pc=1*V(1)
7 Iv=(5-V(2))/2 + (5-V(1))/5
8 Pv=5*Iv
9
10 disp(V)
11 disp(Pv,Pc)
```

Scilab code Exa 2.10 Problem10

```
1 //converting 9v voltage source to current source
2 I=9/0.45
3 I=I-7
4
5 //KCLs
```

```
A=[1/0.45+1/10,-1/10 ; 0.2-1/10,1/10-0.2]
V=inv(A)*[-18;5]

disp(V(2))
```

Scilab code Exa 2.11 Problem11

```
//converting voltage source to current source

I=240/3

//KCLs

A=[1/3+1/6,-1/6;-1/6,1/6+1/12+1/30]
V=inv(A)*[70;5]
Vx=V(1)
Vy=V(2)-60

V6=V(2)-V(1)
P6=V6*V6/6

disp(P6)
```

Scilab code Exa 2.13 Problem13

```
// KVLs

A=[24,-6,-8;-6,20,-5;-8,-5,25]
I=inv(A)*[16;0;0]
I5=I(2)-I(3)
disp(I5)
```

Scilab code Exa 2.14 Problem14

```
1 //convert practical current source to voltage source
2 V=10*5
3
4 //KVLs
5 A=[35,-20;-20,50]
6 I=inv(A)*[50;-100]
7
8 v=20*(I(1)-I(2))
9 disp(v)
```

Scilab code Exa 2.15 Problem15

```
1 i1=0.37
2
3 //KVL for loop 2
4 i2=(-100+20*i1)/50
5
6 //KVL for loop 1
7 R=(50+20*(i2-i1))/i1
8 disp(R)
```

Scilab code Exa 2.16 Problem16

```
1 //Converting current sources to voltage sources
2 // O=[i1;i2;vx]
3
4 A=[10,-3,4;-3,7,0;3,-3,-1]
```

```
5 O=inv(A)*[16;-6;0]
6
7 disp(O)
```

Scilab code Exa 2.17 Problem17

```
1 //convert current sources to voltage
2
3 A=[95,-15;-15,135]
4 I=inv(A)*[20;-70]
5
6 i3=I(1)-I(2)
7
8 I60=0.5-I(1)
9 V60=I60*60
10 P1= 0.5*V60          //O.5 A source
11
12 I80=1+I(2)
13 V80=I80*80
14 P2=1*V80
15
16 disp(P2,P1)
```

Scilab code Exa 2.18 Problem18

```
1 //Nodal Equations
2
3 A=[0.6,-0.5;2,-1.6]
4 V=inv(A)*[4;0]
5 V12=V(1)-V(2)
6 disp(V12)
```

Scilab code Exa 2.19 Problem19

```
1 //convert dependent current source to dependent
     voltage source
2
3 //Mesh Equations
4 A=[14,-2,0;-2,18,3;2,-2,-1]
5 O=inv(A)*[100;0;0]
6
7 disp(O(3))
```

Scilab code Exa 2.20 Problem20

```
1 ////////////////////Part 1
2
3 //Nodal Method
4 v1=(8/5+16/10)/(1/5+1/2+1/10)
5 disp(v1)
6 i5=(8-v1)/5000
7 disp(i5)
8
9
10 ////////////////////Part2
11
12 //Mesh Method
13
14 A=[7,-2;-2,12]
15 I=inv(A)*[8;-16]/1000
16 disp(I)
17
18 v1=2*1000*(I(1)-I(2))
19 disp(v1)
```

Scilab code Exa 2.21 Problem21

```
function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

//deactivate voltage source

i11=4*6/8
i21=4*2/8
v11=i11*2
v21=1*1

//deactivate current source
Req=parallel(2,7)

v22=8*Req/(2+Req)
v12=v22*(2/(2+5))

v1=v11+v12
v2=v21+v22

disp(v2,v1)
```

Scilab code Exa 2.22 Problem22

```
function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

//Thevenin Equivalent
```

```
I=(32-8)/30
Voc=32-20*I
Ro=parallel(20,10)
disp(Ro,Voc)

//Norton Equivalent
Isc=32/20+8/10
disp(Ro,Isc)
```

Scilab code Exa 2.23 Problem23

```
//convert current source to voltage source
V=3.5*20

//KVL
I=100/(10+20+V)
Voc=100-10*I

//Finding Isc
I=100/10
Isc=(1+3.5)*I

Ro=Voc/Isc

disp(Ro,Voc)
```

Scilab code Exa 2.24 Problem24

```
V=32
I=1
R1=20
R2=8
R3=2
```

```
6  Voc1=V/(R1+R2+R3)*(R2+R3)   ///a,b open
7  Isc1=V/R1          ///a,b short
8
9  Voc2=I*R2/(R1+R2+R3)*R1
10 Isc2=I*R2/(R2+R3)
11
12 ////by superposition
13 Voc=Voc1+Voc2
14 Isc=Isc1+Isc2
15
16 disp(Voc)
17 disp(Isc)
```

Scilab code Exa 2.25 Problem25

```
1  function [Ra,Rb,Rc]=delta_to_star(Rab,Rbc,Rca)
2      X=Rab+Rbc+Rca
3      Ra=Rab*Rca/X
4      Rb=Rab*Rbc/X
5      Rc=Rca*Rbc/X
6  endfunction
7
8  function p=parallel(r1,r2)
9      p=r1*r2/(r1+r2)
10 endfunction
11
12 [R1,R2,R3]=delta_to_star(4,12,8)
13 Req=10+4+parallel(R1+15,R2+16)
14
15 I=12/Req
16 disp(I)
```

Scilab code Exa 2.26 Problem26

```
//convert current source to voltage source

V1=4*2
V2=2*2

//Mesh Analysis

A=[7,-3;-15,19]
I=inv(A)*[6;-14]

Vx=3*(I(1)-I(2))
disp(Vx)
```

Scilab code Exa 2.27 Problem27

```
//Short Circuit AB and convert Curr Source to V
   source

V=9*5
Isc=(45-9)/6

function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

Ro=parallel(5+1,3)
disp(Ro,Isc)
```

Scilab code Exa 2.28 Problem28

```
//Mesh Analysis

A=[4,-2;998,24.5]
```

```
4  I=inv(A)*[1/1000;0]
5
6  disp(I)
7
8  P1=I(2)^2*2.5*1000
9  P2=1/1000*I(1)
10 P3=-10^6*I(1)*I(2)
11 P=[P1,P2,P3]
12 disp(P)
```

Scilab code Exa 2.29 Problem29

```
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
3  endfunction
4
5  //as seen from ab
6  Vth1=30*60/(30+60)
7  Rth1=parallel(30,60)
8
9  //as seen from cd
10 Vth2=80*40/(40+60)
11 Rth2=parallel(40,60)
12
13 Vnet=60+Vth1-Vth2
14 Rnet=Rth1+Rth2
15
16 disp(Rnet,Vnet)
```

Scilab code Exa 2.30 Problem30

```
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
```

```
3 endfunction
4
5 R=parallel(60,120)
6
7 //Mesh Analysis
8
9 A=[6,-4;-4,12]
10 I=inv(A)*[2.4;-3.6]
11 I3=I(1)-I(2)
12
13 I60=I3*120/(120+60)
14 disp(I60)
```

Scilab code Exa 2.31 Problem31

```
1 //Nodal Equation
2
3 Vn=198/10.5
4 I60=Vn/60
5 disp(I60)
```

Scilab code Exa 2.32 Problem32

```
1 V8=2*8
2
3 //KVL
4 I1=(30-16)/10
5
6 //KCL at left node
7 I2=2-I1
8
9 //KVL middle mesh
10 I4=(10*I1-2*I2)/4
```

```
11 Vx=4*I4
12
13 //right node
14 Ix=I4-I2
15
16 disp(Vx)
```

Scilab code Exa 2.33 Problem33

```
1 ////////////////////////////////investigate the if
    then else construct
2
3
4
5 I=5
6
7 //KVL
8 R=(-12.5+15)/I-0.02-0.035
9 disp(R)
10
11 P=poly([-25,12.5,0.035],"I","coeff")
12 Z=roots(P)
13 Ib=Z(2)
14 disp(Ib)
15
16 I=(13-12.5)/0.035
17 R=(15-13)/I-0.02
18 disp(R)
```

Scilab code Exa 2.35 Problem35

```
1 R=12*12/4-25
2 disp(R)
```

```
3
4 I=sqrt(1.6/1000/10000)
5 R=12/I-10000-15000
6 disp(R)
7
8 I=0
9 V=12
10 disp(V)
```

Scilab code Exa 2.36 Problem36

```
1 function p=parallel(r1,r2)
2     p=r1*r2/(r1+r2)
3 endfunction
4
5 Req=1+parallel(parallel(1,1),1)
6
7 disp(Req)
```

Scilab code Exa 2.37 Problem37

```
1 function p=parallel(r1,r2)
2     p=r1*r2/(r1+r2)
3 endfunction
4
5 R1=parallel(parallel(40,60),80+40)
6
7 Req=20+parallel(10+R1,30)
8 disp(Req)
```

Scilab code Exa 2.38 Problem38

```
function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

R1=parallel(5,40)+15
Req=parallel(R1,15)+10
i=6/(1000*Req)

ix=i*R1/(R1+15)
disp(ix)

P=i*i*10000  //////wrongly done in the book as ix*ix
   *10000
disp(P)
```

Scilab code Exa 2.39 Problem39

```
function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

R1=parallel(1,3)

//convert current source to voltage
V=20/1000*2000
I=(40-8)/(2+0.75)

Pr=8*I
disp(Pr)
```

Scilab code Exa 2.40 Problem40

```
function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

I1=12/1000
Ix=I1*30/(30+60)
disp(Ix)

I2=20/1000
V2=I2*(10+5)
R1=10+parallel(30,60)
I1=V2/R1
Ix=I1*30/(30+60)
disp(Ix)  //Wrongly printed in the book as 10

Ix=6/1000
I1=(30+60)/30*Ix
V2=I1*R1
I2=V2/15
disp(I2)

Is=45
I1=45*(10+5)/(10+5+R1)
Ix=I1*30/(30+60)
disp(Ix)  ///Answer is wrong in the book
```

Chapter 3

Fundamentals of Reactive Circuits

Scilab code Exa 3.1 Problem1

```
1 function C=seriesC(C1,C2)
2     C=C1*C2/(C1+C2)
3 endfunction
4
5 Ceq1=10+seriesC(10,10)
6 Ceq2=Ceq1
7
8 Ceq=seriesC(seriesC(Ceq1,Ceq2),10)
9 disp(Ceq)
```

Scilab code Exa 3.2 Problem2

```
1 function p=parallel(r1,r2)
2     p=r1*r2/(r1+r2)
3 endfunction
4
```

```
5 Leq=1+parallel(2,2)+parallel(parallel(3,3),3)
6
7 disp(Leq)
```

Scilab code Exa 3.3 Problem3

```
1 function C=seriesC(C1,C2)
2     C=C1*C2/(C1+C2)
3 endfunction
4
5 V=100
6
7 Cp=1+2
8 Ceq=seriesC(Cp,6)
9 q=Ceq*V
10
11 q1=q*(1/(1+2))
12 q2=q-q1
13
14 disp(q2,q1,q)
15
16 E6=q*q/2/6/1000
17 E1=q1*q1/2/1/1000
18 E2=q2*q2/2/2/1000
19 Enet=E1+E2+E6
20
21 disp(Enet,E6,E2,E1)
```

Scilab code Exa 3.4 Problem4

```
1 L=poly([3,-4,1],"L","coeff")
2 disp(roots(L))
```

Scilab code Exa 3.5 Problem5

```
1 function C=seriesC(C1,C2)
2     C=C1*C2/(C1+C2)
3 endfunction
4
5 Ceq=1+seriesC(6,3)
6
7 disp(Ceq)
```

Scilab code Exa 3.6 Problem6

```
1 function p=parallel(r1,r2)
2     p=r1*r2/(r1+r2)
3 endfunction
4
5 Lbc=parallel(1/10,1/20)
6 Leq=1/50+Lbc
7 disp(Leq)
8
9 Vbc=Lbc*150
10 disp(Vbc)
```

Scilab code Exa 3.7 Problem7

```
1 function C=seriesC(C1,C2)
2     C=C1*C2/(C1+C2)
3 endfunction
4
```

```
Ceq=seriesC(seriesC(10,20),40)
disp(Ceq)

q=Ceq*280
disp(q)

V1=q/10
V2=q/20
V3=q/40

disp(V3,V2,V1)
```

Scilab code Exa 3.8 Problem8

```
Ceq=10+20+40
Q=200*[10,20,40]

disp(Q)
Qnet=Q(1)+Q(2)+Q(3)
disp(Qnet)
```

Scilab code Exa 3.9 Problem9

```
//deactivate all independent sources

function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

L=2
Req=parallel(6,12)+4
T1=L/Req
disp(T1)
```

```
11
12 C=1/2
13 Req=2+parallel(6,12)+2
14 T2=Req*C
15 disp(T2)
```

Scilab code Exa 3.11 Problem11

```
1 L=2
2
3 VL_0minus=0 //steady state
4 disp(VL_0minus)
5
6 i_0minus=1
7 i_0plus=i_0minus
8 VL_0plus=12-4*i_0plus
9 disp(VL_0plus)
10
11 di_by_dt_0plus=VL_0plus/L
12 disp(di_by_dt_0plus)
```

Scilab code Exa 3.12 Problem12

```
1 Vc_0m=100
2 Vc_0p=Vc_0m
3 T=(400+100)*2E-6
4 i_0p=100/500
5 P_0p=i_0p^2*400
6 disp(P_0p)
```

Scilab code Exa 3.13 Problem13

```
Vc_0m=10
Vc_0p=Vc_0m
disp(Vc_0p)

//KVL
i1_0p=(10-Vc_0p)/20
i2_0p=Vc_0p/20

//KCL
iC_0p=i1_0p-i2_0p
disp(iC_0p)
iC_inf=0 //capacitor is open circuit
disp(iC_inf)
VC_inf=10*20/(20+20)
disp(VC_inf)
```

Scilab code Exa 3.16 Problem16

```
L=0.25
R=250
V=10
T=L/R

t=0.5E-3
i=V/R*(1-exp(-t/T))
disp(i)

t=2E-3
i=V/R*((exp((1E-3-t)/T)-exp(-t/T)))
disp(i)
```

Scilab code Exa 3.18 Problem18

```
R=5000
C=1.0E-6
Ie=1/1000
Vcf=Ie*R
T=R*C

t=10/1000
Vc10=Vcf*(1-exp(-t/T))
disp(Vc10)

t=20/1000
Vc20=Vcf*(1-exp(-t/T))-Vc10
disp(Vc20)
```

Scilab code Exa 3.21 Problem21

```
//Replace curr source by voltage source
Ics=1/1000
R=100*1000
V=Ics*R

Vc_0m=25/(25+100)*V
disp(Vc_0m)

Vc_0p=Vc_0m
disp(Vc_0p)

Vc_inf=(V-10)*25/(100+25)
disp(Vc_inf)
```

Scilab code Exa 3.22 Problem22

```
L=20/1000
VR2_0p=10
VR2_inf=0
VR2_1=5

t=1/1000
T=-t/log((VR2_1-VR2_inf)/(VR2_0p-VR2_inf))

R2=L/T
R1=1/(2/VR2_0p-1/R2)

disp(R2,R1)
```

Scilab code Exa 3.24 Problem24

```
C=1/4
Vc_0m=12/(12+6)*12
Vc_0p=8
disp(Vc_0p)
t=0
V_0p=6*cos(t)

//at  t=0+
Vth=12/(12+6)*6
Rth=6*12/(6+12)
ic_0p=(Vth-8)/Rth
disp(ic_0p)
d_by_dt_Vc_0p=ic_0p/C
disp(d_by_dt_Vc_0p)
```

Scilab code Exa 3.26 Problem26

```
//at  t=0-
```

```
iL=4
v=0
disp(v,iL)

//at t=0+
iL=4
v=-4*20
disp(v,iL)
```

Scilab code Exa 3.27 Problem27

```
function p=parallel(r1,r2)
    p=r1*r2/(r1+r2)
endfunction

L=25/1000

//at t=0-
R1=parallel(150,75)
iL_0m=30/2
disp(iL_0m)

R2=parallel(150,50)
ix_0m=R2/(R2+75)*30
disp(ix_0m)


//at t=0+
iL_0p=iL_0m

T=L/(75+50)
iL_inf=0

//at t=0.2ms
t=0.2E-3
```

```
25
26 iL=iL_inf+(iL_0p-iL_inf)*exp(-t/T)
27 ix=-iL
28 disp(ix,iL)
```

Scilab code Exa 3.29 Problem29

```
1  R=250
2  C=25E-3
3
4  //at  t=0-
5  v_0m=200*0.2
6
7  //at  t=0+
8  v_0p=v_0m
9
10 T=R*C
11 v_inf=0
12
13 //at  t=0.2ms
14 t=0.2E-3
15
16 t=T*log((v_0p-v_inf)/(20-v_inf))
17 disp(t)
```

Scilab code Exa 3.32 Problem32

```
1  L=0.2
2  R=50+30
3
4  iL_0m=100/50
5  iL_0p=iL_0m
6  iL_inf=0
```

```
T=L/R

t=10/1000
iL_10=iL_0p*exp(-t/T)
disp(iL_10)

t1=-T*log(0.5*iL_0p/(iL_0p))
disp(t1)
```

Scilab code Exa 3.33 Problem33

```
R=5
L=2
V=10
T=L/R

iL_m=V/R
disp(iL_m)
iL_0p=iL_m
iL_inf=2+V/R

//function I=iL(t)
//    I=iL_inf+(iL_0p-iL_inf)*exp(-t/T)
//endfunction

//disp(iL(0.5))
//disp(iL(1.5))

t=0.5
I=iL_inf+(iL_0p-iL_inf)*exp(-t/T)
disp(I)

t=1.5
I=iL_inf+(iL_0p-iL_inf)*exp(-t/T)
disp(I)
```

Scilab code Exa 3.36 Problem36

