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

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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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List of Scilab Codes

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Chapter 1

Elementary Concepts and Definitions

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

```
1  t =0.1
2  R =800
3  i =50* exp ( -10* t ) /1000
4  v =50* cos (25* t )
5  v_i =10* t ^(2.5)
6
7  P1 = i * i * R
8  P2 = v * v / R
9  P3 = v_i
10
11 disp ( P3 , P2 , P1 )
```

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

```
1  v2 =5
2  i2 = v2 /1000
```

```
3  v1=-i2/5
4  vs=v1
5
6  disp(vs)
```

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

```
1  L=20/1000
2
3  ///////////////////////////
4  disp("Part1")
5  function i = i(t)
6      i = 8*exp(-100*t);
7  endfunction
8
9  t=10/1000
10  v= L*(derivative(i,t))
11  disp(v,"V=")
12
13  /////////////////////////Part2
14  disp("Part2")
15  t=0.1
16
17  function v=v(t)
18      v=6*exp(-12*t)
19  endfunction
20
21  i0=8
22
23  i2=1/L*intg(0,t,v)+i0
24  disp(i2)
25
26  /////////////////////////Part3
27  disp("Part3")
28  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
```

16

```
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`

```
1  Im =250/1000
2  w =100
3  r =4
4  L =50/1000
5  t =25/1000
6
7  i = Im * sin (w*t)
8  Vr = i * r
9  Vl = Im * L * w * cos (w*t)
10
11 Pr = i * i * r
12 Pl = Vl * i
13 wl =1/2* L * i * i
14 wl_min =0  // min current =0
15 wl_max =1/2* L * Im * Im  // Im is the max current
16
17 disp (" All values in Joules ")
18 disp ( wl_max , wl_min , wl , Pl , Pr )
```

Scilab code Exa 1.1 `Problem1`

```
1  disp (" v1=A cos (w t+p)")
2  disp (" i1=B cos (w1 t+p1)")
3  disp (" i2=C sin (w2 t+p2)")
4  disp (" All values in degrees ")
5  w = input (" w=")
6  p = input (" p=")
7  w1 = input (" w1=")
8  p1 = input (" p1=")
9  w2 = input (" w2=")
10 p2 = input (" p2=")
11
12 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`

```
1  G1=input ("G1=")
2  G2=input ("G2=")
3  G3=input ("G3=")
4  Is1=input ("Is1=")
5  Is2=input ("Is2=")
6
7  A=[G1+G3,-G3;-G3,G2+G3];
8  I=[Is1;Is2];
9  V=inv(A)*I;
10
11 disp(V)
```

Scilab code Exa 1.5 `Problem5`

```
1
2
3  R1=input ("R1=")
4  R2=input ("R2=")
5  R3=input ("R3=")
6  Vs1=input ("Vs1=")
7  Vs2=input ("Vs2=")
8
9  R=[R1+R3,-R3;-R3,R2+R3];
10 V=[Vs1;-Vs2];
11 I=inv(R)*V;
12
13 disp(I)
```

Scilab code Exa 1.7 `Problem7`

```
1  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`

```
1  v1 =6
2  i2 =2
3  i3 =4
4
5  v2 =2* i2
6  v3 =2* i3
7
8  v4 = -v1 +4* i2+v3 -v2  //KVL
9  i4 = v4 /3
10 disp ( i4 )
```

Scilab code Exa 1.11 `Problem11`

```
1  i1 =4 -1  // KCL  at  node  1
2  disp ( i1 ," i1=")
3
4  v1 = i1 *1
5  v12 =1*1
6  v2 = v1 - v12
7  i2 = v2 /1
8
9  i3 =1 - i2  //KCL  at  node  2
10
11 Vs = v2 -1* i3  //KVL
12 disp ( Vs ," Vs=")
```

Scilab code Exa 1.12 `Problem12`

22

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

Scilab code Exa 1.13 Problem13

```
1  vs =0.01  // * cos (1000* t )
2
3  vpi = vs
4  i0 = - vpi /1000
5  vo = i0 *1000;
6  printf (" v0 = %f * cos (1000* t )" , vo )
```

Scilab code Exa 1.15 Problem15

```
1  t =0.1
2  R =800
3  i =50* exp ( -10* t )/1000
4  v =50* cos (25* t )
5  v_i =10* t ^(2.5)
6
7  P1 = i * i * R
8  P2 = v * v / R
```

```
 9  P3=v_i
10
11  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`

```
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
3  endfunction
4
5
6  v=150
7
8  Req=1000*parallel(parallel(10,5),4)
9  i1=v/(2000+0.2*1000+Req)
10 v1=i1*0.2*1000
11 VReq=Req*i1
12 i2=VReq/4000
13
14 disp(v1)
15 disp(i2)
```

Scilab code Exa 2.5 `Problem5`

```
1  function [Rab,Rbc,Rca]=star_to_delta(Ra,Rb,Rc)
2      X=Ra*Rb+Rb*Rc+Rc*Ra
3      Rab=X/Rc
4      Rbc=X/Ra
5      Rca=X/Rb
6  endfunction
7
8  function p=parallel(r1,r2)
9      p=r1*r2/(r1+r2)
10 endfunction
11
12 [Rx,Ry,Rz]=star_to_delta(8,4,2)
13
14 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
```

```
6  A =[1/0.45+1/10 , -1/10  ;  0.2 -1/10 ,1/10 -0.2]
7  V =inv (A) *[ -18;5]
8
9  disp (V (2) )
```