```
L=4/1000
R=1000
V=9

iL_0m=V/(2*R)
iL_0p=iL_0m
iL_inf=0
isw_inf=V/R
T=L/R

t=5E-6

iL_5=iL_0p*exp(-t/T)
disp(iL_5)

isw_5=isw_inf*(1-exp(-t/T))
disp(isw_5)
```

Scilab code Exa 3.37.38 Problem37 and 38

```
R=20
L=2
C=1/25

//at  t=0-
iR=-4
iL=4
iC=0
vR=-R*4
```

```
10 vC=-vR
11 vL=0
12
13 disp(iR,iL,iC,vR,vL,vC)
14
15 //at t=0+
16 iL=iL
17 vC=vC
18 iR=5-4  //KCL at node 1
19 vR=R*iR
20 iC=4+iR  //KCL at node 2
21 vL=vC+vR  //KVL inner mesh
22
23 disp(iR,iL,iC,vR,vL,vC)
24
25
26 //at t=0+ derivatives are
27 DiL=vL/L
28 DvC=iC/C
29 DiR=-DiL          //Differentiating KCL at node 1
30 DiC=DiR          //Differentiating KCL at node 2
31 DvR=R*DiR
32 DvL=DvR+DvC          //Differentiating KVL inner mesh
33
34 disp(DiR,DiL,DiC,DvR,DvL,DvC)
```

Chapter 4

Steady State Analysis For Sinusoidal Excitation

Scilab code Exa 4.1 Problem1

```
1 Iav=1/(2*%pi)*integrate('20*sin(wt)','wt',%pi/3,%pi)
2 disp(Iav)
3
4 Irms=sqrt(1/(2*%pi)*integrate('(20*sin(wt))^2','wt',
    %pi/3,%pi))
5 disp(Irms)
```

Scilab code Exa 4.2 Problem2

```
1 Iav_by_Im=1/%pi*integrate('sin(wt)','wt',0,%pi)
2 disp(Iav_by_Im)
3
4 //final answer is wrong in the book
```

Scilab code Exa 4.4 Problem4

```
1  ////////////////////part a
2  L=0.05
3  R=20
4  w=1.2E3
5  Xl=w*L
6  V=complex(100,200)
7  I=complex(5,0)
8
9  Xc=-imult(R+imult(Xl)-V/I)
10 C=1/w/Xc
11
12 disp(C)
13
14 ////////////////////part b
15 w=200
16 V=complex(100,0)
17 Xl=w*L
18 Xc=-imult(R+imult(Xl)-V/I)
19 C=1/w/Xc
20
21 disp(C)
```

Scilab code Exa 4.5 Problem5

```
1  L=0.0255
2  R1=6
3  V=240
4  f=50
5  w=2*%pi*f
6  Va=sqrt(V^2/10)
7  Vb=3*Va
8  Xl=w*L
9  Theta1=atan(Xl/R1)
```

```
10 Theta2=%pi/2-Theta1 //Va and Vb are in quadrature
11
12 I=Vb/sqrt(R1^2+Xl^2)
13
14 R=(Va/I)/sqrt(1+tan(Theta2)^2)
15 disp(R)
16
17 Xc=R*tan(Theta2)
18 C=1/w/Xc
19 disp(C)
```

Scilab code Exa 4.6 Problem6

```
1 Z1=complex(10,15)
2 Z2=complex(6,-8)
3
4 I=complex(15,0)
5 I1=I*Z2/(Z1+Z2)
6 I2=I*Z1/(Z1+Z2)
7 phase=[atan(imag(I1)/real(I1));atan(imag(I2)/real(I2
    ))]
8 disp(phase*180/%pi)
9
10 V=I1*Z1
11 disp(180/%pi*atan(imag(V)/real(V)))
```

Scilab code Exa 4.7 Problem7

```
1 function [r,theta]=cart_to_polar(z)
2     x=real(z)
3     y=imag(z)
4     r=norm(z)
5     theta=atan(y/x)
```

```
6  endfunction
7
8  function Zeq=parallel(Z1,Z2)
9      Zeq=Z1*Z2/(Z1+Z2)
10 endfunction
11
12 w=400
13 R=10
14 L=25E-3
15 C=250E-6
16 Xl=w*L*%i
17 Xc=1/(w*C*%i)
18
19 ////////////part a
20 Zin1=R+Xc
21 [r1,theta1]=cart_to_polar(Zin1)
22 disp(theta1*180/%pi,r1)
23
24 ////////////part b
25 //Zin2=10+parallel(Xc,Xl)    ///impedence is infinite
       ...thus an error
26 //[r2,theta2]=cart_to_polar(Zin2)
27 disp(90,"    inf")
28
29
30 ////////////part c
31 Zin3=R+parallel(Xc,Xl+10)
32 [r3,theta3]=cart_to_polar(Zin3)
33 disp(theta3*180/%pi,r3)
```

Scilab code Exa 4.8 Problem8

```
1  function [r,theta]=cart_to_polar(z)
2      x=real(z)
3      y=imag(z)
```

```
4       r=norm(z)
5       theta=atan(y/x)
6   endfunction
7
8   function [x,y]=polar_to_cart(zpolar)
9       r=real(zpolar)
10      theta=imag(zpolar)/180*%pi
11      x=r*cos(theta)
12      y=r*sin(theta)
13  endfunction
14
15  function Zeq=parallel(Z1,Z2)
16      Zeq=Z1*Z2/(Z1+Z2)
17  endfunction
18
19  R=200
20  L=0.5
21  C=50E-6
22  w=200
23
24  Xl=w*L*%i
25  Xc=1/(w*C*%i)
26
27  ////////////////////////////part a
28  Ir=complex(0.02*cos(30*%pi/180),0.02*sin(30*%pi/180)
        )
29  V=Ir*R
30  Il=V/Xl
31  Ic=V/Xc
32  I=Ir+Il+Ic
33  disp(I)
34
35  ////////////////////////////part b
36  [Ix,Iy]=polar_to_cart(complex(2,-40))
37  I=complex(Ix,Iy)
38  Zin=parallel(parallel(R,Xc),Xl)
39  V=Zin*I
40  Ir=V/R
```

```
41 disp(V,Ir)
```

Scilab code Exa 4.9 Problem9

```
1 p=poly([0,2,0,-8],"w","coeff")
2 w=roots(p)
3 disp(w(1))
```

Scilab code Exa 4.10 Problem10

```
1 function Zeq=parallel(Z1,Z2)
2     Zeq=Z1*Z2/(Z1+Z2)
3 endfunction
4
5 Zeq=parallel(5,3-imult(6))
6 I=complex(10,0)
7 V=Zeq*I
8 pf=cos(atan(imag(V)/real(V)))
9 P=norm(V)*norm(I)*pf
10 disp(pf,P)
```

Scilab code Exa 4.11 Problem11

```
1 P1=8000
2 pf1=0.8
3 V1=430
4
5 I1=P1/V1/pf1
6 Pr1=P1-I1^2*1
7 Q1=P1*tan(acos(pf1))
```

```
Qr1=Q1-I1^2*1.2
Sr1=sqrt(Pr1^2+Qr1^2)

Vl=Sr1/I1
Pl=15000
Ql=Pl*tan(acos(0.8))
Pr2=Pl-Pr1
Qr2=Ql-Qr1
Sr2=sqrt(Pr2^2+Qr2^2)

I2=Sr2/Vl
P2=Pr2+I2^2*0.7
Q2=Qr2+I2^2*0.9

pf=cos(atan(Q2/P2))
S2=sqrt(P2^2+Q2^2)
V2=S2/I2

disp(V2,pf,P2,Q2,Q1,Vl)
```

Scilab code Exa 4.12 Problem12

```
V=231
f=50
w=2*%pi*f
Sl=10
pf=0.8
Pl=Sl*pf
Ql=Sl*sin(acos(pf))
Qc=Ql-tan(acos(0.95))*Pl

C=Qc*1000/V^2/w

Is1=10*1000/V
Il=Is1
```

```
14 Is2=norm(Pl+%i*(Ql-Qc))*1000/V
15
16 disp(Is2,Is1,C,Qc)
```

Scilab code Exa 4.13 Problem13

```
1  function [x,y]=polar_to_cart(r,theta)
2      theta=theta/180*%pi
3      x=r*cos(theta)
4      y=r*sin(theta)
5  endfunction
6
7  //converting v source to curr source
8  V=15
9  R=5
10 I1=V/R
11
12
13 [Ix,Iy]=polar_to_cart(2,-30)
14 I2=complex(Ix,Iy)
15
16 //nodal analysis
17 A=[0.7-0.1*%i,-0.5;-0.5,0.5+0.5*%i]
18 V=inv(A)*[I1;I2]
19
20 [rv1,thetav1]=polar(V(1))
21 [rv2,thetav2]=polar(V(2))
22
23 disp(real(thetav2*180/%pi),rv2,real(thetav1*180/%pi)
     ,rv1)
```

Scilab code Exa 4.14 Problem14

```
w=600
R=10
L=10E-3
C=0.5E-3
Xl=w*L*%i
Xc=1/(w*C*%i) //Xc value in the book is wrong
V1=40
V2=complex(0,-30)

//mesh analysis
A=[R+Xl,-R;-R,R+Xc]
I=inv(A)*[V1;V2]

Ir=I(1)-I(2)
Vr=R*Ir

disp(Vr)  //Final answer is different
```

Scilab code Exa 4.15 Problem15

```
Z1=complex(2,-1)
Z2=complex(0,-5)
Z3=complex(2,1)
I1=1
I2=complex(0,-2)

//deactivate curr source 2
V11=I1*(Z2+Z3)/(Z1+Z2+Z3)*Z1
V21=I1*Z1/(Z1+Z2+Z3)*Z3

//deactivate curr source 1
V12=I2*Z3*Z1/(Z1+Z2+Z3)
V22=I2*(Z1+Z2)/(Z1+Z2+Z3)*Z3

V1=V11+V12
```

```
16 V2=V21+V22
17
18 disp(V2,V1)
```

Scilab code Exa 4.16 Problem16

```
1  function [Ra,Rb,Rc]=delta_to_star(Rab,Rbc,Rca)
2      X=Rab+Rbc+Rca
3      Ra=Rab*Rca/X
4      Rb=Rab*Rbc/X
5      Rc=Rca*Rbc/X
6  endfunction
7
8  function Zeq=parallel(Z1,Z2)
9      Zeq=Z1*Z2/(Z1+Z2)
10 endfunction
11
12 V=20
13 w=2
14 R=1
15 C=1/2
16 Xc=1/(w*C*%i)
17 Zab=-%i
18 Zbc=2
19 Zca=2
20
21 [Za,Zb,Zc]=delta_to_star(Zab,Zbc,Zca)
22 Zth=Za+parallel(R+Zb,Xc+Zc)
23
24 Vdc=V*(Zc+Xc)/(R+Zb+Zc+Xc)
25 disp(Zth,Vdc)
26
27 Isc=Vdc/Zth
28 disp(Zth,Isc)
```

Scilab code Exa 4.17 Problem17

```
function Zeq=parallel(Z1,Z2)
    Zeq=Z1*Z2/(Z1+Z2)
endfunction

V=20
Z1=complex(5,10)
Z2=complex(3,-4)

Vth=V*Z2/(Z1+Z2)
Zth=parallel(Z1,Z2)

//by maximum power transfer theorem
Zl=conj(Zth)
P=norm(Vth/(Zth+Zl))^2*real(Zl)
disp(P,Zl)

Rl=sqrt(real(Zth)^2+(4+imag(Zth))^2)
disp(Rl)
```

Scilab code Exa 4.18 Problem18

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

R1=1
R2=6
L=2
```

```
C=1/3

[Vx,Vy]=polar_to_cart(4,30)
[Ix,Iy]=polar_to_cart(0.8,-10)

//deactivate current source
V=complex(Vx,Vy)
w=3
Xl=w*L*%i
Xc=1/(w*C*%i)

Il1=V/(R1+R2+Xl+Xc)
Pav1=norm(Il1)^2*R1

//deactivate voltage source
I=complex(Ix,Iy)
w=5
Xl=w*L*%i
Xc=1/(w*C*%i)

Il2=I*(R2+Xl)/(R2+Xl+R1+Xc)
Pav2=norm(Il2)^2*R1

Pav=Pav1+Pav2
disp(Pav)
```

Scilab code Exa 4.21 Problem21

```
I=35
VR=25
Vrl=40
VRrl=50
Vc=45
C=50E-6
Xc=Vc/I
```

```
w=1/(Xc*C)

theta=acos((VR^2+VRrl^2-Vrl^2)/(2*VR*VRrl))
x=VRrl*cos(theta)-25
y=VRrl*sin(theta)

r=x/I
L=y/(I*w)
Vappl=sqrt((VR+x)^2+y^2)
R=VR/I

disp(L,r,R)
```

Scilab code Exa 4.22 Problem22

```
V=12
w=1000
R=4
L=5E-3
C=400E-6
Xl=w*L*%i
Xc=1/(w*C*%i)

//mesh analysis
A=[R+Xl,-Xl;2-Xl,Xl+Xc]
I=inv(A)*[12;0]

disp(I(1)) //answer is wrong in the book
```

Scilab code Exa 4.23 Problem23

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

```
3       x=r*cos(theta)
4       y=r*sin(theta)
5   endfunction
6
7   [I1x,I1y]=polar_to_cart(2,10)
8   [I2x,I2y]=polar_to_cart(3,120)
9
10  I1=complex(I1x,I1y)
11  I2=complex(I2x,I2y)
12  w=4
13  R=2
14  L=3
15  C=1/4
16  Xl=w*L*%i
17  Xc=1/(w*C*%i)
18
19  //deactivate source 2
20  i1=(R+Xl)/(R+Xl+Xc)*I1
21  i2=1/(R+Xl+Xc)*I2
22  i=i1+i2
23  disp(i)  //answer is wrong in the book
```

Scilab code Exa 4.24 Problem24

```
1   V=230
2   w=2*%pi*50
3   R=8
4   L=0.1
5   C=160E-6
6
7   Xl=w*L*%i
8   disp(Xl)
9
10  Xc=1/(w*C*%i)
11  disp(Xc)
```

```
12
13 Z=norm(R+Xl+Xc)
14 disp(Z)
15 I=V/Z
16 disp(I)
17 pf=cos(atan(norm(Xl+Xc)/R))
18 disp(pf)
19
20 Vcoil=I*norm(R+Xl)
21 Vc=norm(I*Xc)
22 disp(Vc,Vcoil)
```

Scilab code Exa 4.25 Problem25

```
1 function Zeq=parallel(Z1,Z2)
2     Zeq=Z1*Z2/(Z1+Z2)
3 endfunction
4
5 V=100
6 Z1=complex(0,-5)
7 Z2=complex(5,0)
8 Z3=complex(0,5)
9 I=[0,0,0]
10
11 Z=Z1+parallel(Z2,Z3)
12 I(1)=V/Z
13
14 I(2)=Z3/(Z2+Z3)*I(1)
15 I(3)=Z2/(Z2+Z3)*I(1)
16
17 disp(I)
```

Scilab code Exa 4.26 Problem26

```
function Zeq=parallel(Z1,Z2)
    Zeq=Z1*Z2/(Z1+Z2)
endfunction

//converting curr source to v source
I=0.4
R1=15
V=I*R1
w=400

R2=5
R3=80
L=25E-3
Xl=w*L*%i

Zeq=R1+R2+parallel(R3,Xl)
I=V/Zeq
Il=I*R3/(R3+Xl)
Ix=I*Xl/(R3+Xl)

disp(Il,Ix)
```

Scilab code Exa 4.27 Problem27

```
V=4
w=2

R=4
L=2
Xl=w*L*%i

Il=V/(Xl+R)
Xc=-V/imag(Il)
C=1/(w*Xc)
disp(C)
```

Scilab code Exa 4.28 Problem28

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

I=4
w=500
[Ir,Ic]=polar_to_cart(3,40)
Ix=complex(Ir,Ic)
C=1E-3
L=10E-3
Xl=w*L*%i
Xc=1/(w*C*%i)

Il=I-Ix
Ic=Ix
Vc=Ic*Xc
Vl=Il*Xl
Vx=Vl-Vc
disp(Vx)  //answer wrong in the book
```

Scilab code Exa 4.29 Problem29

```
w=10
R=2
L=0.3
Ir=10*(cos(%pi/4)+%i*sin(%pi/4))
Vr=Ir*R
```

```
6  Vc=20*(cos(%pi/4)-%i*sin(%pi/4))
7  V=Vr+Vc
8  Ic=Ir
9  C=Ic/(w*Vc*%i)
10 disp(real(C))        ///////Wrong in book
```

Scilab code Exa 4.30 Problem30

```
1  R=2000
2  C=5E-6
3  w=1000
4
5  Xc=1/(w*C*%i)
6  Y=1/R+1/Xc
7  Z=1/Y
8  Req=real(Z)
9  Ceq=-1/(imag(Z)*w)
10
11 disp(Ceq*1E6,Req)    //////Answer wrong in the book
```

Scilab code Exa 4.31 Problem31

```
1  I=10*(cos(%pi/180*37)-%i*sin(%pi/180*37))
2  V=6
3  C=250E-6
4  w=1000
5  Xc=1/(w*C*%i)
6
7  Ic=V/Xc
8  disp(Ic)
9
10 Ix=imag(I-Ic)
11 X=abs(V/Ix)
```

```
12 Ir=real(I-Ic)
13 R=V/Ir
14
15 disp(R,X)
```

Scilab code Exa 4.32 Problem32

```
1  V1=30+10*%i
2  V2=30
3  w=1000
4  L=1
5  C1=1E-6
6  C2=1E-6
7  R1=1000
8  R2=1000
9
10 Xl=%i*w*L
11 Xc1=%i/(w*C1)
12 Xc2=%i/(w*C2)
13
14 ////////mesh equations
15
16 A=[1,%i; %i,1-2*%i]
17 I=inv(A)*[10*%i;30]
18
19 Ic1=I(1)-I(2)
20
21 disp(Ic1)
```

Scilab code Exa 4.33 Problem33

```
1  function [x,y]=polar_to_cart(r,theta)
2      theta=theta/180*%pi
```

```
3       x=r*cos(theta)
4       y=r*sin(theta)
5   endfunction
6
7   [Ir,Ic]=polar_to_cart(3,30)
8   I=complex(Ir,Ic)
9   Zc=-5*%i
10  Zrl=10+5*%i
11
12  Ic=Zrl/(Zc+Zrl)*I
13  Vth=Ic*Zc
14  Zth=parallel(Zc,Zrl)
15  In=Vth/Zth
16
17  disp(Rth,In,Vth)
```

Scilab code Exa 4.34 Problem34

```
1   function [x,y]=polar_to_cart(r,theta)
2       theta=theta/180*%pi
3       x=r*cos(theta)
4       y=r*sin(theta)
5   endfunction
6
7   [Ir,Ic]=polar_to_cart(2,10)
8   I1=complex(Ir,Ic)
9   [Ir,Ic]=polar_to_cart(3,90+30)
10  I2=complex(Ir,Ic)
11
12  w=4
13  R=2
14  L=0.5
15  C=1/4
16  Xl=w*L*%i
17  Xc=1/(w*C*%i)
```

```
18
19 //deactivate voltage source
20 i1=I1*(R+Xl)/(R+Xl+Xc)
21
22 //deactivate curr source
23 i2=I2/(R+Xl+Xc)
24
25 i=i1+i2
26 disp(i)
```

Scilab code Exa 4.35 Problem35

```
1  function Zeq=parallel(Z1,Z2)
2      Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  I=10
6  w=2000
7  R=200
8  L=0.125
9
10 Xl=w*L*%i
11
12 Zeq=parallel(R,Xl)
13 V=I*Zeq
14 Il=V/Xl
15 Ir=V/R
16
17 t=1/1000
18 I1=sqrt(2)*real(I*exp(%i*w*t))
19 Il1=sqrt(2)*real(Il*exp(%i*w*t))
20 Ir1=sqrt(2)*real(Ir*exp(%i*w*t))
21 V1=sqrt(2)*real(V*exp(%i*w*t))
22
23 Ps=-V1*I1
```

```
Pr=-V1*Ir1
Pl=-V1*Il1

disp(Pl,Pr,Ps)
```

Scilab code Exa 4.36 Problem36

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

[Vr,Vc]=polar_to_cart(120,45)
V=complex(Vr,Vc)

[Zr,Zc]=polar_to_cart(16.3,24.5)
Z=complex(Zr,Zc)

w=50

I=V/Z
P=V*conj(I)
Pavg=real(P)
pf=real((V/I)/norm(V/I))

disp(pf,Pavg)
```

Scilab code Exa 4.37 Problem37

```
function Zeq=parallel(Z1,Z2)
    Zeq=Z1*Z2/(Z1+Z2)
endfunction
```

```
4
5  function [x,y]=polar_to_cart(r,theta)
6      theta=theta/180*%pi
7      x=r*cos(theta)
8      y=r*sin(theta)
9  endfunction
10
11 [Ir,Ic]=polar_to_cart(20,60)
12 I=complex(Ir,Ic)
13
14 w=5000
15 R=3000
16 L=1
17 C=0.25E-6
18 Xl=w*L*%i
19 Xc=1/(w*C*%i)
20
21 Z=parallel(R+Xl,Xc)
22 V=I*Z
23 disp(V)
```

Scilab code Exa 4.38 Problem38

```
1  function Zeq=parallel(Z1,Z2)
2      Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  V=5
6  w=5
7  R=2
8  L1=0.8
9  L2=1
10 C=1/5
11 Xl1=w*L1*%i
12 Xl2=w*L2*%i
```

```
13 Xc=1/(w*C*%i)
14
15 Vth=R/(R+Xl2)*V
16 Zth=Xc+parallel(Xl2,R)
17 disp(Zth,Vth)
18
19 I=Vth/(Zth+Xl1)
20 Vl=I*Xl1
21 S=Vl*conj(I)/2
22 disp(S)
```

Scilab code Exa 4.39 Problem39

```
1 Pm=600
2 Vm=sqrt(3*Pm)
3 f=15.36E6
4 w=2*%pi*f
5 t=20.3E-3
6 theta=%pi/2-modulo(w*t,2*%pi)
7
8 disp(theta*180/%pi)
```

Scilab code Exa 4.40 Problem40

```
1 V=240
2 w=100*%pi
3 R=6
4
5 Vr=120
6 I=Vr/R
7
8 t=(205/I)^2          ////t=r^2+Xl^2
```

```
r=((240/I)^2-t-R*R)/2/R          ///this part solved
   wrong in the book
Xl=sqrt(t-r*r)
Z=sqrt(t)
disp(r)
disp(Xl)
disp(Z)

Pl_choke=I*I*r
disp(Pl_choke)
pf=Pl_choke/205/20
disp(pf)
```

Scilab code Exa 4.41 Problem41

```
w=2
L=1
C=0.5
Xl=w*L*%i
Xc=1/(w*C*%i)

V=1
I=V/(1+%i)
Y=I/V
R=1/real(Y)

disp(R,Y)
```

Scilab code Exa 4.42 Problem42

```
w=400
R=5
L=25E-3
```

```
4  C=1.25E-3
5  Xl=w*L*%i
6  Xc=1/(w*C*%i)
7
8  Z=R+Xl+Xc
9  Y=1/Z
10 C=-imag(Y)/w
11 Yn=real(Y)
12 Rn=1/Y
13
14 disp(C)
```

Scilab code Exa 4.43 Problem43

```
1  function Zeq=parallel(Z1,Z2)
2      Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  w=800
6  R1=10
7  R2=20
8  L=0.05
9  C=0.25E-3
10 Xl=w*L*%i
11 Xc=1/(w*C*%i)
12
13 Zeq1=R2+parallel(Xc,R1+Xl)
14 Zeq2=parallel(parallel(R1,R2)+Xc,Xl)
15
16 disp(Zeq2,Zeq1)
```

Scilab code Exa 4.44 Problem44

```
pf=0.707
theta=acos(pf)
P=200
Q=tan(theta)*P
pf2=0.85
theta_n=acos(pf2)
Qn=Q*tan(theta_n)
Qc=Q-Qn

w=314
V=2000
C=Qc/(V*V*w)

disp(C)
```

Scilab code Exa 4.45 Problem45

```
I=20
w=2000
R=200
L=0.25
Xl=w*L*%i

Ir=I*Xl/(Xl+R)
Il=I-Ir
Vl=Xl*Il

t=1E-3
ir=sqrt(2)*real(Ir*exp(%i*w*t))
il=sqrt(2)*real(Il*exp(%i*w*t))
vl=sqrt(2)*real(Vl*exp(%i*w*t))
is=sqrt(2)*real(I*exp(%i*w*t))
vs=vl

Pr=ir*ir*R
```

```
19 Pl=vl*il
20 Ps=is*ir*R
21 Pr=ir*vl
22
23 disp(Ps,Pl,Pr)
```

Scilab code Exa 4.46 Problem46

```
1  Vl=1
2  w=2
3  R=1
4  r=1/2
5  L=0.5
6  C=1
7  Xl=w*L*%i
8  Xc=1/(w*C*%i)
9
10 Il=Vl/Xl
11 VR=Il*R
12 Vs=Vl+VR
13
14 Vr=Vs
15 Ir=Vr/r
16 Ic=Vs/Xc
17 Is=Ir+Ic+Il
18
19 PR=-VR*VR/R
20 Pr=-Vr*Vr/r
21 Ps=Vs*conj(Is)
22
23 disp(real(Ps),Pr,PR)
```

Scilab code Exa 4.47 Problem47

```
V=10*%i
w=1000
R=2
L=2E-3
C=500E-6
Xl=w*L*%i
Xc=1/(w*C*%i)

Zeq=Xl+Xc+parallel(R,Xl)
disp(Zeq)

I=V/Z
Ir=I*Xl/(R+Xl)
Il2=I-Ir
Vl=I*Xl
Vc=I*Xc

disp(I,Ir,Il2,Vl,Vc)
```

Scilab code Exa 4.48 Problem48

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

[Vr,Vc]=polar_to_cart(100,120)
V1=complex(Vr,Vc)

I=10
w=5000
R=10000
L=2.4E-3
C=0.05E-3
```

```
15
16
17 [Vr,Vc]=polar_to_cart(96,60)
18 Vl=complex(Vr,Vc)
19
20 Xl=w*L*%i
21 Xc=1/(w*C*%i)
22
23 Il=Vl/Xl
24 Ic=I-Il
25 V2=(R+Xc)*Ic+V1
26 V3=V2-Vl
27 V1=Ic*Xc
28
29 disp(V1,V2,V3)
```

Scilab code Exa 4.49 Problem49

```
1 function Zeq=parallel(Z1,Z2)
2     Zeq=Z1*Z2/(Z1+Z2)
3 endfunction
4
5 ////////////short AB
6 Vab=0
7 Isc=50/4
8
9 ////////////for Zn
10 Zn=parallel(4,8*%i)
11
12 disp(Isc,Zn)
```

Scilab code Exa 4.50 Problem50

```
function Zeq=parallel(Z1,Z2)
    Zeq=Z1*Z2/(Z1+Z2)
endfunction

V=12*%i

Vth=4-12*%i/(4-12*%i+6+9*%i)*V
Zth=parallel(4-12*%i,6+9*%i)

I=Vth/(Zth+6+12*%i)
S=V*conj(I)
disp(S)

Zl=conj(Zth)
I=Vth/(Zth+Zl)
S=V*conj(I)
disp(Zth,S)
```

Scilab code Exa 4.51 Problem51

```
function Zeq=parallel(Z1,Z2)
    Zeq=Z1*Z2/(Z1+Z2)
endfunction

I=5

Zth=parallel(40,30*%i)
Zl=conj(Zth)
Vth=Zth*I
Z=Zth+Zl
Il=Vth/Z
Pmax=abs(Il*Il*real(Zl))

disp(Zth,Pmax)
```

Scilab code Exa 4.52 Problem52

```
V=4*sqrt(2)
w=2
R=4
L=2
Xl=w*L*%i

Il=V/(R+Xl)
Ic=-imag(Il)*%i
C=Ic/(V*%i*w)

disp(C)
```

Chapter 5

Frequency Response

Scilab code Exa 5.1 Problem1

```
1  Q0=200
2
3  //a
4  R=1
5  C=2E-6
6  L=C/(Q0/R)^2
7  disp(L)
8
9  L=2E-15
10 C=1.2E-9
11 R=Q0*sqrt(L/C)
12 disp(R)
13
14 R=118500
15 L=120E-12
16 C=L*(Q0/R)^2
17 disp(C)
```

Scilab code Exa 5.2 Problem2

```
R=1000
C=49E-6
L=13E-3

w0=1/sqrt(L*C)
Q0=w0*R*C

disp(Q0,w0)
```

Scilab code Exa 5.3 Problem3

```
R=5
C=0.08E-6
L=5E-3

w0=1/sqrt(L*C)
f0=w0/2/%pi
Q0=w0*L/R
bandwidth=w0/Q0
wb=bandwidth
w=[w0-1/2*wb,w0+1/2*wb]

disp(w(2),w(1))
```

Scilab code Exa 5.4 Problem4

```
L=40E-6
R=4.02
f0=800E3

w0=2*%pi*f0
C=1/(w0*w0*L)
Q0=w0*L/R
```

```
fb=f0/Q0

Xl=w0*L*%i
Xc=1/(w0*C*%i)
Zin=R+Xl+Xc

disp(Zin,fb,C)
```

Scilab code Exa 5.5 Problem5

```
G=5E-6
L=2E-3
I=2E-3
w=5000

C=1/(w*w*L)
Vmax=I/G
Il=1
I=Il*w*L*G

disp(I,Vmax,C)
```

Scilab code Exa 5.6 Problem6

```
w0=1000
w2=1050
wb=2*(w2-w0)

Q0=w0/wb
disp(Q0)
```

Scilab code Exa 5.7 Problem7

```
w0=200E3
wb=5E3
L=2.5E-3
Q=65

Q0=w0/wb
r=w0*L/Q

disp(r)
```

Scilab code Exa 5.8 Problem8

```
C=12E-9
L=4E-3
R=5

w0=1/sqrt(L*C)

Vc=1.5
I=w0*C*Vc
Zi=R
Vi=R*I

disp(Vi,w0)
```

Scilab code Exa 5.9 Problem9

```
w0=2.5E6
Zin=60E3
Q0=80

```

```
5  R=60E3
6  C=Q0/(w0*R)
7  L=1/(C*w0*w0)
8
9  disp(C,L,R)
```

Scilab code Exa 5.10 Problem10

```
1  C=2.5E-6
2  R=8
3  wb=400
4
5  L=R/wb
6  w0=1/sqrt(L*C)
7  Q0=w0*L/R
8  w1=w0-wb/2
9  w2=w0+wb/2
10
11 disp(w2,w1,Q0,w0,L)
```

Scilab code Exa 5.11 Problem11

```
1  w=1E6
2  wb=1000
3  V=0.05
4  I=5E-3
5
6  R=V/I
7  Q0=w0/wb
8  L=R*Q0/w0
9  C=1/(w0*w0*L)
10 Vl=w0*L*I
11 Vc=Vl
```

```
12 w1=w0-wb/2
13 w2=w0+wb/2
14
15 disp(w2,w1,Vc,Vl,C,L,Q0,R)
```

Scilab code Exa 5.12 Problem12

```
1  R=1E6
2  L=1
3  C=1E-6
4  I=10E-6
5
6  w0=1/sqrt(L*C)
7  V=I*R
8
9  wb=1/(R*C)
10 Q0=w0/wb
11 w1=w0-wb/2
12 w2=w0+wb/2
13
14 disp(w2,w1,V,Q0,w0)
```

Scilab code Exa 5.13 Problem13

```
1 f0=1E6
2 Cmax=500E-12
3 C=450E-12
4 w0=2*%pi*f
5
6 L=1/(w0*w0*Cmax)
7
8 w=1/sqrt(L*C)
9 f=w/(2*%pi)
```

```
10 wb=2*2*%pi*(f-f0)
11 r=wb*L
12 Q0=2*%pi*f*L/r
13
14 disp(Q0,L,r)
15
16 ////////calculation mistakes in book
```

Scilab code Exa 5.14 Problem14

```
1 R=10E3
2 L=50E-3
3 C=100E-6
4
5 w0=1/sqrt(L*C)
6 Q0=w0*R*C
7 alpha=w0/2/Q0
8 zeta=alpha/w0
9 wd=w0*sqrt(1-zeta^2)
10
11 disp(wd,zeta,alpha,Q0,w0)
12
13 /////////calculation mistakes in the book
```

Scilab code Exa 5.15 Problem15

```
1 w0=1000
2 wd=997
3 Yin=1.2E-3
4
5 zeta=sqrt(1-(wd/w0)^2)
6 alpha=zeta*w0
7 R=1/Yin
```

```
C=1/(2*alpha*R)
L=1/(w0*w0*C)

disp(C,L,R)
```

Scilab code Exa 5.17 Problem17

```
I=1
w=400
R=500
L=1/40
C=250E-6
Xl=w*L*%i
Xc=1/(w*C*%i)

w0=1/sqrt(L*C)
////////at resonance
Ir=I
V=R*I
Il=V/Xl
Ic=V/Xc
Icir=abs(Il)
Ic+Il=0
Icl=Ic+Il

disp(Icl,Ic,Il,Ir)
```

Scilab code Exa 5.18 Problem18

```
V=100
R=10
L=2E-3
C=200E-6
```

```
5
6  w0=1/sqrt(L*C)
7  Xl=w0*L*%i
8  Xc=1/(w0*C*%i)
9  I=V/R
10
11 Vl=I*Xl
12 Vc=I*Xc
13 Vlc=Vl+Vc
14
15 disp(Vlc,Vc,Vl,I,w0)
```

Scilab code Exa 5.19 Problem19

```
1  R=1
2  L=10E-6
3  C=10E-12
4  V=10
5
6
7  w0=1/sqrt(L*C)
8  Xl=w0*L*%i
9  Xc=1/(w0*C*%i)
10
11 Q0=w0*L/R
12 Z=R*Q0*Q0
13 Iin=V/Z
14
15 Ic=V/Xc
16
17 disp(Ic,Iin,Z,Q0,w0)
```

Scilab code Exa 5.20 Problem20

```
V=200
R=2
L=0.02

f=25
w0=2*%pi*f
C=1/(w0*w0*L)
I=V/2
Vc=1/(C*w0)
disp(I,Vc)

f=50
w0=2*%pi*f
C=1/(w0*w0*L)
I=V/2
Vc=1/(C*w0)
disp(I,Vc)

f=100
w0=2*%pi*f
C=1/(w0*w0*L)
I=V/2
Vc=1/(C*w0)
disp(I,Vc)
```

Scilab code Exa 5.21 Problem21

```
R=10
L=0.1
C=150E-6

w=sqrt((1+R*R*C/L)/(L*C))
f=w/(2*%pi)

disp(f)
```

```
9  Req=R/(1-w*w*L*C+(w*R*C)^2)
10 disp(Req)
```

Scilab code Exa 5.22 Problem22

```
1  R=35
2  Q0=50
3  f1=540E3
4  f2=1610E3
5  w1=2*%pi*f1
6  w2=2*%pi*f2
7
8
9  L=1/(w1*(Q0/R))
10 Cmax=(Q0/R)^2*L
11 Cmin=1/(L*w2^2)
12
13 disp(Cmin*1000000,Cmax*1000000,L*1000000)
```

Scilab code Exa 5.28 Problem28