Scilab code Exa 2.11 `Problem11`

```
1  // converting  voltage  source  to  current  source
2
3  I =240/3
4
5  // KCLs
6
7  A =[1/3+1/6 , -1/6; -1/6 ,1/6+1/12+1/30]
8  V =inv (A) *[70;5]
9  Vx =V (1)
10  Vy =V (2) -60
11
12  V6 =V (2) -V (1)
13  P6 =V6 *V6 /6
14
15  disp (P6)
```

Scilab code Exa 2.13 `Problem13`

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

```scilab
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
3  endfunction
4
5  //deactivate voltage source
6
7  i11=4*6/8
8  i21=4*2/8
9  v11=i11*2
10 v21=1*1
11
12 //deactivate current source
13 Req=parallel(2,7)
14
15 v22=8*Req/(2+Req)
16 v12=v22*(2/(2+5))
17
18 v1=v11+v12
19 v2=v21+v22
20
21 disp(v2,v1)
```

Scilab code Exa 2.22 Problem22

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

```
6  I=(32-8)/30
7  Voc=32-20*I
8  Ro=parallel(20,10)
9  disp(Ro,Voc)
10
11 //Norton Equivalent
12 Isc=32/20+8/10
13 disp(Ro,Isc)
```

Scilab code Exa 2.23 Problem23

```
1  //convert current source to voltage source
2  V=3.5*20
3
4  //KVL
5  I=100/(10+20+V)
6  Voc=100-10*I
7
8  //Finding Isc
9  I=100/10
10 Isc=(1+3.5)*I
11
12 Ro=Voc/Isc
13
14 disp(Ro,Voc)
```

Scilab code Exa 2.24 Problem24

```
1  V=32
2  I=1
3  R1=20
4  R2=8
5  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

```
1  //convert  current  source  to  voltage  source
2
3  V1=4*2
4  V2=2*2
5
6  //Mesh  Analysis
7
8  A=[7,-3;-15,19]
9  I=inv(A)*[6;-14]
10
11  Vx=3*(I(1)-I(2))
12  disp(Vx)
```

Scilab code Exa 2.27 Problem27

```
1  //Short  Circuit  AB  and  convert  Curr  Source  to  V
       source
2
3  V=9*5
4  Isc=(45-9)/6
5
6  function  p=parallel(r1,r2)
7      p=r1*r2/(r1+r2)
8  endfunction
9
10  Ro=parallel(5+1,3)
11  disp(Ro,Isc)
```

Scilab code Exa 2.28 Problem28

```
1  //Mesh  Analysis
2
3  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

```
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
3  endfunction
4
5  R1=parallel(5,40)+15
6  Req=parallel(R1,15)+10
7  i=6/(1000*Req)
8
9  ix=i*R1/(R1+15)
10 disp(ix)
11
12 P=i*i*10000   //////wrongly done in the book as ix*ix
       *10000
13 disp(P)
```

Scilab code Exa 2.39 Problem39

```
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
3  endfunction
4
5  R1=parallel(1,3)
6
7  //convert current source to voltage
8  V=20/1000*2000
9  I=(40-8)/(2+0.75)
10
11 Pr=8*I
12 disp(Pr)
```

Scilab code Exa 2.40 Problem40

```scilab
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
3  endfunction
4
5  I1=12/1000
6  Ix=I1*30/(30+60)
7  disp(Ix)
8
9  I2=20/1000
10 V2=I2*(10+5)
11 R1=10+parallel(30,60)
12 I1=V2/R1
13 Ix=I1*30/(30+60)
14 disp(Ix)  //Wrongly printed in the book as 10
15
16 Ix=6/1000
17 I1=(30+60)/30*Ix
18 V2=I1*R1
19 I2=V2/15
20 disp(I2)
21
22 Is=45
23 I1=45*(10+5)/(10+5+R1)
24 Ix=I1*30/(30+60)
25 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
```

```
5 Ceq=seriesC(seriesC(10,20),40)
6 disp(Ceq)
7
8 q=Ceq*280
9 disp(q)
10
11 V1=q/10
12 V2=q/20
13 V3=q/40
14
15 disp(V3,V2,V1)
```

Scilab code Exa 3.8 Problem8

```
1 Ceq=10+20+40
2 Q=200*[10,20,40]
3
4 disp(Q)
5 Qnet=Q(1)+Q(2)+Q(3)
6 disp(Qnet)
```

Scilab code Exa 3.9 Problem9

```
1 //deactivate all independent sources
2
3 function p=parallel(r1,r2)
4     p=r1*r2/(r1+r2)
5 endfunction
6
7 L=2
8 Req=parallel(6,12)+4
9 T1=L/Req
10 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`

```
1  Vc_0m =10
2  Vc_0p = Vc_0m
3  disp ( Vc_0p )
4
5  //KVL
6  i1_0p =(10 - Vc_0p ) /20
7  i2_0p = Vc_0p /20
8
9  //KCL
10 iC_0p = i1_0p - i2_0p
11 disp ( iC_0p )
12 iC_inf =0  // capacitor  is  open  circuit
13 disp ( iC_inf )
14 VC_inf =10*20/(20+20)
15 disp ( VC_inf )
```

Scilab code Exa 3.16 `Problem16`

```
1  L =0.25
2  R =250
3  V =10
4  T = L / R
5
6  t =0.5E-3
7  i = V / R *(1 - exp ( - t / T ) )
8  disp ( i )
9
10 t =2E-3
11 i = V / R *(( exp ((1E-3-t ) / T ) - exp ( - t / T ) ) )
12 disp ( i )
```

Scilab code Exa 3.18 `Problem18`

```
1  R =5000
2  C =1.0E-6
3  Ie =1/1000
4  Vcf = Ie * R
5  T = R * C
6
7  t =10/1000
8  Vc10 = Vcf *(1 - exp ( -t / T ))
9  disp ( Vc10 )
10
11 t =20/1000
12 Vc20 = Vcf *(1 - exp ( -t / T )) - Vc10
13 disp ( Vc20 )
```

Scilab code Exa 3.21 `Problem21`

```
1  // Replace  curr  source  by  voltage  source
2  Ics =1/1000
3  R =100*1000
4  V = Ics * R
5
6  Vc_0m =25/(25+100) * V
7  disp ( Vc_0m )
8
9  Vc_0p = Vc_0m
10 disp ( Vc_0p )
11
12 Vc_inf =( V -10) *25/(100+25)
13 disp ( Vc_inf )
```

Scilab code Exa 3.22 `Problem22`

```
1  L=20/1000
2  VR2_0p=10
3  VR2_inf=0
4  VR2_1=5
5
6  t=1/1000
7  T=-t/log((VR2_1-VR2_inf)/(VR2_0p-VR2_inf))
8
9  R2=L/T
10 R1=1/(2/VR2_0p-1/R2)
11
12 disp(R2,R1)
```

Scilab code Exa 3.24 Problem24

```
1  C=1/4
2  Vc_0m=12/(12+6)*12
3  Vc_0p=8
4  disp(Vc_0p)
5  t=0
6  V_0p=6*cos(t)
7
8  //at  t=0+
9  Vth=12/(12+6)*6
10 Rth=6*12/(6+12)
11 ic_0p=(Vth-8)/Rth
12 disp(ic_0p)
13 d_by_dt_Vc_0p=ic_0p/C
14 disp(d_by_dt_Vc_0p)
```

Scilab code Exa 3.26 Problem26

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

```
2  iL =4
3  v =0
4  disp(v,iL)
5
6  //at  t=0+
7  iL =4
8  v = -4*20
9  disp(v,iL)
```

Scilab code Exa 3.27 Problem27

```
1  function p=parallel(r1,r2)
2      p=r1*r2/(r1+r2)
3  endfunction
4
5  L =25/1000
6
7  //at  t=0-
8  R1 =parallel(150,75)
9  iL_0m =30/2
10 disp(iL_0m)
11
12 R2 =parallel(150,50)
13 ix_0m =R2/(R2+75)*30
14 disp(ix_0m)
15
16
17 //at  t=0+
18 iL_0p =iL_0m
19
20 T =L/(75+50)
21 iL_inf =0
22
23 //at  t=0.2ms
24 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
```

53

```
7  T=L/R

8

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

12

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

Scilab code Exa 3.33 Problem33

```
1  R=5
2  L=2
3  V=10
4  T=L/R

5

6  iL_m=V/R
7  disp(iL_m)
8  iL_0p=iL_m
9  iL_inf=2+V/R

10

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

14

15  //disp(iL(0.5))
16  //disp(iL(1.5))

17

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

21

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

Scilab code Exa 3.36 Problem36

```
 1  L=4/1000
 2  R=1000
 3  V=9
 4
 5  iL_0m=V/(2*R)
 6  iL_0p=iL_0m
 7  iL_inf=0
 8  isw_inf=V/R
 9  T=L/R
10
11  t=5E-6
12
13  iL_5=iL_0p*exp(-t/T)
14  disp(iL_5)
15
16  isw_5=isw_inf*(1-exp(-t/T))
17  disp(isw_5)
```

Scilab code Exa 3.37.38 Problem37 and 38

```
 1  R=20
 2  L=2
 3  C=1/25
 4
 5  //at  t=0-
 6  iR=-4
 7  iL=4
 8  iC=0
 9  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`

```scilab
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`

```scilab
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)
```

```scilab
 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))
```

```
8   Qr1=Q1-I1^2*1.2
9   Sr1=sqrt(Pr1^2+Qr1^2)
10
11  Vl=Sr1/I1
12  Pl=15000
13  Ql=Pl*tan(acos(0.8))
14  Pr2=Pl-Pr1
15  Qr2=Ql-Qr1
16  Sr2=sqrt(Pr2^2+Qr2^2)
17
18  I2=Sr2/Vl
19  P2=Pr2+I2^2*0.7
20  Q2=Qr2+I2^2*0.9
21
22  pf=cos(atan(Q2/P2))
23  S2=sqrt(P2^2+Q2^2)
24  V2=S2/I2
25
26  disp(V2,pf,P2,Q2,Q1,Vl)
```

Scilab code Exa 4.12 `Problem12`