```
1  function [x,y]=polar_to_cart(r,theta)
2      theta=theta/180*%pi
3      x=r*cos(theta)
4      y=r*sin(theta)
5  endfunction
6
7  [Vr,Vc]=polar_to_cart(4,30)
8  V=complex(Vr,Vc)
9
10 [Ir,Ic]=polar_to_cart(0.8,-10)
11 I=complex(Ir,Ic)
12
```

```
13 wv=3
14 wi=5
15 R1=1
16 L=2
17 R6=6
18 C=1/3
19
20 //////////deactivating curr source
21 Xl=wv*L*%i
22 Xc=1/(wv*C*%i)
23 Il1=V/(R1+R6+Xl+Xc)
24 Pav1=norm(Il1)^2*R1
25
26 //////////deactivating voltage source
27 Xl=wi*L*%i
28 Xc=1/(wi*C*%i)
29 Il2=I*(R6+Xl)/(R6+Xl+R1+Xc)
30 Pav2=norm(Il2)^2*R1
31
32 Pav=Pav1+Pav2
33
34 disp(Pav)
```

Scilab code Exa 5.29 Problem29

```
1 L=10E-6
2 R=1
3 C=10E-9
4 V=10
5
6 Zmax=L/R/C
7 I=V/Zmax
8 w0=1/sqrt(L*C)
9 w=0.9*w0
10
```

```
11 Y=R*C/L+%i*(w*C-1/w/L)
12 I=norm(Y)*V
13
14 disp(I)
```

Chapter 6

Three Phase Circuits

Scilab code Exa 6.1 Problem1

```
1  function [x,y]=polar_to_cart(r,theta)
2      theta=theta/180*%pi
3      x=r*cos(theta)
4      y=r*sin(theta)
5  endfunction
6
7  omega=exp(%i*120/180*%pi)
8  Va=200
9  Vb=200/omega
10 Vc=200*omega
11
12 [Zr,Zc]=polar_to_cart(100,60)
13 Z=complex(Zr,Zc)
14
15 Ia=Va/Z
16 Ib=Vb/Z
17 Ic=Vc/Z
18
19 disp(Va,Vb,Vc,Ia,Ib,Ic)
```

Scilab code Exa 6.2 Problem2

```
1  Vl=400
2  Vph=Vl
3  pf=0.8
4
5  Pph=1500/3
6  Iph=Pph/Vph/pf
7  Il=sqrt(3)*Iph
8  theta=acos(0.8)
9  Iph=Iph*exp(%i*theta)
10 Zph=Vph/Iph
11
12 disp(Iph,Il,Zph)
```

Scilab code Exa 6.3 Problem3

```
1  Vl=400
2  pf=0.8
3
4  Pph=1200/3
5  Vph=Vl/sqrt(3)
6  Iph=Pph/Vph/pf
7  Il=Iph
8  theta=acos(0.8)
9  Zph=Vph/Iph*exp(%i*theta)
10
11 disp(Il,Iph,Zph)
```

Scilab code Exa 6.4 Problem4

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

Vl=400
Vp=Vl/sqrt(3)
disp(Vp)

[Ir,Ic]=polar_to_cart(50,-30)
Il=complex(Ir,Ic)
Ip=Il
Zy=Vp/Il
disp(Zy)

P=sqrt(3)*Vl*Il*cos(30/180*%pi)
Q=sqrt(3)*Vl*Il*sin(30/180*%pi)
disp(P,Q)
```

Scilab code Exa 6.5 Problem5

```
Vl=400
Z=16+%i*12

Vp=Vl
Ip=Vp/Z
pf=cos(atan(imag(Z)/real(Z)))
Il=Ip*sqrt(3)

P=sqrt(3)*Vl*Il*pf
Q=sqrt(3)*Vl*Il*sin(acos(pf))

```

```
12 S=P+%i*Q
13
14 disp(Ip,Il,pf,P,Q,S)
```

Scilab code Exa 6.6 Problem6

```
1  Vl=400
2  Zload=60+%i*15
3
4  Vs=Vl/sqrt(3)
5  Z=0.3+%i*1+Zload
6
7  Il=Vs/Z
8  Vload=Il*Zload*sqrt(3)
9  Pload=3*Il*Il*real(Zload)
10 Qload=3*Il*Il*imag(Zload)
11 Sload=Pload+%i*Qload
12
13 ////////////ll=lineloss
14 Pll=3*Il*Il*real(Z-Zload)
15 Qll=3*Il*Il*imag(Z-Zload)
16 Sll=Pll+%i*Qll
17
18 Ssource=Sload+Sll
19
20 disp(Il,Vload,Sload,Sll,Ssource)
```

Scilab code Exa 6.7 Problem7

```
1 Ig1=200000/sqrt(3)/11000/0.75
2 PG1=200000
3 QG1=200000*tan(acos(0.75))
4 SG1=PG1+%i*QG1
```

```
5
6  Pll=3*Ig1*Ig1*1
7  Qll=3*Ig1*Ig1*2.2
8  Sll=Pll+%i*Qll
9  SlG1=SG1-Sll
10 Vl=SlG1/sqrt(3)/Ig1
11
12
13 Pl=400000
14 Ql=400000*tan(acos(0.8))
15 PlG2=Pl-real(SlG1)
16 QlG2=Ql-imag(SlG1)
17 SlG2=PlG2+%i*QlG2
18
19 IG2=SlG2/sqrt(3)/Vl
20
21 Pll2=3*IG2*IG2*0.6
22 Qll2=3*IG2*IG2*1.2
23
24 PG2=PlG2+Pll2
25 QG2=QlG2+Qll2
26 SG2=PG2+%i*QG2
27 VG2=SG2/sqrt(3)/IG2
28
29 disp(norm(SG2),norm(VG2))
```

Scilab code Exa 6.9 Problem9

```
1  function [x,y]=polar_to_cart(r,theta)
2      theta=theta/180*%pi
3      x=r*cos(theta)
4      y=r*sin(theta)
5  endfunction
6
7  Vl=400
```

```
[Ir,Ic]=polar_to_cart(20,-30)
Iab=complex(Ir,Ic)

omega=exp(%i*120/180*%pi)
Ibc=Iab/omega
Ica=Iab*omega

IAa=Iab-Ica
Pab=Vl*norm(Iab)*cos(30/180*%pi)
Ptotal=3*Pab

Zp=Vl/Iab
Rp=real(Zp)

disp(IAa)
disp(Ptotal)
disp(Rp)
```

Scilab code Exa 6.10 Problem10

```
omega=exp(%i*120/180*%pi)

Zp=17.32+%i*10
Vab=400
Iab=Vab/Zp
Ica=Iab/omega
IAa=Iab-Ica
IBb=IAa/omega
ICc=IAa*omega
disp(ICc,IBb,IAa)

Pab=(norm(Iab)^2)*real(Zp)
Ptotal=3*Pab
disp(Ptotal)

```

```
16 Itotal=IAa+IBb+ICc
17 disp(Itotal)
```

Scilab code Exa 6.11 Problem11

```
1  omega=exp(%i*120/180*%pi)
2
3  function [x,y]=polar_to_cart(r,theta)
4      theta=theta/180*%pi
5      x=r*cos(theta)
6      y=r*sin(theta)
7  endfunction
8
9  [Zr,Zc]=polar_to_cart(5,60)
10 Z=complex(Zr,Zc)
11
12 [Vr,Vc]=polar_to_cart(25,30)
13 Van=complex(Vr,Vc)
14
15 Ian=Van/Z
16 Ibn=Ian/omega
17 Icn=Ian*omega
18
19 Vcn=Van*omega
20 Vac=Van-Vcn
21
22 disp(Ibn,Icn,Vac)
```

Scilab code Exa 6.12 Problem12

```
1 V=400
2 w=2*50*%pi
3 P=25000
```

```
pf1=0.7
theta1=acos(pf1)
Il1=P/(sqrt(3)*V*pf1)*exp(-%i*theta1)
Ip1=Il1/sqrt(3)


pf2=0.85
theta2=acos(pf2)
Il2=P/(sqrt(3)*V*pf2)*exp(-%i*theta2)
Ip2=Il2/sqrt(3)

Ic=Ip2-Ip1                          ////calculation
   mistake in the book at this step
C=real(Ic/(V*w*%i))
disp(C)
```

Scilab code Exa 6.13 Problem13

```
omega=exp(%i*120/180*%pi)
Vrn=400/sqrt(3)
Vyn=Vrn/omega
Vbn=Vrn*omega

P1=4000
P2=8000
P3=12000

Ir=conj(P1/Vrn)
Iy=conj(P2/Vyn)
Ib=conj(P3/Vbn)

In=Ir+Iy+Ib

disp(norm(Ir),norm(Iy),norm(Ib),norm(In))
```

Scilab code Exa 6.14 Problem14

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


Vbc=-400*%i
Rl=1

[Sr,Sc]=polar_to_cart(10000,acos(0.8))
S=complex(Sr,Sc)


Vl=Vbc
Il=norm(S/(sqrt(3)*Vl))          ////////calculation
   mistake in book here
P=3*Il*Il*Rl
disp(P)

Van=norm(Vbc/sqrt(3))

Ia=Il*exp(-%i*acos(0.8))
omega=exp(%i*120/180*%pi)
Ib=Ia/omega

disp(Van,Ia,Ib)
```

Scilab code Exa 6.15 Problem15

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

[Vr,Vc]=polar_to_cart(231,60)
Van=complex(Vr,Vc)

Sp=(2.5-%i*1.2)*1000

omega=exp(%i*120/180*%pi)
Vbn=Van/omega
Vcn=Van*omega

Vbc=Vbn-Vcn

Ibc=conj(Sp/Vbc)
Ica=Ibc*omega
Iab=Ibc/omega

IaA=Ica-Iab

disp(IaA)
```

Scilab code Exa 6.16 Problem16

```
omega=exp(%i*120/180*%pi)
Vab=400
Vca=400*omega
Vbc=400/omega

//Mesh Method
A=[80+100*%i,100*%i;100*%i,50*%i]
I=inv(A)*[-Vca;Vbc]
```

```
Ia=I(1)
Ib=I(2)

Ic=-(Ia+Ib)
Van=80*Ia
Vbn=-50*%i*Ib
Vcn=100*%i*Ic

disp(Ia,Ib,Ic,Van,Vbn,Vcn)
```

Scilab code Exa 6.17 Problem17

```
omega=exp(%i*120/180*%pi)
Vab=400
Vca=400*omega
Vbc=400/omega

Iab=Vab/(100*%i)
Ibc=Vbc/(-50*%i)
Ica=Vca/80

Ia=Iab-Ica        ///calaculation mistake in the book
    here
Ib=Ibc-Iab
Ic=Ica-Ibc

disp(Ia,Ib,Ic)
```

Scilab code Exa 6.18 Problem18

```
V=400
P=900
pf=0.8
```

```
4
5 Pph=P/3
6 Vph=V/sqrt(3)
7 Iph=Pph/Vph/pf
8 Zph=Vph/Iph
9 theta=acos(pf)
10 Zph=Zph*exp(-%i*theta)
11 disp(Zph)
```

Scilab code Exa 6.19 Problem19

```
1 V=400
2 Z=complex(40,30)
3
4 Iph=V/Z
5 Il=sqrt(3)*norm(Iph)
6 Ptotal=sqrt(3)*Il*V*cos(atan(imag(Z)/real(Z)))
7
8 disp(Iph,Il,Ptotal)
```

Scilab code Exa 6.20 Problem20

```
1 Ig1=15000/sqrt(3)/800/0.8
2 PG1=15000
3 QG1=15000*tan(acos(0.8))
4 SG1=PG1+%i*QG1
5
6 Pll=3*Ig1*Ig1*1.2
7 Qll=3*Ig1*Ig1*1.8
8 Sll=Pll+%i*Qll
9 SlG1=SG1-Sll
10 Vl=SlG1/sqrt(3)/Ig1
11
```

```
12
13 Pl=30000
14 Ql=30000*tan(acos(0.8))
15 PlG2=Pl-real(SlG1)
16 QlG2=Ql-imag(SlG1)
17 SlG2=PlG2+%i*QlG2
18
19 IG2=SlG2/sqrt(3)/Vl
20
21 Pll2=3*IG2*IG2*0.8
22 Qll2=3*IG2*IG2*1.2
23
24 PG2=PlG2+Pll2
25 QG2=QlG2+Qll2
26 SG2=PG2+%i*QG2
27 VG2=SG2/sqrt(3)/IG2
28
29 disp(norm(SG2),norm(VG2))
```

Scilab code Exa 6.21 Problem21

```
1 omega=exp(%i*120/180*%pi)
2 w=2*50*%pi
3 Vry=415
4 Vyb=Vry/omega
5 Vbr=Vry*omega
6
7 C=40E-6
8 Zry=100
9 Zyb=complex(20,60)
10 Zbr=1/(%i*w*C)
11
12 I1=Vry/Zry
13 I2=Vyb/Zyb
14 I3=Vbr/Zbr
```

```
15
16 Ir=I1-I3
17 Iy=I2-I1
18 Ib=I3-I2
19
20 disp(norm(Ir),norm(Iy),norm(Ib))
```

Chapter 7

Magnetic Circuits

Scilab code Exa 7.1 Problem1

```
uo=(4*%pi)*1E-7

i1=5
i2=2.5
r=0.4
H=i1/(2*%pi*r)

F=uo*H*i2          //////// attractive
ur=8000
Firon=ur*F

disp(H,F,Firon)
```

Scilab code Exa 7.2 Problem2

```
l=0.15
i1=50

```

```
4 H1=i1/(2*%pi*(0.1+l))
5 i2=-H1*(2*%pi*0.1)
6
7
8 disp(i2)
```

Scilab code Exa 7.3 Problem3

```
1 Ha=4/(2*%pi*0.2)
2 Hb=Ha
3 H=sqrt(Ha^2+Hb^2)
4 theta=(%pi+atan(-Hb/Ha))*180/%pi
5
6 disp(H,theta)
```

Scilab code Exa 7.4 Problem4

```
1 uo=(4*%pi)*1E-7
2
3 Bg=1.2
4 N=400
5 ur=4000
6
7 lc=(2*(20-4+16-4)-0.2)/100
8 Ac=4/100*4/100
9 Rc=lc/(ur*uo*Ac)
10
11 lg=0.2/100
12 Rg=lg/(uo*Ac)
13
14 R=Rc+Rg
15
16 flux=Bg*Ac
```

```
17 i=flux*R/N
18
19 disp(i)
```

Scilab code Exa 7.5 Problem5

```
1  function Zeq=parallel(Z1,Z2)
2      Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  uo=(4*%pi)*1E-7
6  fluxg1=0.8E-3
7
8  lg1=0.02/100
9  lg2=0.02/100
10 lg3=0.025/100
11 Ag1=2/100*1/100
12 Ag2=1/100*1/100
13 Ag3=1/100*1/100
14
15 Rg1=lg1/(uo*Ag1)
16 Rg2=lg2/(uo*Ag2)
17 Rg3=lg3/(uo*Ag3)
18 Req=Rg1+parallel(Rg2,Rg3)
19
20 MMF=fluxg1*Req
21
22 disp(MMF)
```

Scilab code Exa 7.6 Problem6

```
1 uo=(4*%pi)*1E-7
2 ur=4000
```

```
3  fluxc=0.01
4  N=500
5
6  Ll=(2*(20+4)+25+4)/100
7  Lc=(25+4)/100
8  Lr=Ll-0.02/100
9  Lg=0.02/100
10 A=4/100*4/100
11
12 Rl=Ll/(ur*uo*A)
13 Rc=Lc/(ur*uo*A)
14 Rr=Lr/(ur*uo*A)
15 Rg=Lg/(uo*A)
16
17 Fab=fluxc*Rc
18 fluxr=Fab/(Rr+Rg)
19 fluxl=fluxc+fluxr
20
21 F=fluxl*Rl+Fab
22 I=F/N
23
24 disp(I)
```

Scilab code Exa 7.7 Problem7

```
1  uo=(4*%pi)*1E-7
2
3  l1=50/100
4  l2=20/100
5  l3=50/100
6  lbc=0.025/100
7
8  A1=25E-4
9  A2=12.5E-4
10 A3=25E-4
```

```
11
12 fluxg=0.75E-3
13
14 B=fluxg/A1
15 Fbc=B/uo*lbc
16
17 Hcd=200
18 Hab=Hcd
19 Fabcd=Hab*l1
20 Fad=Fbc+Fabcd
21 Had=Fab/l2
22 Bad=1.04
23 fluxad=Bad*A2
24
25 fluxdea=fluxad+fluxg
26 Bdea=fluxdea/A3
27 Hdea=500
28 Fdea=Hdea*l3
29
30 F=Fdea+Fad
31
32 disp(F)
```

Scilab code Exa 7.8 Problem8

```
1 uo=(4*%pi)*1E-7
2 ur=3000
3 Ac=10/100*10/1000
4 Bc=1.4
5 Hc=Bc/(uo*ur)
6 lc=150/100
7 Ftotal=Hc*lc
8
9 N2=800
10 I2=2
```

```
11 F2=N2*I2
12 F1=Ftotal-F2
13
14 N1=400
15 I1=F1/N1  ////out of terminal a
16 disp(I1)
17
18
19 Bc=1.4
20 fluxc=Bc*Ac
21 Rc=lc/(Ac*uo*ur)
22 Wf=1/2*Rc*fluxc*fluxc
23 disp(Wf)
24
25
26
27 L1=N1*N1/Rc
28 L2=N2*N2/Rc
29 M=sqrt(L1*L2)
30 disp(M)
```

Scilab code Exa 7.9 Problem9

```
1 uo=(4*%pi)*1E-7
2 ur=6000
3 A=5/2*2/10000
4 Lr=(%pi*(20+25)/2-0.1)/100
5 Lg=0.1/100
6 Rr=Lr/(uo*ur*A)
7 Rg=Lg/(uo*A)
8 Rtotal=Rr+Rg
9
10 F=2*500
11 flux=F/Rtotal
12 Bg=flux/A
```

```
disp(Bg)

L=flux*500/2
disp(L)

Wfr=1/2*Rr*flux*flux
Wfg=1/2*Rg*flux*flux
disp(Wfg,Wfr)

imax=2
flux_max=flux
E=4.44*314/(2*%pi)*500*flux_max
flux_max2=100/(sqrt(2)*4.44*314/(2*%pi)*500)
Fmax2=flux_max2*Rtotal
imax2=Fmax2/500
disp(imax2)
```