```
1   V=231
2   f=50
3   w=2*%pi*f
4   Sl=10
5   pf=0.8
6   Pl=Sl*pf
7   Ql=Sl*sin(acos(pf))
8   Qc=Ql-tan(acos(0.95))*Pl
9
10  C=Qc*1000/V^2/w
11
12  Is1=10*1000/V
13  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

```
1  w=600
2  R=10
3  L=10E-3
4  C=0.5E-3
5  Xl=w*L*%i
6  Xc=1/(w*C*%i) //Xc value in the book is wrong
7  V1=40
8  V2=complex(0,-30)
9
10 //mesh analysis
11 A=[R+Xl,-R;-R,R+Xc]
12 I=inv(A)*[V1;V2]
13
14 Ir=I(1)-I(2)
15 Vr=R*Ir
16
17 disp(Vr)  //Final answer is different
```

Scilab code Exa 4.15 Problem15

```
1  Z1=complex(2,-1)
2  Z2=complex(0,-5)
3  Z3=complex(2,1)
4  I1=1
5  I2=complex(0,-2)
6
7  //deactivate curr source 2
8  V11=I1*(Z2+Z3)/(Z1+Z2+Z3)*Z1
9  V21=I1*Z1/(Z1+Z2+Z3)*Z3
10
11 //deactivate curr source 1
12 V12=I2*Z3*Z1/(Z1+Z2+Z3)
13 V22=I2*(Z1+Z2)/(Z1+Z2+Z3)*Z3
14
15 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

```
1  function Zeq=parallel(Z1,Z2)
2      Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  V=20
6  Z1=complex(5,10)
7  Z2=complex(3,-4)
8
9  Vth=V*Z2/(Z1+Z2)
10 Zth=parallel(Z1,Z2)
11
12 //by maximum power transfer theorem
13 Zl=conj(Zth)
14 P=norm(Vth/(Zth+Zl))^2*real(Zl)
15 disp(P,Zl)
16
17 Rl=sqrt(real(Zth)^2+(4+imag(Zth))^2)
18 disp(Rl)
```

Scilab code Exa 4.18 Problem18

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

```
10  C =1/3
11
12  [Vx ,Vy ]= polar_to_cart (4 ,30)
13  [Ix ,Iy ]= polar_to_cart (0.8 , -10)
14
15  // deactivate  current  source
16  V= complex (Vx ,Vy)
17  w =3
18  Xl =w*L*%i
19  Xc =1/( w*C*%i)
20
21  Il1 =V/( R1 + R2 + Xl + Xc)
22  Pav1 = norm (Il1 )^2* R1
23
24  // deactivate  voltage  source
25  I= complex (Ix ,Iy)
26  w =5
27  Xl =w*L*%i
28  Xc =1/( w*C*%i)
29
30  Il2 =I*( R2 + Xl)/( R2 + Xl + R1 + Xc)
31  Pav2 = norm (Il2 )^2* R1
32
33  Pav = Pav1 + Pav2
34  disp (Pav)
```

Scilab code Exa 4.21 `Problem21`

```
1  I =35
2  VR =25
3  Vrl =40
4  VRrl =50
5  Vc =45
6  C =50E -6
7  Xc =Vc /I
```

```
8  w =1/( Xc * C )
9
10  theta = acos (( VR ^2+ VRrl ^2 - Vrl ^2)/(2* VR * VRrl ))
11  x = VRrl * cos ( theta ) -25
12  y = VRrl * sin ( theta )
13
14  r = x / I
15  L = y /( I * w )
16  Vappl = sqrt (( VR + x )^2+ y ^2)
17  R = VR / I
18
19  disp ( L , r , R )
```

Scilab code Exa 4.22 Problem22

```
1  V =12
2  w =1000
3  R =4
4  L =5 E -3
5  C =400 E -6
6  Xl = w * L *% i
7  Xc =1/( w * C *% i )
8
9  // mesh  analysis
10  A =[ R + Xl , - Xl ;2 - Xl , Xl + Xc ]
11  I = inv ( A ) *[12;0]
12
13  disp ( I (1))  // answer  is  wrong  in  the  book
```

Scilab code Exa 4.23 Problem23

```
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    [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

```
1  function Zeq=parallel(Z1,Z2)
2      Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  //converting curr source to v source
6  I=0.4
7  R1=15
8  V=I*R1
9  w=400
10
11 R2=5
12 R3=80
13 L=25E-3
14 Xl=w*L*%i
15
16 Zeq=R1+R2+parallel(R3,Xl)
17 I=V/Zeq
18 Il=I*R3/(R3+Xl)
19 Ix=I*Xl/(R3+Xl)
20
21 disp(Il,Ix)
```