Scilab code Exa 7.10 Problem10

```
Ac=12/10000
Fmin=160*9.81
B=sqrt(Fmin*2*uo/Ac)

H=2800
L=75/100
F=H*L
Lg=0.1/1000
A=24/10000
Rg=Lg/(uo*A)
fluxg=B*A
Fg=fluxg*Rg

Ftotal=F+Fg
imin=Ftotal/1000
disp(imin)
```

Scilab code Exa 7.11 Problem11

```
Wm1=1/2*(1200-750)*0.012
disp(Wm1)

flux_g=0.012/750*1200
Wm2=1/2*(flux_g-0.012)*1200
disp(Wm2)

Ra=1200/0.012
Rb=1200/flux_g
Fo=-1/2*(0.012^2)*0.75*10^6
Fc=-1/2*(flux_g^2)*0.75*10^6
disp(Fc,Fo)
```

Scilab code Exa 7.12 Problem12

```
V1=10

//Mesh Method
A=[1+10*%i,-80*%i;80*%i,-500-800*%i]
I=inv(A)*[V1;0]

V2=500*I(2)

disp(V1,V2,I)
```

Scilab code Exa 7.14 Problem14

```
uo=(4*%pi)*1E-7
ur=1600

lc=160/100
lg=0.8/1000
A=5/10000
N=1200

Rc=lc/(uo*ur*A)
Rg=lg/(uo*A)
R=Rc+Rg

L=N*N/R
disp(L)
```

Scilab code Exa 7.15 Problem15

```
N=100
l1=0.15
l2=0.3
l3=0.45
A=0.001

ur1=1447
ur2=5969
ur3=47750

flux=0.6E-3

B=flux/A

H1=B/(uo*ur1)
H2=B/(uo*ur2)
H3=B/(uo*ur3)
disp(H1,H2,H3)
```

```
19
20 F=H1*l1+H2*l2+H3*l3
21 disp(F)
22
23 I=F/N
24 disp(I)
```

Scilab code Exa 7.16 Problem16

```
1  Pl1=1500
2  f1=50
3  Pl2=3000
4  f2=75
5
6  Y=[1,f1;1,f2]
7  X=inv(Y)*[Pl1/f1;Pl2/f2]
8
9  Ph1=X(1)*f1
10 Pe1=X(2)*f1*f1
11 Ph2=X(1)*f2
12 Pe2=X(2)*f2*f2
13
14 disp(Ph1,Pe1,Ph2,Pe2)
```

Scilab code Exa 7.17 Problem17

```
1 uo=(4*%pi)*1E-7
2 F=750*1
3 disp(F)
4
5 dm=(16+20)/200
6 lc=dm*%pi
7 Hc=F/lc
```

```
disp(Hc)

flux=1.25/1000
Ac=(20-16)*2.5/10000
Bc=flux/Ac
disp(Bc)

R=F/flux
disp(R)

u=Bc/Hc
disp(u)

ur=u/uo
disp(ur)            //calculation mistake in the book
   here
```

Scilab code Exa 7.18 Problem18

```
fluxc=1.5E-3
Ac=12/10000
Bc=fluxc/Ac
Hc=1250
lc=0.3
F=Hc*lc

Fa=200*1
Fb=600*0.75

Fc=F-Fb+Fa
Nc=Fc/0.5
disp(Nc)     ////clockwise5
```

Scilab code Exa 7.19 Problem19

```
uo=(4*%pi)*1E-7
ur=2000
V=200
f=50
N=1600
Ac=5/10000

flux_max=V/(4.44*f*N)
Bmax=flux_max/Ac
disp(Bmax)

Rc=20/100/(uo*ur*Ac)
Rg=0.5/1000/(uo*Ac)
R=Rc+Rg

imax=flux_max*R/N
disp(imax)

Wfmax=1/2*R*(flux_max^2)
disp(Wfmax)

percent=Rg/R*100
disp(percent)
```

Chapter 8

Transformers

Scilab code Exa 8.1 Problem1

```
1  V1=3300
2  f=50
3  N1=100
4  N2=300
5  Z=100+35*%i
6  flux_max=V1/(sqrt(2)*%pi*f*N1)
7  V2=V1*N2/N1
8  I2=V2/Z
9  I1=N2/N1*I2
10 S=V1*conj(I1)
11 Z1=Z*(N1/N2)^2
12
13 disp(flux_max)
14 disp(I1,I2)
15 disp(real(S),imag(S))
16 disp(Z1)
```

Scilab code Exa 8.2 Problem2

```
a=2400/240

R=0.2+a*a*2/1000
X=0.6+a*a*6/1000
disp(R,X)

Rlv=1/a/a*R
Xlv=1/a/a*X
disp(Rlv,Xlv)

I2=150*1000/2400
Z=R+%i*X
V=I2*Z
pcnt=norm(V)/2400*100
disp(V,pcnt)

Im=2400/1600
Ii=2400/10000
Io=Ii-%i*Im
pf=cos(atan(imag(Io)/real(Io)))
disp(Io,pf)
```

Scilab code Exa 8.3 Problem3

```
P=200E3
V1=11000
V2=415
f=50
N2=80

N1=V1/V2*N2
a=N1/N2
disp(a)

I2=P/V2
```

```
12 disp(I2)
13 I1=I2/a
14 disp(I1)
15
16 Z2=V2*V2/P
17 disp(Z2)
18 Z21=Z2*a*a
19 disp(Z21)
```

Scilab code Exa 8.4 Problem4

```
1  V1=200
2  f=50
3  N1=150
4  Ac=10*5/10000
5
6
7  Flux_max=V1/(sqrt(2)*%pi*f*N1)
8  Bmax=Flux_max/Ac
9  Hmax=250
10 l=2*(25+10)+2*(20+10)
11 l=l/100
12 AT_max=Hmax*l
13 Im_max=AT_max/150
14 Im_rms=Im_max/sqrt(2)
15 disp(Im_rms)
16
17 Fe_loss=23000
18
19 Cv = 2*(25+2*10)*10*5 + 2*20*10*5
20 Cv=Cv/1000000
21 Cl=Fe_loss*Cv
22 disp(Cl)
23
24 Ii=150/V1
```

```
25 disp(Ii)
```

Scilab code Exa 8.5 Problem5

```
1  function [x,y]=polar_to_cart(r,theta)
2      theta=theta/180*%pi
3      x=r*cos(theta)
4      y=r*sin(theta)
5  endfunction
6
7  [Zr,Zc]=polar_to_cart(5,30)
8  Z2=complex(Zr,Zc)
9
10 V=200
11 N2=75
12 N1=100
13
14 I2=V/Z2
15 I1=N2/N1*I2
16
17 disp(norm(I1))
18 disp(" lagging" , real(I1)/norm(I1))
```

Scilab code Exa 8.6 Problem6

```
1  R=60
2  V=6
3  Rs=2400
4
5  a=sqrt(Rs/R)
6  disp(a)
7
8  Pl_max=1/2*(R*R)/(Rs+Rs)
```

```
I1=V/2/Rs

Il=I1*a
disp(Il)
Vl=V/2/a
disp(Vl)
```

Scilab code Exa 8.7 Problem7

```
f=50
a=1100/220
Rhv=0.125
Xhv=0.625
Rlv=0.005
Xlv=0.025

Zhv=Rhv+%i*Xhv
Zlv=Rlv+%i*Xlv

Z1=Zhv+a*a*Zlv
disp(Z1)
Z2=Z1/a/a
disp(Z2)

Zpu1=Z1*0.05/1.1/1.1
disp(Zpu1)
Zpu2=Z2*0.05/0.22/0.22
disp(Zpu2)
```

Scilab code Exa 8.8 Problem8

```
P=600E3
a=2400/600
```

```
r1=0.05
r2=0.004
x1=0.025
x2=0.016
R1=1667
Xm=417

/////As seen from the LV side

Zlv=r2+%i*x2+1/a/a*(r1+%i*x1)
disp(Zlv)

RiLV=R1/a/a
disp(RiLV)
XmLV=Xm/a/a
disp(XmLV)


Zpu=Zlv*0.6/0.6/0.6
disp(Zpu)
Ri=RiLV*0.6/0.6/0.6
disp(Ri)
Xm=XmLV*0.6/0.6/0.6
disp(Xm)
```

Scilab code Exa 8.9 Problem9

```
P=50E3
a=2200/220

/////OC Parameters
Poc=405
Ioc=5
Voc=220

```

```
9  /////SC Parameters
10 Psc=805
11 Isc=20.2
12 Vsc=95
13
14
15 Y0=Ioc/Voc
16 Gi=Poc/Voc/Voc
17 Bm=sqrt(Y0*Y0-Gi*Gi)
18
19 Z=Vsc/Isc
20 R=Psc/Isc/Isc
21 X=sqrt(Z*Z-R*R)
22
23 ///////////Referred to HV side
24 GiHV=Gi/a/a
25 disp(GiHV)
26 BmHV=Bm/a/a
27 disp(BmHV)
28 disp(R)
29 disp(X)
30
31 ////////////Referred to LV side
32 disp(Gi)
33 disp(Bm)
34 RLV=R/a/a
35 disp(RLV)
36 XLV=X/a/a
37 disp(XLV)
38
39
40 /////////Per unit
41 GiPU=GiHV/0.0103
42 BmPU=BmHV/0.0103
43 RPU=R/96.8
44 XPU=X/96.8
45 disp(GiPU)
46 disp(BmPU)
```

```
47 disp(RPU)
48 disp(XPU)
```

Scilab code Exa 8.10 Problem10

```
1  P=50E3
2  a=2200/110
3
4  /////OC Parameters
5  Poc=400
6  Ioc=10
7  Voc=110
8
9  Y0=Ioc/Voc
10 Gi=Poc/Voc/Voc
11 disp(Gi)
12 Bm=sqrt(Y0*Y0-Gi*Gi)
13 disp(Bm)
14
15 ///////////Referred to HV side
16 GiHV=Gi/a/a
17 disp(GiHV)
18 BmHV=Bm/a/a
19 disp(BmHV)
20
21 //////////Per unit
22 GiPU=Gi*P/Voc/Voc
23 BmPU=Bm*P/Voc/Voc
24 disp(GiPU)
25 disp(BmPU)
```

Scilab code Exa 8.11 Problem11

```
P=25000
V1=2200
V2=220
a=V1/V2
f=50
r1=2
r2=0.025
x1=7
x2=0.07
Xm=16000

Im=V2/Xm
disp("pf=0, 90 degree lag Po=0", Im)

R=r1+a*a*r2
X=x1+a*a*x2
Z=sqrt(R*R+X*X)
Ifl=P/V1
Vsc=Z*Ifl
Vsc_percent=Vsc/V1*100
disp(Vsc,Vsc_percent)
Im=Vsc/Xm
Im_percent=Im/Ifl*100
disp(Im,Im_percent)

Sc_pf=cos(atan(X/R))
disp(Sc_pf)

//////////Per unit
ZBpu=1000*2.2*2.2/25
r1pu=r1/193.6
r2pu=a*a*r2/193.6
x1pu=x1/193.6
x2pu=a*a*x2/193.6

Rpu=r1pu+r2pu
Xpu=x1pu+x2pu

```

```
39 Xmpu=Xm/193.6
40 disp(Rpu,Xpu,Xmpu)
```

Scilab code Exa 8.12 Problem12

```
1  P=10000
2  v1=2300
3  v2=230
4  a=v1/v2
5  f=50
6  r1=3.96
7  r2=0.0396
8  x1=15.8
9  x2=0.158
10
11 R=r1+a*a*r2
12 X=x1+a*a*x2
13 V2=v2*a
14 I=P/V2
15 theta=acos(0.80)
16 V1=V2+I*(R*cos(theta)+X*sin(theta))
17 disp(V1)
18 VR=(V1-V2)/V2
19 disp(VR)
20
21 pf=X/sqrt(R*R+X*X)
22 theta2=acos(pf)
23 Il=I*(cos(theta)-%i*sin(theta))
24 Ic=real(Il*tan(theta2))-imag(Il)
25 Rating_Cap=V2*Ic
26 disp(Rating_Cap)
27 V1=V2
28 disp(V1)
```

Scilab code Exa 8.13 Problem13

```
P=100000
N1=400
N2=100
a=N1/N2
r1=0.3
r2=0.015
x1=1.1
x2=0.055
V1=2400

R=r1+a*a*r2
disp(R)
X=x1+a*a*x2
disp(X)

I1=P/V1
pf=0.8
theta=acos(pf)
Vd=I1*(R*cos(theta)+X*sin(theta))
VR=Vd/V1*100
V2=(V1-Vd)/a
disp(VR,V2)
Vd=I1*(R*cos(theta)-X*sin(theta))
VR=Vd/V1*100
V2=(V1-Vd)/a
disp(VR,V2)

pf=cos(atan(R/X))              /////wrong in the book
disp("leading",pf)
```

Scilab code Exa 8.14 Problem14

```
P=10000
v1=2300
v2=230
a=v1/v2
f=50
r1=3.96
r2=0.0396
x1=15.8
x2=0.158

R=r1+a*a*r2
X=x1+a*a*x2
V2=v2*a
I=P/V2
pf=0.8
theta=acos(pf)
V1=V2+I*(R*cos(theta)+X*sin(theta))
Pi=75*V1*V1/V2/V2
Pc=I*I*R
Pl=Pi+Pc
P0=P*pf
effi=P0/(P0+Pl)*100
disp(effi)

V1=V2
Pi=75
pf2=X/sqrt(R*R+X*X)
I=P0/V1/pf2
Pc=I*I*R
Pl=Pi+Pc
P0=P*pf
effi=P0/(P0+Pl)*100
disp(effi)

I=sqrt(Pi/R)
Load=V2*I
```

```
P0=Load*pf
Pl=2*Pi
effi_max=P0/(P0+Pl)*100
disp(effi_max)
```

Scilab code Exa 8.15 Problem15

```
P=15E3
a=3000/250

/////OC Parameters
Poc=105
Ioc=0.62
Voc=250

/////SC Parameters
Psc=360
Isc=5.2
Vsc=157


Y0=Ioc/Voc
Gi=Poc/Voc/Voc
Bm=sqrt(Y0*Y0-Gi*Gi)

Z=Vsc/Isc
R=Psc/Isc/Isc
X=sqrt(Z*Z-R*R)

//////////Referred to HV side
GiHV=Gi/a/a
disp(GiHV)
BmHV=Bm/a/a
disp(BmHV)
disp(R)
```

```
disp(X)

//////////Per unit
ZB=3.12/5.2
GiPU=Gi*ZB
BmPU=Y0*ZB
RPU=R/ZB/1000
XPU=X/ZB/1000
disp(GiPU)
disp(BmPU)
disp(RPU)
disp(XPU)


pf=0.8
theta=acos(pf)
V2=250*a
I=P/V2
Vd=I*(R*cos(theta)-X*sin(theta))
VR=-Vd/V2*100
disp(VR)
Pi=105
Pc=I*I*R
Pl=Pi+Pc
P0=P*pf
effi=P0/(Pl+P0)*100

pf2=cos(atan(R/X))
disp("leading", pf2)


IPU=sqrt(Pi/P/RPU)
effi_max=IPU
disp(effi_max)
```

Scilab code Exa 8.16 Problem16

```
v1=2500
v2=250
P=25000
Pc=130
Pcfl=320
pf=0.8

V2=2750

P0=P*pf
Pl=Pcfl+Pc
effi=P0/(P0+Pl)*100
disp(effi)

I2=P/v2
I1=I2+P/v1
kVA=I1*v1/1000
P0=kVA*pf*1000
effi=P0/(P0+Pl)*100
disp(effi)
```

Scilab code Exa 8.17 Problem17

```
a=10
Load=120000
V=400

I=Load/V/sqrt(3)
Vll=a*V/sqrt(3)
Ill=sqrt(3)*I/a
all=Vll/V
disp(Vll,Ill,all)

```

```
11 Vll=a*V*sqrt(3)
12 Ill=I/a/sqrt(3)
13 all=Vll/V
14 disp(Vll,Ill,all)
```

Scilab code Exa 8.18 Problem18

```
1  f=50
2  N1=500
3
4  Pin=60
5  Io=0.4
6  Vin=220
7  r=0.8
8
9  Pci=Io*Io*r
10 Pi=Pin-Pci
11 disp(Pi)
12 theta=acos(Pin/Vin/Io)
13 Im=Io*sin(theta)
14 Xm=Vin/Im
15 disp(Xm)
16 Iio=Io*cos(theta)
17 Ri=Vin/Iio
18 disp(Ri)
```

Scilab code Exa 8.19 Problem19

```
1 P=15E3
2 v1=2200
3 v2=220
4 a=v1/v2
5
```

```
6  /////OC Parameters
7  Poc=185
8  Ioc=2.72
9  Voc=220
10
11 /////SC Parameters
12 Psc=197
13 Isc=6.3
14 Vsc=112
15
16 Pi=Poc
17 disp(Pi)
18
19 IHVfl=P/v1
20 Pcfl=IHVfl*IHVfl/Isc/Isc*Psc
21 disp(Pcfl)
22
23 pf=0.85
24 Po=P*pf
25 Pl=Pi+Pcfl
26 effi=Po/(Po+Pl)*100
27 disp(effi)
28
29 Z=Vsc/Isc
30 R=Psc/Isc/Isc
31 X=sqrt(Z*Z-R*R)
32 pf=0.8
33 theta=acos(pf)
34 Vd1=IHVfl*(R*cos(theta)+X*sin(theta))
35 Vd2=IHVfl*(R*cos(theta)-X*sin(theta))
36 VR1=Vd1/v1*100
37 VR2=Vd2/v1*100
38 disp(VR1, VR2)
```

Scilab code Exa 8.20 Problem20

```
P=50000
lr=0.9

P0=P*1*0.9
effi=0.974
Pl=(1-effi)/effi*P0
Pi=Pl/2
Pcfl=Pi/lr/lr

pf=0.8
P0=P*pf
Pl=Pi+Pcfl
effi=P0/(P0+Pl)*100
disp(effi)

P0=P/2*lr
Pl=Pi+Pcfl/2/2
effi=P0/(P0+Pl)*100
disp(effi)

//////////calculation mistakes in the book
```

Scilab code Exa 8.21 Problem21

```
P=500E3
effi=0.95

A=[1,1;1,0.6*0.6]
Pa=inv(A)*[P*(1-effi)/effi;P*0.6*(1-effi)/effi]
Pi=Pa(1)
disp(Pi)
Pc=Pa(2)
disp(Pc)

Pl=Pi+0.75*0.75*Pc
```

```
12 effi=P*0.75/(P*0.75+Pl)
13 disp(effi)
```

Scilab code Exa 8.22 Problem22

```
1  v1=2200
2  v2=220
3  f=50
4  emfperturn=12
5
6  N1=floor(v1/emfperturn)
7  N2=floor(v2/emfperturn)
8  disp(N1)
9  disp(N2)
10
11 fluxmax=emfperturn/4.44/f
12 Bmax=1.5
13 Ac=fluxmax/Bmax
14 disp(Ac)
```

Scilab code Exa 8.23 Problem23

```
1  v1=3300
2  v2=600
3  f=50
4  Ac=25/10000
5  l=1.2
6
7  Bmax=1.2
8  fluxmax1=Bmax*Ac
9  N1=v1/4.44/f/fluxmax1
10 N2=v2/4.44/f/fluxmax1
11 disp(N1,N2)
```

```
12
13 I2=20
14 pf=0.8
15 I1=N2/N1*I2
16 I1=I1*(pf-%i*sin(acos(0.8)))
17 disp(I1)
18
19 Hmax=250
20 ATmax=Hmax*l
21 immax=ATmax/N1/sqrt(2)
22 Ii=0
23 I1=-%i*immax+I1
24 disp("lagging", real(I1)/norm(I1), norm(I1))
```

Scilab code Exa 8.24 Problem24

```
1 P=50000
2 v1=2400
3 v2=240
4 f=50
5 a=v1/v2
6 Pd=375
7 pf=0.4
8
9 I0=Pd/v1/pf
10 I0_prime=I0*a
11 disp(I0_prime,pf)
```

Scilab code Exa 8.25 Problem25

```
1 v1=220
2 v2=110
3 z1=0.32+%i*0.85
```

```
4  z2=0.11+%i*0.27
5  a=v1/v2
6
7  z=z1+a*a*z2
8  IHV=v1/norm(z)
9  ILV=IHV*a
10 disp(IHV,ILV)
```

Scilab code Exa 8.26 Problem26

```
1  P=1000000
2  v1=11000
3  v2=230
4  f=50
5  Vsc=310
6  Psc=5210
7
8  Isc=P/v1
9  Z=Vsc/Isc
10 R=Psc/Isc/Isc
11 X=sqrt(Z*Z-R*R)
12
13 pf=1
14 theta=acos(pf)
15 Vd=Isc*(R*cos(theta)+X*sin(theta))
16 VR=Vd/v1*100
17 V1=v1+Vd
18 disp(VR,V1)
19
20 pf=0.8
21 theta=acos(pf)
22 Vd=Isc*(R*cos(theta)+X*sin(theta))
23 VR=Vd/v1*100
24 V1=v1+Vd
25 disp(VR,V1)
```

```
26
27 pf=0.8
28 theta=acos(pf)
29 Vd=Isc*(R*cos(theta)-X*sin(theta))     //calculation
      mistake in the book at this point
30 VR=Vd/v1*100
31 V1=v1+Vd
32 disp(VR,V1)
```

Scilab code Exa 8.27 Problem27

```
1  P=10000
2  v1=2200
3  v2=220
4  r1=4
5  r2=0.04
6  x1=5
7  x2=0.05
8  a=v1/v2
9  R=r1+a*a*r2
10 X=x1+a*a*x2
11 I1=P/v1
12 pf=0.8
13 V2=v2*a
14 theta=acos(pf)
15 Vd=I1*(R*cos(theta)+X*sin(theta))
16 VR=Vd/v1*100
17 V1=v1+Vd
18 disp(VR,V1)
19
20 pf=cos(atan(X/R))
21 disp("leading",pf)
22
23 Pr=P*pf
24 Q=-P*sin(acos(pf))
```

```
25 disp(Q,Pr)
```

Scilab code Exa 8.28 Problem28

```
1  P=20000
2  v1=200
3  v2=400
4  f=50
5  V1=600
6  V2=200
7
8  a=V1/V2
9  disp(a)
10
11 I1=P/v2
12 VA=V1*I1
13 disp(VA)
14
15 disp(I1)
16 I2=30000/V2
17 Is=I2-I1
18 disp(I2)
19 disp(Is)
20
21 VAtrans=v2*I1
22 VAcond=30000-VAtrans
23 disp(VAtrans)
24 disp(VAcond)
```

Scilab code Exa 8.29 Problem29

```
1  P=100000
2  v1=11000
```

```
v2=400

Vl=400
Vp=Vl/sqrt(3)

a=ceil(v1/Vp)
disp(a)

Il=P/sqrt(3)/Vl
Ip=Il
disp(Il,Ip)

Il=P/sqrt(3)/v1
Ip=Il/sqrt(3)
disp(Il,Ip)
```

Chapter 9

EMF and Torque in Electric Machines

Scilab code Exa 9.1 Problem1

```
1  f=50
2  flux=0.016
3  S=36
4  P=6
5  N=10
6
7
8  m=S/P
9  gammaa=%pi/m
10 Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
11 Nph=S*N*2/2
12 Ep=4.44*Kb*f*Nph*flux
13 kVA=Ep*N/1000
14 disp(kVA)
15
16 m=S/2/P
17 gammaa=%pi/2/m
18 Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
19 Nph=S*N*2/2/2
```

```
20 Ep=4.44*Kb*f*Nph*flux
21 Eline=Ep*sqrt(2)
22 kVA=Ep*N*2/1000
23 disp(kVA)
24
25 m=S/3/P
26 gammaa=%pi/3/m
27 Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
28 Nph=S*N*2/2/3
29 Ep=4.44*Kb*f*Nph*flux
30 Eline=Ep*sqrt(3)
31 kVA=Ep*N*3/1000
32 disp(kVA)
```

Scilab code Exa 9.2 Problem2

```
1 S=54
2 P=6
3 m=S/3/P
4 gammaa=%pi/3/m
5
6 Kb1=sin(m*gammaa/2)/m/sin(gammaa/2)
7 Kb3=sin(m*gammaa/2*3)/m/sin(gammaa/2*3)
8 Kb5=sin(m*gammaa/2*5)/m/sin(gammaa/2*5)
9
10 disp(Kb1)
11 disp(Kb3)
12 disp(Kb5)
```

Scilab code Exa 9.3 Problem3

```
1 f=50
2 n=500
```

```
3  m=5
4  N=12
5  flux=0.025
6
7  P=120*f/n
8  S=m*3*P
9  Nph=S*N*2/2/3
10 gammaa=%pi/3/m
11 Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
12 polepitch=S/N
13 coilpitch=13
14 spa=(polepitch-coilpitch)*gammaa
15 Kp=cos(spa/2)
16
17 Ep=4.44*Kb*Kp*f*Nph*flux
18 disp(Ep)
19 Eline=sqrt(3)*Ep
20 disp(Eline)
```

Scilab code Exa 9.4 Problem4

```
1 f=50
2 P=6
3 ns=120*f/P
4 disp(ns)
5 wm=2*%pi/60*ns
6 disp(wm)
```

Scilab code Exa 9.5 Problem5

```
1 F2=850
2 F1=400
3 lambda=123.6/180*%pi
```

```
4 ppp=1.408/1000
5
6 theta=%pi-lambda
7 Fr=sqrt(F1*F1+F2*F2-2*F1*F2*cos(theta))
8
9 fluxr=2/%pi*ppp*Fr
10 disp(fluxr)
```

Scilab code Exa 9.6 Problem6

```
1
2 P=6
3 N=1000
4
5 f=P*N/120
6 ns=120*f/4
7 s=0.04
8 n=(1-s)*ns
9 disp(n)
```

Scilab code Exa 9.7 Problem7

```
1
2 P=4
3 f=50
4
5
6 ns=120*f/P
7 n1=-1500
8 s1=(ns-n1)/ns
9 f2=s1*f
10 SRV=s1*80
11 disp(f2,SRV)
```

```
12
13 n2=1000
14 s2=(ns-n2)/ns
15 f2=s2*f
16 SRV=s2*80
17 disp(f2,SRV)
```

Scilab code Exa 9.8 Problem8

```
1
2 betaa=acos(0)*2/5
3 coilpitch=%pi-betaa
4 disp(coilpitch/%pi*180)
5
6 P=6
7 S=72
8 m=S/P
9 gammaa=%pi/m
10 cpis=150/180*%pi
11 betaa=%pi-cpis
12 Kp1=cos(betaa/2)
13 Kp3=cos(5*betaa/2)
14 Kp13=cos(13*betaa/2)
15 disp(Kp1)
16 disp(Kp3)
17 disp(Kp13)
```

Scilab code Exa 9.9 Problem9

```
1
2 P=2
3 f=50
4 S=42
```

```
m=S/3/P
gammaa=%pi/3/m
Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
coilpitch=17
polepitch=S/2
spa=(polepitch-coilpitch)*gammaa
Kp=cos(spa/2)

N=S*2
Nc=N/2
Coilsperphase=Nc/3
Nph=Coilsperphase/2
Eline=2300
flux=Eline/sqrt(3)/4.44/Kb/Kp/f/Nph
disp(flux)
```

Scilab code Exa 9.10 Problem10

```
f=50
ns=1000
P=120*f/ns
disp(P)
s=(ns-940)/ns
disp(s*100)
nrr=ns-940
disp(nrr)
nrs=1000
disp(nrs)
s=2*s
n=1000*(1-s)
disp(n)
```

Scilab code Exa 9.11 Problem11

```
ns=1000
s=(ns-940)/ns
news=2*s
n=1000*(1-news)
disp(n)
```

Scilab code Exa 9.12 Problem12

```
P=8
f1=60
f2=50
If1=5
If2=f1/f2*If1
disp(If2)
nA2=120*f2/P
disp(nA2)
```

Scilab code Exa 9.13 Problem13

```
f1=60
f2=50
P1=12
P2=f2/f1*P1
disp(P2)
nset=120*f1/P1
disp(nset)
```

Scilab code Exa 9.14 Problem14

```
m=6
```

```
2 gammaa=%pi/m
3 Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
4
5 m=4
6 Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
```

Scilab code Exa 9.15 Problem15

```
1
2 f=50
3 n=965
4 P=floor(120*f/n)
5 disp(P)
6
7 s=(1000-965)/1000
8 disp(s)
9 f2=s*f
10 disp(f2)
11
12 nsr=1000-965
13 disp(nsr)
14 nrr=120*f2/P
15 nsrf=1000-965-nrr
16 disp(nsrf)
```

Scilab code Exa 9.16 Problem16

```
1 f=50
2 P=4
3 a=2
4
5 ns=120*f/P
6 n=1440
```

```
 7  s=1-n/ns
 8  disp(s)
 9  f2=s*f
10  disp(f2)
11  E1p=400
12  E2f=400/a
13  E2f2=E2f*f2/f
14  E2l=sqrt(3)*E2f2
15  disp(E2l)
```

Chapter 10

DC Machines

Scilab code Exa 10.1 Problem1

```
1  P=6
2  S=36
3  coilside=2
4  N=8
5  A=2
6  d=0.25
7  l=0.18
8  Ia=10
9  avgflux=0.8
10 n=1200
11
12 Z=S*coilside*N
13 flux=%pi*d/P*l*avgflux
14 Ea=flux*n*Z/60*P/A
15 Pm=Ea*Ia
16 disp(Pm)
17 T=Pm/2/%pi/n*60
18 disp(T)
```

Scilab code Exa 10.2 Problem2

```
P=4
A=4
ra=0.145
l=0.21
Z=2*33*11
K=Z*P/2/%pi/A
disp(K)

Ap=2*%pi*ra/P*0.7*l
Barc=0.8
flux=Ap*Barc
n=1200
Ea=K*flux*2*%pi*n/60
disp(Ea)

Ia=240
Ic=Ia/A
disp(Ic)

T=K*flux*Ia
disp(T)
Pg=Ea*Ia
disp(Pg)
```

Scilab code Exa 10.3 Problem3

```
P=5000
Vt=215
n=1000
Ra=0.4
Ia=P/Vt
Eag=Vt+Ra*Ia
Eam=Vt-Ra*Ia
```

```
8 newn=Eam/Eag*n/1.1
9 disp(newn)
```

Scilab code Exa 10.4 Problem4

```
1 P=200000
2 V=400
3 n=600
4 Z=864
5 Pl=8000
6
7 Ia=P/V
8 Ra=Pl/Ia/Ia
9 Ea=V-Ia*Ra
10 flux=Ea*60/n/Z
11 disp(flux)
```

Scilab code Exa 10.5 Problem5

```
1 N=1800
2 ///////from figure
3 Voc=250
4 If=4.1
5 Rf=Voc/If
6 disp(If)
7 disp(Rf)
8
9 Rfcrit=150/2
10 disp(Rfcrit)
11
12 V3=120
13 Ncrit=N*V3/150
14 disp(Ncrit)
```

```
15
16 Rf220=220/3.2
17 Rext=Rf220-Rf
18 disp(Rext)
```

Scilab code Exa 10.6 Problem6

```
1  P=4
2  V=230
3  Z=888
4  Ra=0.8
5  flux=5.4E-3
6  A=2
7
8  Il=2
9  If=0.6
10 Ia=Il-If
11 Ea=V-Ia*Ra
12 n0=Ea*60/flux/Z/P*A
13 disp(n0)
14
15 T=29.6
16 Ia=T*2*%pi/flux/Z/P*A
17 Il=Ia+If
18 disp(Il)
19 Ea=V-Ra*Ia
20 n=Ea*60/flux/Z/P*A
21 disp(n)
22 sr=(1-n/n0)*100
23 disp(sr)
```

Scilab code Exa 10.7 Problem7

```
n1=1000
V=230
Ia=75
Ra=0.1
Ea1=V-Ia*Ra
Rf=275
If=V/Rf
Ke=Ea1/If/n1

n2=1200
Ia=125
Ea2=V-Ia*Ra
If2=Ea2/Ke/n2
Rf2=V/If2
Rfext=Rf2-Rf
disp(Rfext)
```

Scilab code Exa 10.8 Problem8

```
V=115
Ia1=25
Ra=0.3

n1=1450
Ea1=V-Ia1*Ra
Ke=Ea1/n1

n2=1200
Ea2=Ke*n2
Ia2=3/4*Ia1
Raext=(V-Ea2)/Ia2-Ra
disp(Raext)
effia=Ea2/V*100      ///calculation mistake in the
   book at this point
disp(effia)
```

```
16 V=Ea2+Ia2*Ra
17 effia=Ea2/V*100
18 disp(effia)
```

Scilab code Exa 10.9 Problem9

```
1  /////solving quadratic
2  Ra=0.5
3  P=8000
4  V=230
5  Ea=V
6  n=1200
7  Ke=V/n
8
9  p=poly([P*Ra,-V,1],"w","coeff")
10 w=roots(p)
11
12 Ea=w(1)      ///rejecting small value
13 n=Ea/Ke
14 disp(n)
15 T=P/2/%pi/n*60
16 disp(T)
17 Ia=(V-Ea)/Ra
18 disp(Ia)
19 Kt=T/Ia
20
21
22 p=poly([-Kt*V/Ra,Kt*Ke/Ra,0.6E-4],"w","coeff")
23 w=roots(p)
24 n=w(2)
25 disp(n)
```

Scilab code Exa 10.10 Problem10

```
V=300
Ea=V
n1=1200
n2=1100
Kaphi=Ea/2/%pi/n1*60

T=350
Ia=T/Kaphi
disp(Ia)
Ea=V*n2/n1
Pm=Ea*Ia
disp(Pm)

Ra=(V-Ea)/Ia
disp(Ra)

disp(T)
Ea=600-Ia*Ra
n=Ea*60/Kaphi/2/%pi
Pm=Ea*Ia
disp(Pm)
disp(n)
```

Scilab code Exa 10.11 Problem11

```
V=300
Ea=V
n1=1200
n2=1100
Kaphi=Ea/2/%pi/n1*60

T=350
Ia=T/Kaphi
Ea=V*n2/n1

```

```
11 Ra=(V-Ea)/Ia
12
13
14 Kaphi=Kaphi/2
15 n=Ea/Kaphi*60/2/%pi
16 Pm=Ea*Ia
17 T=Kaphi*Ia
18 disp(T)
19 disp(Pm)
20 disp(n)
```

Scilab code Exa 10.12 Problem12

```
1 V=600
2 Ia=40
3 R=0.5
4 Ea=V-Ia*R
5 n=500
6 Ka=Ea/Ia/2/%pi/n*60
7 T=Ka*Ia*Ia
8
9 n2=450
10 T=T*n2*n2/n/n
11 Ia=sqrt(T/Ka)
12 Ea=Ka*Ia*2*%pi*n2/60
13 Rtotal=(V-Ea)/Ia
14 Rext=Rtotal-R
15 disp(Rext)
```