Scilab code Exa 4.27 Problem27

```
1  V=4
2  w=2
3
4  R=4
5  L=2
6  Xl=w*L*%i
7
8  Il=V/(Xl+R)
9  Xc=-V/imag(Il)
10 C=1/(w*Xc)
11 disp(C)
```

Scilab code Exa 4.28 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  I=4
8  w=500
9  [Ir,Ic]=polar_to_cart(3,40)
10 Ix=complex(Ir,Ic)
11 C=1E-3
12 L=10E-3
13 Xl=w*L*%i
14 Xc=1/(w*C*%i)
15
16 Il=I-Ix
17 Ic=Ix
18 Vc=Ic*Xc
19 Vl=Il*Xl
20 Vx=Vl-Vc
21 disp(Vx)   //answer wrong in the book
```

Scilab code Exa 4.29 Problem29

```
1  w=10
2  R=2
3  L=0.3
4  Ir=10*(cos(%pi/4)+%i*sin(%pi/4))
5  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=(Zc*Zrl)/(Zc+Zrl);
15  In=Vth/Zth
16
17  disp(Zth,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
```

```
24  Pr=-V1*Ir1
25  Pl=-V1*Il1
26
27  disp(Pl,Pr,Ps)
```

Scilab code Exa 4.36 Problem36

```
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(120,45)
8   V=complex(Vr,Vc)
9
10  [Zr,Zc]=polar_to_cart(16.3,24.5)
11  Z=complex(Zr,Zc)
12
13  w=50
14
15  I=V/Z
16  P=V*conj(I)
17  Pavg=real(P)
18  pf=real((V/I)/norm(V/I))
19
20  disp(pf,Pavg)
```

Scilab code Exa 4.37 Problem37

```
1   function Zeq=parallel(Z1,Z2)
2       Zeq=Z1*Z2/(Z1+Z2)
3   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 =15.36 E6
4  w =2*% pi * f
5  t =20.3 E -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
```

80

```
9   r=((240/I)^2-t-R*R)/2/R              ///this part solved
        wrong in the book
10  Xl=sqrt(t-r*r)
11  Z=sqrt(t)
12  disp(r)
13  disp(Xl)
14  disp(Z)
15
16  Pl_choke=I*I*r
17  disp(Pl_choke)
18  pf=Pl_choke/205/20
19  disp(pf)
```

Scilab code Exa 4.41 Problem41

```
1   w=2
2   L=1
3   C=0.5
4   Xl=w*L*%i
5   Xc=1/(w*C*%i)
6
7   V=1
8   I=V/(1+%i)
9   Y=I/V
10  R=1/real(Y)
11
12  disp(R,Y)
```

Scilab code Exa 4.42 Problem42

```
1   w=400
2   R=5
3   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

```
1  pf =0.707
2  theta=acos(pf)
3  P =200
4  Q=tan(theta)*P
5  pf2=0.85
6  theta_n=acos(pf2)
7  Qn=Q*tan(theta_n)
8  Qc=Q-Qn
9
10 w=314
11 V =2000
12 C=Qc/(V*V*w)
13
14 disp(C)
```

Scilab code Exa 4.45 Problem45

```
1  I =20
2  w =2000
3  R =200
4  L=0.25
5  Xl=w*L*%i
6
7  Ir=I*Xl/(Xl+R)
8  Il=I-Ir
9  Vl=Xl*Il
10
11 t=1E-3
12 ir=sqrt(2)*real(Ir*exp(%i*w*t))
13 il=sqrt(2)*real(Il*exp(%i*w*t))
14 vl=sqrt(2)*real(Vl*exp(%i*w*t))
15 is=sqrt(2)*real(I*exp(%i*w*t))
16 vs=vl
17
18 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`

```
1  function a = parallel(b,c)
2  a = b*c/(b+c)
3  endfunction
4  V=10*%i
5  w=1000
6  R=2
7  L=2E-3
8  C=500E-6
9  Xl=w*L*%i
10 Xc=1/(w*C*%i)
11
12 Zeq=Xl+Xc+parallel(R,Xl)
13 disp(Zeq)
14
15 I=V/Zeq
16 Ir=I*Xl/(R+Xl)
17 Il2=I-Ir
18 Vl=I*Xl
19 Vc=I*Xc
20
21 disp(I,Ir,Il2,Vl,Vc)
```

Scilab code Exa 4.48 `Problem48`

```
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(100,120)
8  V1=complex(Vr,Vc)
9
10 I=10
11 w=5000
```

```
12 R=10000
13 L=2.4E-3
14 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

```
1  function Zeq=parallel(Z1,Z2)
2       Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  V=12*%i
6
7  Vth=4-12*%i/(4-12*%i+6+9*%i)*V
8  Zth=parallel(4-12*%i,6+9*%i)
9
10 I=Vth/(Zth+6+12*%i)
11 S=V*conj(I)
12 disp(S)
13
14 Zl=conj(Zth)
15 I=Vth/(Zth+Zl)
16 S=V*conj(I)
17 disp(Zth,S)
```