Scilab code Exa 10.13 Problem13

```
1 V=220
2 Ra=1
```

```
3 Rse=0.4
4 Ia1=20
5 Ia2=sqrt(Ia1*Ia1*0.7*0.7*0.7)
6 Ea1=V-Ia1*(Ra+Rse)
7 Ea2=Ia2*0.7*Ea1/Ia1
8 Rext=(V-Ea2)/Ia2-Ra-Rse
9 disp(Rext)
```

Scilab code Exa 10.14 Problem14

```
1 V=250
2 Ia=25
3 n=1000
4 KaNfNse=V/Ia*60/2/%pi/n
5 T=KaNfNse*Ia*Ia
6 Ia=sqrt(V*2/KaNfNse/sqrt(KaNfNse*2*%pi*n/60*2*%pi*n
     /60/T/2))
7 w=sqrt(KaNfNse*2*%pi*n/60*2*%pi*n/60/T/2)*Ia
8 n=w*60/2/%pi
9
10 disp(n)
11 disp(Ia)
```

Scilab code Exa 10.15 Problem15

```
1 V=230
2 Rf=120
3 Ra=0.15
4 If=V/Rf
5 Psh=V*V/Rf
6
7 I=14.5
8 Pin=I*V
```

```
Ia=I-If
Pk=Pin-Ia*Ia*Ra

I=215
Ia=I-If
Pl=Ia*Ia*Ra+Pk
Pin=V*I
effi=(Pin-Pl)/Pin
disp(effi)

Ia=sqrt(Pk/Ra)
Il=Ia+If
Pl=2*Pk
Pin=V*Il
effi=(Pin-Pl)/Pin
disp(effi)
```

Scilab code Exa 10.16 Problem16

```
V=250
Rf=125
Ra=0.2
If=V/Rf
I=16
Ia0=I-If
Pk=V*Ia0-Ia0*Ia0*Ra+V*If

I=152
Ia=I-If
Pl=Ia*Ia*Ra+Pk
Pin=V*I
effi=(Pin-Pl)/Pin
disp(effi)

Il=152
```

```
17 Ia=Il+If
18 Pl=Ia*Ia*Ra+Pk
19 Pout=V*Il
20 effi=Pout/(Pout+Pl)
21 disp(effi)
```

Scilab code Exa 10.17 Problem17

```
1  V=250
2  n=800
3  Ra=0.15
4  Rse=0.1
5  R=Ra+Rse
6
7  Ia1=120
8  Ea1=V-Ia1*R
9
10 Ia2=60
11 Ea2=V-Ia2*R
12 n2=Ea2/Ea1*n/0.7
13 disp(n2)
```

Scilab code Exa 10.18 Problem18

```
1  R=1.2
2  V=220
3  Ea35=V-35*R
4  n35=(475+400)/2
5
6  V=200
7  E0=V-35*(R+2)
8  n=n35*E0/Ea35
9  disp(n)
```

Scilab code Exa 10.19 Problem19

```
V=250
Ia=200
Ra=0.22

Ea=V-Ia*Ra
Pm=Ea*Ia
Prl=600
Pmout=Pm-Prl
n=1250
wm=2*%pi*n/60
Tl=Pmout/wm
disp(Tl)

Rf=125
Psh=V*V/Rf
Pein=V*Ia+Psh
effi=Pmout/Pein
disp(effi)
```

Scilab code Exa 10.20 Problem20

```
P=25000
n=1600
V=250
If=1.5
Rf=V/If
disp(Rf)

Ra=0.1
```

```
9  V=220
10 Ia=P/V
11 Ea=V-Ia*Ra
12 If=0.875
13 disp(If)
14 Rf=V/If
15 disp(Rf)
16
17 Pdev=Ea*Ia
18 disp(Pdev)
19 Tdev=Pdev/2/%pi/n*60
20 disp(Tdev)
```

Scilab code Exa 10.21 Problem21

```
1
2  V=230
3  Ea=210
4  Ia=40
5  Ra=(V-Ea)/Ia
6  disp(Ra)
7
8  Pdev=Ea*Ia
9  n=1200
10 wm=2*%pi*n/60
11 Tdev=Pdev/wm
12 disp(Pdev)
13 disp(Tdev)
14
15 n=n*V/Ea
16 disp(n)
```

Scilab code Exa 10.22 Problem22

```
V=400
Ia=50
n=500
Ra=0.5
Ea=V-Ia*Ra
Tdev=Ea*Ia/2/%pi/n*60

Iastart=75
Rs=V/Iastart-Ra
disp(Rs)
Tstart=Tdev*(Iastart/Ia)^2
disp(Tstart)

n2=200
Ea200=Ea*n2/n
Rs=(V-Ea200)/Iastart-Ra
disp(Rs)
```

Scilab code Exa 10.23 Problem23

```
n1=1200
Rfcrit=260/4
n2=1600
Vfactor=n2/n2
Vnl=395
disp(Vnl)
```

Scilab code Exa 10.24 Problem24

```

Ia=500
Ra=0.05
Vb=2
```

```
5 Va=Ia*Ra+Vb
6 Vt=330
7 disp(Vt)
```

Scilab code Exa 10.25 Problem25

```
1 V=240
2 Ea=V
3 n=800
4 I=16
5 Ke=V/n/I
6 K=I/n
7
8 n=sqrt(V*2/Ke/K/sqrt(2))
9 disp(n)
10 Ia=sqrt(2)*K*n
11 disp(Ia)
```

Scilab code Exa 10.26 Problem26

```
1 V=600
2 Pout=60000
3 effi=0.85
4 Pin=Pout/effi
5 Il=Pin/V
6 Rf=100
7 If=V/Rf
8 Ia=Il-If
9 Ra=0.16
10 Ea=V-Ia*Ra
11
12 n=900
13 n0=n*V/Ea
```

```
14 sr=n0/n-1
15 disp(n0)
16 disp(sr)
17
18 TL=Pin-Pout
19 Pcu=Ia*Ia*Ra
20 Psh=If*If*Rf
21 Prl=TL-Pcu-Psh
22 disp(Prl)
```

Chapter 11

Synchronous Machine

Scilab code Exa 11.1 Problem1

```
P=1000000
Vrated=6600
If=60
Xs_unsat=4700/sqrt(3)/98
disp(Xs_unsat)
Xs_adj=Vrated/sqrt(3)/143
disp(Xs_adj)

Ia=P/sqrt(3)/Vrated
pf=0.8
theta=-acos(pf)
Ia=Ia*(exp(%i*theta))
Ef=norm(Vrated+%i*Xs_adj*Ia*sqrt(3))
disp(Ef)
VR=Ef/Vrated-1
disp(VR)
```

Scilab code Exa 11.2 Problem2

```
P=45000
V=440
pf=0.8
Ia=P/sqrt(3)/V*exp(%i*acos(pf))
Vt=V/sqrt(3)
Rs=0.2
Xs=1.8
Ef=norm(Vt-Ia*(Rs+%i*Xs))
If=Ef/85
Pein=pf*P
Rf=35
Fl=If*If*Rf
Pin=Pein+Fl
Pcu=norm(3*Ia*Ia*Rs)
Pshaft=Pein-Pcu
Prl=1500
Pshaft_net=Pshaft-Prl
effi=Pshaft_net/Pin

disp(Pshaft_net)
disp(If)
disp(effi)
```

Scilab code Exa 11.3 Problem3

```
V=12500
Xs=8

Vt=V/sqrt(3)
Ef=Vt

Ef=Vt*1.2
Ia=(Ef-Vt)/Xs
theta=%pi/2
pf=0
```

```
Pe=0
Qe=-sqrt(3)*V*Ia
disp(Ia)
disp(Pe)
disp(Qe)
disp(pf)

Ef=Vt*0.8
Ia=(Vt-Ef)/Xs
theta=-%pi/2
pf=0
Pe=0
Qe=sqrt(3)*V*Ia
disp(Ia)
disp(Pe)
disp(Qe)
disp(pf)
```

Scilab code Exa 11.4 Problem4

```
Pe=10000000
V=12500
Xs=8
Vt=V/sqrt(3)
Ef=Vt*1.2

delta=asin(Pe/3/Vt/Ef*Xs)
Ia=(Ef*exp(%i*delta)-Vt)/%i/Xs
pf=real(Ia)/norm(Ia)
Qe=-sqrt(3)*V*imag(Ia)

disp(norm(Ia))
disp(pf)
disp(Qe)
```

Scilab code Exa 11.5 Problem5

```
1
2 Pein=1000000
3 pf=0.9
4 Xs=3.24
5 theta=acos(pf)
6 V=3300
7 Ia=Pein/sqrt(3)/pf/V*exp(%i*theta)
8 Vt=V/sqrt(3)
9 Ef=norm(Vt-%i*Ia*Xs)
10 Pemax=3*Vt*Ef/Xs
11 Ia=(Vt+Ef*%i)/%i/Xs
12 Qe=-sqrt(3)*V*imag(Ia)
13
14 disp(Pemax)
15 disp(norm(Ia))
16 disp(real(Ia)/norm(Ia))
17 disp(Qe)
```

Scilab code Exa 11.6 Problem6

```
1 Pe=20000
2 Pm=20000
3 V=400
4 pf=0.8
5 Xs=4.5
6 Ia=Pm/sqrt(3)/V/pf*exp(%i*acos(pf))
7 Vt=V/sqrt(3)
8 Ef=Vt-%i*Ia*Xs       ///calculation mistake in the
    book at this step
9 Efline=norm(Ef)*sqrt(3)
```

```
10 disp(Efline)
11 disp(atan(imag(Ef)/real(Ef)))
12
13 delta=-%pi/2
14 Efmin=Pe/3*Xs/Vt*sin(-delta)
15 Efminline=Efmin*sqrt(3)
16 disp(Efminline)
17 disp(delta/%pi*180)
18 Ia=(Vt+%i*Efmin)/%i/Xs
19 disp(norm(Ia))
20 disp(real(Ia)/norm(Ia))
```

Scilab code Exa 11.7 Problem7

```
1 f=50
2 ns=100
3 P=110000
4 pf=0.8
5
6 p=120*f/ns
7 disp(p)
8 kVA=P/pf/1000
9 disp(kVA)
10 kW=P/0.971/1000
11 disp(kW)
12 Tpm=kW*1000*60/2/%pi/ns
13 disp(Tpm)
```

Scilab code Exa 11.8 Problem8

```
1 P=12E6
2 Q=6E6
3 V=22000
```

```
4  Xs=8
5  S=P+%i*Q
6  theta=atan(Q/P)
7  disp(theta/%pi*180)
8
9  Ia=norm(S)/sqrt(3)/V
10 Ef=V/sqrt(3)+%i*Xs*Ia*exp(-%i*theta)
11 delta=atan(imag(Ef)/real(Ef))
12 disp(delta/%pi*180)
13
14 emf=norm(Ef)*sqrt(3)
15 disp(emf)
```

Scilab code Exa 11.9 Problem9

```
1  Isc=60
2  If=50
3
4  Voc=15300
5  Isc=60
6  Xs_unsat=Voc/sqrt(3)/Isc
7  disp(Xs_unsat)
8
9  V=11000
10 Isc=67.5
11 Xs_sat=V/sqrt(3)/Isc
12 disp(Xs_sat)
13
14 pf=0.85
15 theta=acos(pf)
16 Ia=50*exp(-%i*theta)
17 Vt=11000
18 Vl=Vt/sqrt(3)
19 Ef=Vl+%i*Xs_sat*Ia
20 Efline=norm(Ef)*sqrt(3)
```

```
21 disp(Efline)
22
23 Voc=Efline
24 VR=Voc/Vt-1
25 disp(VR)
26 If=57.5
27 disp(If)
```

Scilab code Exa 11.10 Problem10

```
1  P=10000
2  V=400
3  pf=0.8
4  Xs=16
5  theta=acos(pf)
6  Ia=P/sqrt(3)/V*exp(-%i*theta)
7  Vt=V/sqrt(3)
8  Ef=Vt+%i*Xs*Ia
9  disp(norm(Ef))
10 disp(atan(imag(Ef)/real(Ef))*180/%pi)
11
12 Ef2=1.2*norm(Ef)
13 Pe=P*pf
14 delta=asin(norm(Pe/3*Xs/Ef2/Vt))
15 Ef2=Ef2*exp(%i*delta)
16 Ia=(Ef2-Vt)/%i/Xs        //calculation mistake in the
       book at this point
17 disp(norm(Ia))
18 pf=real(Ia)/norm(Ia)
19 disp(pf)
20 disp(acos(pf)*180/%pi)
21
22 delta=%pi/2
23 Pemax=norm(3*Ef*Vt/Xs*sin(delta))
24 disp(Pemax)
```

```
25 Ef=norm(Ef)*%i
26 Ia=(Ef-Vt)/%i/Xs
27 disp(norm(Ia))
28 disp(real(Ia)/norm(Ia))
```

Scilab code Exa 11.11 Problem11

```
1  f=50
2  MechLoad=(8+0.5)*1000
3  Pein=MechLoad
4  Vt=231
5  Ef=750/sqrt(3)
6  Xs=16
7  delta=asin(Pein/3*Xs/Ef/Vt)
8  Ef=Ef*exp(-%i*delta)
9  Ia=(Vt-Ef)/%i/Xs
10 ns=120*50/4
11 ws=ns/60*2*%pi
12 Tdev=Pein/ws
13 Tshaft=8000/ws
14 disp(norm(Ia))
15 disp(real(Ia)/norm(Ia))
16 disp(acos(real(Ia)/norm(Ia))*180/%pi)
17 disp(Tdev)
18 disp(Tshaft)
19
20 Ef=600/sqrt(3)
21 delta=0
22 Ia=(Vt-Ef)/%i/Xs
23 kVAR=sqrt(3)*400*norm(Ia)
24 disp(norm(Ia))
25 disp(real(Ia)/norm(Ia))
26 disp(kVAR)
27 C=norm(Ia)/Vt/2/%pi/f
28
```

```
Ef=300/sqrt(3)
Ia=(Vt-Ef)/%i/Xs
kVAR=sqrt(3)*400*norm(Ia)
disp(norm(Ia))
disp(real(Ia)/norm(Ia))
disp(kVAR)
L=Vt/norm(Ia)/2/%pi/f

kVAR=6000
Ia=kVAR/sqrt(3)/400*%i
Ef=Vt-%i*Xs*Ia
disp(Ef*sqrt(3))
```

Scilab code Exa 11.12 Problem12

```
P=1000000
V=6600
Xs=25
pf=0.8
theta=acos(pf)
Ia=P/sqrt(3)/V*exp(-%i*theta)
Vt=V/sqrt(3)
Ef=Vt+%i*Xs*Ia
delta=asin(norm(Xs*Ia*cos(theta)/Ef))
Vt=norm(Ia)*Xs*sin(%pi-asin(pf)-delta)/sin(delta)
Vl=Vt*sqrt(3)
disp(Vl)
```

Scilab code Exa 11.13 Problem13

```


Xs=8
```

```
4  Ia=40
5  V=600
6  Vt=V/sqrt(3)
7  Ef=V
8
9  delta=acos((1-(Xs*Ia/V)^2+(Vt/V)^2)/2/Vt*V)
10 theta=-atan((cos(delta)-Vt/V)/sin(delta))
11 pf=cos(theta)
12 Pout=sqrt(3)*V*pf*Ia
13 disp(Pout)
14
15 theta=-theta
16 Pin=Pout
17 disp(Pout)
```

Scilab code Exa 11.14 Problem14

```
1
2  V=400
3  Vt=V/sqrt(3)
4  Ia=50
5  pf=1
6  theta=0
7  Xs=1.3
8
9  Ef=Vt-%i*Xs*Ia
10 delta=atan(imag(Ef)/real(Ef))
11 disp(delta*180/%pi)
12
13 Pelec=sqrt(3)*V*pf*Ia
14 Pmech=Pelec
15 pf=0.8
16 theta=acos(0.8)
17 Ia=Pelec/sqrt(3)/V/pf*exp(%i*theta)
18 Ef2=Vt-%i*Xs*Ia
```

```
19 If=0.9*norm(Ef2)/norm(Ef)
20 disp(If)
```

Scilab code Exa 11.15 Problem15

```
1  Xspu=0.8
2  P=1000000
3  V=3000
4  Xs=Xspu*V*V/P
5
6  Vt=V/sqrt(3)
7  Pm=750000
8  Pe=Pm
9  pf=0.85
10 theta=acos(pf)
11 Ia=Pm/0.8/sqrt(3)/V*exp(-%i*theta)
12
13 Ef=Vt-%i*Xs*Ia
14 Efline=sqrt(3)*norm(Ef)
15 disp(Efline)
16
17 delta=%pi/2
18 Pmax=3*Vt*norm(Ef)/Xs
19 disp(Pmax)
20 ns=120*50/12
21 ws=ns*2*%pi/60
22 Tmax=Pmax/ws          //////calculation mistake in the
       book at this point
23 disp(Tmax)
24
25 delta=90
26 Efmin=Pm/3*Xs/Vt
27 Efmin_line=sqrt(3)*Efmin
28 disp(Efmin_line)
29
```

```
30 Ia=(Vt+%i*Efmin)/%i/Xs
31 disp(norm(Ia))
32 pf=real(Ia)/norm(Ia)
33 disp(pf)
```

Chapter 12

Induction Motor

Scilab code Exa 12.1 Problem1

```
1  V=400
2  I=80
3  pf=0.75
4  Pin=sqrt(3)*V*I*pf
5  Pshaft=Pin*0.85
6  disp(Pshaft)
7  ns=1000
8  s=0.04
9  n=(1-s)*ns
10 w=2*%pi*n/60
11 Tshaft=Pshaft/w
12 disp(Tshaft)
```

Scilab code Exa 12.2 Problem2

```
1  f=50
2  f2=120/60
3  s=f2/f
```

```
4  ns=1500
5  n=(1-s)*ns
6  w=2*%pi*n/60
7
8  T=100
9  Pshaft=T*w
10 disp(Pshaft)
11 Pm=(T+7)*w
12 Pcur=Pm*s/(1-s)
13 disp(Pcur)
14 Pin=Pm+Pcur+700
15 disp(Pin)
16 effi=Pshaft/Pin
17 disp(effi)
```