Scilab code Exa 4.51 Problem51

```
1  function Zeq=parallel(Z1,Z2)
2       Zeq=Z1*Z2/(Z1+Z2)
3  endfunction
4
5  I=5
6
7  Zth=parallel(40,30*%i)
8  Zl=conj(Zth)
9  Vth=Zth*I
10 Z=Zth+Zl
```

```
11  Il=Vth/Z
12  Pmax=abs(Il*Il*real(Zl))
13
14  disp(Zth,Pmax)
```

Scilab code Exa 4.52 Problem52

```
1   V=4*sqrt(2)
2   w=2
3   R=4
4   L=2
5   Xl=w*L*%i
6
7   Il=V/(R+Xl)
8   Ic=-imag(Il)*%i
9   C=Ic/(V*%i*w)
10
11  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`

```
1  R=1000
2  C=49E-6
3  L=13E-3
4
5  w0=1/sqrt(L*C)
6  Q0=w0*R*C
7
8  disp(Q0,w0)
```

Scilab code Exa 5.3 `Problem3`

```
1  R=5
2  C=0.08E-6
3  L=5E-3
4
5  w0=1/sqrt(L*C)
6  f0=w0/2/%pi
7  Q0=w0*L/R
8  bandwidth=w0/Q0
9  wb=bandwidth
10 w=[w0-1/2*wb,w0+1/2*wb]
11
12 disp(w(2),w(1))
```

Scilab code Exa 5.4 `Problem4`

```
1  L=40E-6
2  R=4.02
3  f0=800E3
4
5  w0=2*%pi*f0
6  C=1/(w0*w0*L)
7  Q0=w0*L/R
```

```
 8  fb=f0/Q0
 9
10  Xl=w0*L*%i
11  Xc =1/(w0*C*%i)
12  Zin=R+Xl+Xc
13
14  disp(Zin,fb,C)
```

Scilab code Exa 5.5 Problem5

```
 1  G=5E-6
 2  L=2E-3
 3  I=2E-3
 4  w=5000
 5
 6  C=1/(w*w*L)
 7  Vmax=I/G
 8  Il=1
 9  I=Il*w*L*G
10
11  disp(I,Vmax,C)
```

Scilab code Exa 5.6 Problem6

```
 1  w0=1000
 2  w2=1050
 3  wb=2*(w2-w0)
 4
 5  Q0=w0/wb
 6  disp(Q0)
```

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Scilab code Exa 5.7 `Problem7`

```
1  w0 =200 E3
2  wb =5E3
3  L=2.5E-3
4  Q=65
5
6  Q0=w0/wb
7  r=w0*L/Q
8
9  disp(r)
```

Scilab code Exa 5.8 `Problem8`

```
1  C=12E-9
2  L=4E-3
3  R=5
4
5  w0 =1/sqrt(L*C)
6
7  Vc =1.5
8  I=w0*C*Vc
9  Zi=R
10 Vi=R*I
11
12 disp(Vi,w0)
```

Scilab code Exa 5.9 `Problem9`

```
1  w0 =2.5E6
2  Zin =60E3
3  Q0=80
4
```

```
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  w0=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*f0
 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
```

```
8  C=1/(2*alpha*R)
9  L=1/(w0*w0*C)
10
11 disp(C,L,R)
```

Scilab code Exa 5.17 Problem17

```
1  I=1
2  w=400
3  R=500
4  L=1/40
5  C=250E-6
6  Xl=w*L*%i
7  Xc=1/(w*C*%i)
8
9  w0=1/sqrt(L*C)
10 ////////at resonance
11 Ir=I
12 V=R*I
13 Il=V/Xl
14 Ic=V/Xc
15 Icir=abs(Il)
16 Ic+Il=0
17 Icl=Ic+Il
18
19 disp(Icl,Ic,Il,Ir)
```

Scilab code Exa 5.18 Problem18

```
1  V=100
2  R=10
3  L=2E-3
4  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`

```
1  V=200
2  R=2
3  L=0.02
4
5  f=25
6  w0=2*%pi*f
7  C=1/(w0*w0*L)
8  I=V/2
9  Vc=1/(C*w0)
10 disp(I,Vc)
11
12 f=50
13 w0=2*%pi*f
14 C=1/(w0*w0*L)
15 I=V/2
16 Vc=1/(C*w0)
17 disp(I,Vc)
18
19 f=100
20 w0=2*%pi*f
21 C=1/(w0*w0*L)
22 I=V/2
23 Vc=1/(C*w0)
24 disp(I,Vc)
```

Scilab code Exa 5.21 `Problem21`

```
1  R=10
2  L=0.1
3  C=150E-6
4
5  w=sqrt((1+R*R*C/L)/(L*C))
6  f=w/(2*%pi)
7
8  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`

```
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
8  Vp=Vl/sqrt(3)
9  disp(Vp)
10
11  [Ir,Ic]=polar_to_cart(50,-30)
12  Il=complex(Ir,Ic)
13  Ip=Il
14  Zy=Vp/Il
15  disp(Zy)
16
17  P=sqrt(3)*Vl*Il*cos(30/180*%pi)
18  Q=sqrt(3)*Vl*Il*sin(30/180*%pi)
19  disp(P,Q)
```

Scilab code Exa 6.5 `Problem5`

```
1  Vl=400
2  Z=16+%i*12
3
4  Vp=Vl
5  Ip=Vp/Z
6  pf=cos(atan(imag(Z)/real(Z)))
7  Il=Ip*sqrt(3)
8
9  P=sqrt(3)*Vl*Il*pf
10  Q=sqrt(3)*Vl*Il*sin(acos(pf))
11
```

```
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
```

```
 8  [Ir ,Ic]=polar_to_cart (20 ,-30)
 9  Iab=complex(Ir ,Ic)
10
11  omega=exp(%i*120/180*%pi)
12  Ibc=Iab/omega
13  Ica=Iab*omega
14
15  IAa=Iab-Ica
16  Pab=Vl*norm(Iab)*cos(30/180*%pi)
17  Ptotal=3*Pab
18
19  Zp=Vl/Iab
20  Rp=real(Zp)
21
22  disp(IAa)
23  disp(Ptotal)
24  disp(Rp)
```

Scilab code Exa 6.10 Problem10

```
 1  omega=exp(%i*120/180*%pi)
 2
 3  Zp=17.32+%i*10
 4  Vab=400
 5  Iab=Vab/Zp
 6  Ica=Iab/omega
 7  IAa=Iab-Ica
 8  IBb=IAa/omega
 9  ICc=IAa*omega
10  disp(ICc ,IBb ,IAa)
11
12  Pab=(norm(Iab)^2)*real(Zp)
13  Ptotal=3*Pab
14  disp(Ptotal)
15
```

```
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
```

```
4 pf1=0.7
5 theta1=acos(pf1)
6 Il1=P/(sqrt(3)*V*pf1)*exp(-%i*theta1)
7 Ip1=Il1/sqrt(3)
8
9
10 pf2=0.85
11 theta2=acos(pf2)
12 Il2=P/(sqrt(3)*V*pf2)*exp(-%i*theta2)
13 Ip2=Il2/sqrt(3)
14
15 Ic=Ip2-Ip1                    ////calculation
      mistake  in  the  book  at  this  step
16 C=real(Ic/(V*w*%i))
17 disp(C)
```

Scilab code Exa 6.13 Problem13

```
1 omega=exp(%i*120/180*%pi)
2 Vrn=400/sqrt(3)
3 Vyn=Vrn/omega
4 Vbn=Vrn*omega
5
6 P1=4000
7 P2=8000
8 P3=12000
9
10 Ir=conj(P1/Vrn)
11 Iy=conj(P2/Vyn)
12 Ib=conj(P3/Vbn)
13
14 In=Ir+Iy+Ib
15
16 disp(norm(Ir),norm(Iy),norm(Ib),norm(In))
```

Scilab code Exa 6.14 Problem14

```scilab
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
8  Vbc=-400*%i
9  Rl=1
10
11 [Sr,Sc]=polar_to_cart(10000,acos(0.8))
12 S=complex(Sr,Sc)
13
14
15 Vl=Vbc
16 Il=norm(S/(sqrt(3)*Vl))        ////////calculation
       mistake in book here
17 P=3*Il*Il*Rl
18 disp(P)
19
20 Van=norm(Vbc/sqrt(3))
21
22 Ia=Il*exp(-%i*acos(0.8))
23 omega=exp(%i*120/180*%pi)
24 Ib=Ia/omega
25
26 disp(Van,Ia,Ib)
```

Scilab code Exa 6.15 Problem15

```scilab
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(231,60)
8  Van=complex(Vr,Vc)
9
10 Sp=(2.5-%i*1.2)*1000
11
12 omega=exp(%i*120/180*%pi)
13 Vbn=Van/omega
14 Vcn=Van*omega
15
16 Vbc=Vbn-Vcn
17
18 Ibc=conj(Sp/Vbc)
19 Ica=Ibc*omega
20 Iab=Ibc/omega
21
22 IaA=Ica-Iab
23
24 disp(IaA)
```

Scilab code Exa 6.16 Problem16

```scilab
1  omega=exp(%i*120/180*%pi)
2  Vab=400
3  Vca=400*omega
4  Vbc=400/omega
5
6  //Mesh  Method
7  A=[80+100*%i,100*%i;100*%i,50*%i]
8  I=inv(A)*[-Vca;Vbc]
```

```
9   Ia=I(1)
10  Ib=I(2)
11
12  Ic=-(Ia+Ib)
13  Van=80*Ia
14  Vbn=-50*%i*Ib
15  Vcn=100*%i*Ic
16
17  disp(Ia,Ib,Ic,Van,Vbn,Vcn)
```

Scilab code Exa 6.17 Problem17

```
1   omega=exp(%i*120/180*%pi)
2   Vab=400
3   Vca=400*omega
4   Vbc=400/omega
5
6   Iab=Vab/(100*%i)
7   Ibc=Vbc/(-50*%i)
8   Ica=Vca/80
9
10  Ia=Iab-Ica        ///calaculation mistake in the book
        here
11  Ib=Ibc-Iab
12  Ic=Ica-Ibc
13
14  disp(Ia,Ib,Ic)
```

Scilab code Exa 6.18 Problem18