Scilab code Exa 12.3 Problem3

```
1
2  ns=120*50/20
3  sfl=1-292.5/ns
4
5  R2=0.12
6  X2=1.12
7  smaxT=R2/X2
8  disp(smaxT)
9
10 Tmax_by_Tfl=0.5/X2/(R2/sfl/((R2/sfl)^2+X2^2))
11 disp(Tmax_by_Tfl)
```

Scilab code Exa 12.5 Problem5

```
1
2  ns=750
```

```
3  R2=0.5
4  X2=5
5  smaxT=R2/X2
6  n=(1-smaxT)*ns
7  disp(n)
8
9  k=R2/X2
10 Tmax_by_Tstart=(1+k*k)/2/k
11 disp(Tmax_by_Tstart)
12
13 p=poly([1,-4,1],"k","coeff")
14 w=roots(p)
15 R2=w*5
16 R2ext=R2-0.5
17
18 R2total=18.66
19 smaxT=R2total/X2
20 R2ext=R2ext(2)
21 disp(R2ext)
```

Scilab code Exa 12.6 Problem6

```
1
2  Tmax=200
3  Tstart=80
4
5  p=poly([1,-2*Tmax/Tstart,1],"smaxT","coeff")
6  smaxT=roots(p)
7  smaxT=smaxT(2)
8  disp(smaxT)
9
10
11 p=poly([1,-4,1],"w","coeff")
12 w=roots(p)
13 sfl=smaxT/w(1)
```

```
14 disp(sfl)
15
16 ratio=sqrt(((smaxT/sfl)^2+1)/(smaxT^2+1))
17 disp(ratio)
18
19 p=poly([1,-((smaxT/sfl)^2+1)*sfl,smaxT^2],"k","coeff
   ")
20 k=roots(p)
21 k=k(2)
22 disp(k)
```

Scilab code Exa 12.7 Problem7

```
1  V=440
2  ns=1000
3  ws=2*%pi*ns/60
4  n=975
5  s=1-n/ns
6  Z=1.06+0.576/s+%i*(1.68+0.75)
7  I2=V/sqrt(3)/Z
8  Im=-%i*V/sqrt(3)/44.2
9  I1=Im+I2
10 pf=real(I1)/norm(I1)
11 Pin=sqrt(3)*V*norm(I1)*pf
12 Pout=norm(3*I2*I2*0.576*(1/s-1))-415
13 effi=Pout/Pin
14 Tnet=Pout/ws/(1-s)
15
16 disp(Tnet)
17 disp(Pin)
18 disp(norm(I1))
19 disp(pf)
20 disp(effi)
```

Scilab code Exa 12.8 Problem8

```
V=400
P0=1210
I0=8.7
Ri=(V/sqrt(3))^2/P0*3
disp(Ri)
pf=P0/sqrt(3)/V/I0
theta0=acos(pf)
Xm=Ri/tan(theta0)
disp(Xm)

P1=6050
V1=200
I1=47.8
R=P1/3/I1/I1
R1=0.42
disp(R1)
R2=R-R1
disp(R2)
Z=V1/sqrt(3)/I1
X=sqrt(Z*Z-R*R)
disp(X)

ns=750
n=710
ws=ns*2*%pi/60
s=1-n/ns
Z=R1+R2/s+%i*X
I2=V/sqrt(3)/Z
I0=I0*exp(-%i*theta0)
I1=I0+I2
disp(norm(I1))
pf=real(I1)/norm(I1)
```

```
33 disp(pf)
34 T=norm(3*I2*I2*R2/s/ws)
35 disp(T)
36 Pout=T*ws*(1-s)
37 Pin=sqrt(3)*V*norm(I1)*pf
38 effi=Pout/Pin
39 disp(effi)
40
41 s=1
42 Z=R+%i*X
43 I2=V/sqrt(3)/Z
44 I1=I0+I2
45 disp(norm(I1))
46 Tstart=norm(3*I2*I2*R2/s/ws)
47 disp(Tstart)
48
49 smaxT=R2/sqrt(R1^2+X^2)
50 Z=R1+R2/smaxT+%i*X
51 I2=V/sqrt(3)/norm(Z)
52 Tmax=3*I2*I2*R2/smaxT/ws
53 disp(Tmax)
54 disp(smaxT)
```

Scilab code Exa 12.9 Problem9

```
1 Is_by_Ifl=5
2 sfl=0.04
3 Ts_by_Tfl=Is_by_Ifl^2*sfl
4 disp("pu",Ts_by_Tfl)
```

Scilab code Exa 12.10 Problem10

```
1
```

```
2 R2=0.5
3 X2=5
4 Tm_by_Tfl=3.5
5
6 Ts_by_Tfl=R2*Tm_by_Tfl*2*X2/(R2^2+X2^2)
7 disp(Ts_by_Tfl)
8
9 Ts_by_Tfl2=Ts_by_Tfl/3
10 disp(Ts_by_Tfl2)
11
12 Ts_by_Tfl3=0.7*0.7*Ts_by_Tfl          //calculation
     mistake in the book at this point
13 disp(Ts_by_Tfl3)
```

Scilab code Exa 12.11 Problem11

```
1
2 s1=1-960/1000
3 s2=1-800/1000
4 R2ext=4/3*s2*0.25/s1-0.25
5 disp(R2ext)
```

Scilab code Exa 12.12 Problem12

```
1
2 smaxT=1-860/1000
3 R2=0.25
4 X2=R2/smaxT
5 Tmax=180
6 k=Tmax*X2
7
8 s=0.045
```

```
T=2*100.6/((R2/s)^2+X2^2)*R2/s    //some mistake in
    the book at this point. (What is V1/a)
T=105
disp(T)

R2ext=X2-R2
disp(R2ext)
```

Scilab code Exa 12.13 Problem13

```
V=400
Poutmech=5000
Prl=285
Pm=Poutmech+Prl
s=1-1445/1500
s2=1-900/1500



p=poly([0,-(1-s)*V*V/Pm/s,1/s/s+1/s2/s2],"R2","coeff
    ")
r=roots(p)
R2=r(1)
X2=R2/s2

ws=2*%pi*1500/60
Tmax=3/ws*V*V/3*0.5/X2
disp(Tmax)
```

Scilab code Exa 12.14 Problem14

```
Pmout=20000
Pwfl=1500
```

```
Pm=Pmout+Pwfl
disp(Pm)
ns=1500
n=1440
s=1-n/ns
Pg=Pm/(1-s)
disp(Pg)
Pcu=s*Pg
disp(Pcu)
```

Scilab code Exa 12.15 Problem15

```
V1=400
R1=2.28*3/2
R1ac=1.1*3.42

Y0=3.5/sqrt(3)/V1
Gi=(445/3)/V1/V1
Bm=sqrt(Y0^2-Gi^2)
Ri=1/Gi
Xm=1/Bm

V2=200
Z=V2/16.7*sqrt(3)
R=2220/16.7/16.7
X=sqrt(Z*Z-R*R)
R2=R-R1ac

n=935
ns=1000
s=1-n/ns
Z=R1ac+R2/s+%i*X
I2=V1/Z
Ii=V1/Ri-%i*V1/Xm
I1=I2+Ii
```

```
24 Iline=norm(I1)*sqrt(3)
25 pf=real(I1)/norm(I1)
26 ws=2*%pi*ns/60
27 T=norm(3*I2*I2*R2/s/ws)
28 disp(T)
29 disp(Iline)
30
31 Pm=norm(3*I2*I2*R2*(1-s)/s)
32 Pin=sqrt(3)*V1*Iline*pf
33 effi=Pm/Pin
34 disp(effi)
35
36 V=400
37 s=1
38 Z=R1ac+R2/s+%i*X
39 I2=V/sqrt(3)/Z      ////calculation mistake in the
      book at this step
40 Ts=norm(3*I2*I2*R2/ws)
41 disp(Ts)
```

Scilab code Exa 12.16 Problem16

```
1 V=400
2 Pmout=5000
3 Prl=285
4 Pm=Pmout+Prl
5
6 s=1-1445/1500
7 smaxT=1-900/1500
8 R2=(1/s-1)*V*V/Pm/(1/s^2+1/smaxT^2)
9 X2=R2/smaxT
10 ws=2*%pi*1500/60
11 Tmax=V*V/ws/2/X2
12 disp(Tmax)
```

Scilab code Exa 12.17 Problem17

```
1  V=440
2  I=25
3  pf=0.85
4  Pin=sqrt(3)*V*I*pf
5  ns=1500
6  Pcore=750
7  Pcus=950
8  Pcur=450
9  Pwfl=250
10
11 Pg=Pin-Pcore-Pcus
12 disp(Pg)
13
14 Pm=Pg-Pcur
15 disp(Pm)
16
17 Pmout=Pm-Pwfl
18 disp(Pmout)
19
20 effi=Pmout/Pin
21 disp(effi)
22
23 s=Pcur/Pg
24 n=(1-s)*ns
25 disp(n)
26
27 w=2*%pi*n/60
28 Tdev=Pm/w
29 disp(Tdev)
30 Tnet=Pmout/w
31 disp(Tnet)
```

Chapter 14

Measurement Techniques and Electric and Electronic Instrumentation

Scilab code Exa 14.1 Problem1

```
1 Rv1=60/1000*10000
2 Rv2=120/1000*10000
3 Rx=(Rv2-Rv1)*(1/(27.5/30*2-1)-1)
4 I=27.5/1000/600*(Rx+600)/Rx
5 Vact=Rx*I
6 disp(Vact)
```

Scilab code Exa 14.2 Problem2

```
1
2 Ifsd=25/1000
3 Ix=4.975
4 Rx=Ifsd*5/Ix
5 disp(Rx)
```

```
6
7 Rx=20/Ifsd-5
8 disp(Rx)
```

Scilab code Exa 14.3 Problem3

```
1
2 R1=40/0.025-5
3 R2=60/0.025-5-R1
4 disp(R1)
5 disp(R2)
```

Scilab code Exa 14.4 Problem4

```
1
2 W1=500
3 W2=-200
4 P=W1+W2
5 phi=atan((W1-W2)/(W1+W2))
6 pf=cos(phi)
7 disp(pf)
8 disp(P)
```

Scilab code Exa 14.5 Problem5

```
1
2 E=4
3 R1=800
4 R2=80
5 R3=1605
```

```
R4=160
Rg=80
s=8

Eth=E*(R2/(R2+R4)-R1/(R1+R3))
Rth=R1*R3/(R1+R3)+R2*R4/(R2+R4)
Ig=Eth/(Rth+Rg)
D=s*Ig*1000000
disp(D)
```

Scilab code Exa 14.6 Problem6

```
function Zeq=parallel(Z1,Z2)
    Zeq=Z1*Z2/(Z1+Z2)
endfunction

f=1000
w=2*%pi*f

///AB
R=2000
C=0.045E-6
Xc=1/%i/w/C
Z1=parallel(R,Xc)

////BC
R=1000
C=0.45E-6
Xc=1/%i/w/C
Z2=R+Xc

////AD
C=0.4E-6
Z3=1/%i/w/C

```

```
24 Z4=Z2*Z3/Z1
25 disp(Z4)
```

Scilab code Exa 14.7 Problem7

```
1
2 ksine=1.11
3 ksqr=1
4
5 err=(ksine-ksqr)/ksqr*100
6 disp("percent",err)
```

Scilab code Exa 14.8 Problem8

```
1
2 f=50E6
3 w=2*%pi*f
4 theta=5*%pi/180
5
6
7 C=1E-12
8 R=1/theta/w/C
9 disp(R)
10
11 C=10E-12
12 R=1/theta/w/C
13 disp(R)
14
15 C=100E-12
16 R=1/theta/w/C
17 disp(R)
```

Scilab code Exa 14.9 Problem9

```
1
2 f=8E6
3 w=2*%pi*f
4 C=150E-12
5 R=5
6
7 Q1=1/w/C/R
8
9 Rins=0.1
10 Q2=1/w/C/(R+Rins)
11 err=(Q1-Q2)/Q1*100
12 disp(err)
```

Scilab code Exa 14.10 Problem10

```
1 f=100E3
2 w=2*%pi*f
3 C=400E-12
4
5 L=1/C/w/w
6 disp(L)
```

Scilab code Exa 14.11 Problem11

```
1
2 Resolution=1/10^4
3 disp(Resolution)
```

```
4
5 disp("14.760")
6
7 R_1V=1*Resolution
8 disp("0.5434")  ///since any digits upto 4th decimal
      can be shown
9
10 R_10V=10*Resolution
11 disp("00.543")  ///since only three decimal digits
     can be shown
```

Scilab code Exa 14.12 Problem12

```
1
2 Vp=10
3 Vref=5
4 R=100000
5 C=0.22E-6
6 T=Vp*R*C/Vref
7 disp(T)
```

Scilab code Exa 14.13 Problem13

```
1
2 V=3.217
3 bits=4
4 base=5
5 a=0
6
7 for i=1:bits
8     a=floor(V/base*(2^i))
9     disp(a);
10    V=V-a*base/(2^i)
```

```
11 end
```

Scilab code Exa 14.14 Problem14

```
1
2 reading=5
3 x=0.005/100*reading      //0.005% of reading
4 err=x+1E-6      //final digit
5 disp("seconds",err)
6
7 reading=500
8 x=0.005/100*reading      //0.005% of reading
9 err=x+1      //final digit
10 disp("seconds",err)
```

Scilab code Exa 14.15 Problem15

```
1 V=5.9
2 Rx=0
3 Rm=2000
4 R1=49000
5 Ifsd=100E-6
6 Vam=Rm*Ifsd
7 I=(V-Vam)/R1
8 Ish=I-Ifsd
9 R2=Vam/Ish
10 disp(R2)
11
12 I=0.6*I
13 Req=V/I
14 Rx=Req-R1-Rm*R2/(R2+Rm)
15 disp(Rx)
```

Scilab code Exa 14.17 Problem17

```
f=50
w=2*%pi*f

Z2=1000
Z3=16800

C=0.38E-6
Xc=1/%i/w/C
Z4=833+Xc

Z1=Z2*Z3/Z4
Rx=real(Z1)
Lx=imag(Z1)/w

disp(Rx)
disp(Lx)
```

Scilab code Exa 14.18 Problem18

```
f=50
w=2*%pi*f
T=1/f

Iav=1/(T/2)*integrate('sin(w*t)','t',0,T/2)
disp(Iav)
```

Chapter 15

Power Systems

Scilab code Exa 15.1 Problem1

```
1 V1=250
2 V2=480
3 Vol2_by_Vol1=V1/V2
4
5 sav=(1-Vol2_by_Vol1)*100
6 disp(sav)
```

Scilab code Exa 15.2 Problem2

```
1 P=5E6
2 pf=0.85
3 V=33000
4 l=50000
5 rho=3E-8
6 Pt=P*pf
7 Pl=Pt*0.1
8 I=P/V
9 A1=2*I*I*rho*l/Pl
```

```
Vol1=2*l*A1
disp(Vol1)

Il=P/sqrt(3)/V
A2=3*Il*Il*rho*l/Pl
Vol2=3*l*A2
disp(Vol2)
```

Scilab code Exa 15.3 Problem3

```
f=50
w=2*%pi*f
I=0.8
V=220
P=75
phi=acos(P/V/I)

phi_new=acos(0.9)
Ic=I*cos(phi)*(tan(phi)-tan(phi_new))
C=Ic/V/w
disp(C)

phi_new=acos(1)
Ic=I*cos(phi)*(tan(phi)-tan(phi_new))
C=Ic/V/w
disp(C)
```

Scilab code Exa 15.4 Problem4

```
Cond_cost=100
charge=60
phi2=asin(0.1*Cond_cost/charge)
pf=cos(phi2)
```

```
5 disp(pf)
```

Scilab code Exa 15.5 Problem5

```
1
2 Oc=400000
3 pf1=0.8
4 phi1=acos(pf1)
5 ab=Oc/cos(phi1)*sin(phi1)
6 pf2=0.25
7 phi3=acos(pf2)
8 pf2=0.484
9
10 gammaa=(ab-pf2*Oc)/(pf2*cos(phi3)+sin(phi3))
11 disp(gammaa)
```

Scilab code Exa 15.6 Problem6

```
1 f=50
2 w=2*%pi*f
3 P=2E6
4 V=11000
5 pf=0.8
6 phi=acos(pf)
7 Xl=10
8 IR=P/sqrt(3)/V/pf
9 Vr=V/sqrt(3)
10 Vs=Vr+IR*Xl*sin(phi)
11 Vsll=Vs*sqrt(3)
12 disp(Vsll)
13 VR=Vsll/V-1
14 disp(VR)
15
```

```
16 pf=1
17 disp(pf)
18 Qc=P*tan(phi)
19 C=Qc/V/V/w
20 disp(C)
```

Scilab code Exa 15.7 Problem7

```
1  f=50
2  w=2*%pi*f
3  V=33000
4  Vr=V/sqrt(3)
5  P=24E6/3
6  pf=0.8
7  phi=acos(pf)
8  Ia=P/Vr/pf
9  Rl=4
10 Xl=20
11 Vs=Vr+Ia*(Xl*sin(phi)+Rl*cos(phi))
12 Vsll=sqrt(3)*Vs
13 VR=Vsll/V-1
14 disp(Vsll)
15 Ia=Ia*exp(-%i*phi)
16 disp(norm(Ia))
17
18 phi1=atan(-Rl/Xl)
19 pf=cos(phi1)
20 Ia1=P/Vr/pf
21 Ia1=Ia1*exp(-%i*phi1)        ////calculation mistake
      in the book at this step
22
23 Ic=Ia1-Ia
24 C=norm(Ic/w/Vr)
25 disp(C)
26
```

```
27 LL1=norm(Ia*Ia*Rl)
28 effi1=P/(P+LL1)
29 LL2=norm(Ia1*Ia1*Rl)
30 effi2=P/(P+LL2)
31 disp(effi1)
32 disp(effi2)
```