```
1   V=400
2   P=900
3   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`

```
1 uo=(4*%pi)*1E-7
2
3 i1=5
4 i2=2.5
5 r=0.4
6 H=i1/(2*%pi*r)
7
8 F=uo*H*i2          //////////attractive
9 ur=8000
10 Firon=ur*F
11
12 disp(H,F,Firon)
```

Scilab code Exa 7.2 `Problem2`

```
1 l=0.15
2 i1=50
3
```

```
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=Fabcd/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
```

```
13  disp(Bg)
14
15  L=flux*500/2
16  disp(L)
17
18  Wfr=1/2*Rr*flux*flux
19  Wfg=1/2*Rg*flux*flux
20  disp(Wfg,Wfr)
21
22  imax=2
23  flux_max=flux
24  E=4.44*314/(2*%pi)*500*flux_max
25  flux_max2=100/(sqrt(2)*4.44*314/(2*%pi)*500)
26  Fmax2=flux_max2*Rtotal
27  imax2=Fmax2/500
28  disp(imax2)
```

Scilab code Exa 7.10 Problem10

```
1   Ac=12/10000
2   Fmin=160*9.81
3   B=sqrt(Fmin*2*uo/Ac)
4   u0 = 4%pi*10^ 7
5   H=2800
6   L=75/100
7   F=H*L
8   Lg=0.1/1000
9   A=24/10000
10  Rg=Lg/(uo*A)
11  fluxg=B*A
12  Fg=fluxg*Rg
13
14  Ftotal=F+Fg
15  imin=Ftotal/1000
16  disp(imin)
```

Scilab code Exa 7.11 Problem11

```
1  Wm1 =1/2*(1200 -750) *0.012
2  disp ( Wm1 )
3
4  flux_g =0.012/750*1200
5  Wm2 =1/2*( flux_g -0.012) *1200
6  disp ( Wm2 )
7
8  Ra =1200/0.012
9  Rb =1200/ flux_g
10 Fo = -1/2*(0.012^2) *0.75*10^6
11 Fc = -1/2*( flux_g^2) *0.75*10^6
12 disp (Fc ,Fo )
```

Scilab code Exa 7.12 Problem12

```
1  V1 =10
2
3  //Mesh  Method
4  A =[1+10*%i ,-80*%i ;80*%i ,-500 -800*%i]
5  I =inv (A) *[ V1 ;0]
6
7  V2 =500*I (2)
8
9  disp (V1 ,V2 ,I )
```

Scilab code Exa 7.14 Problem14

```
 1  uo=(4*%pi)*1E-7
 2  ur=1600
 3
 4  lc=160/100
 5  lg=0.8/1000
 6  A=5/10000
 7  N=1200
 8
 9  Rc=lc/(uo*ur*A)
10  Rg=lg/(uo*A)
11  R=Rc+Rg
12
13  L=N*N/R
14  disp(L)
```

Scilab code Exa 7.15 Problem15

```
 1  N=100
 2  l1=0.15
 3  l2=0.3
 4  l3=0.45
 5  A=0.001
 6  u0 = 4*%pi*10^  7  ;
 7
 8  ur1=1447
 9  ur2=5969
10  ur3=47750
11
12  flux=0.6E-3
13
14  B=flux/A
15
16  H1=B/(uo*ur1)
17  H2=B/(uo*ur2)
18  H3=B/(uo*ur3)
```

```
19  disp(H1,H2,H3)
20
21  F=H1*l1+H2*l2+H3*l3
22  disp(F)
23
24  I=F/N
25  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
8  disp(Hc)
9
10 flux=1.25/1000
11 Ac=(20-16)*2.5/10000
12 Bc=flux/Ac
13 disp(Bc)
14
15 R=F/flux
16 disp(R)
17
18 u=Bc/Hc
19 disp(u)
20
21 ur=u/uo
22 disp(ur)              //calculation mistake in the book
      here
```

Scilab code Exa 7.18 Problem18

```
1  fluxc=1.5E-3
2  Ac=12/10000
3  Bc=fluxc/Ac
4  Hc=1250
5  lc=0.3
6  F=Hc*lc
7
8  Fa=200*1
9  Fb=600*0.75
10
11 Fc=F-Fb+Fa
12 Nc=Fc/0.5
13 disp(Nc)     ////clockwise5
```

Scilab code Exa 7.19 Problem19

```
1  uo=(4*%pi)*1E-7
2  ur=2000
3  V=200
4  f=50
5  N=1600
6  Ac=5/10000
7
8  flux_max=V/(4.44*f*N)
9  Bmax=flux_max/Ac
10 disp(Bmax)
11
12 Rc=20/100/(uo*ur*Ac)
13 Rg=0.5/1000/(uo*Ac)
14 R=Rc+Rg
15
16 imax=flux_max*R/N
17 disp(imax)
18
19 Wfmax=1/2*R*(flux_max^2)
20 disp(Wfmax)
21
22 percent=Rg/R*100
23 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`

```
1  a=2400/240
2
3  R=0.2+a*a*2/1000
4  X=0.6+a*a*6/1000
5  disp(R,X)
6
7  Rlv=1/a/a*R
8  Xlv=1/a/a*X
9  disp(Rlv,Xlv)
10
11 I2=150*1000/2400
12 Z=R+%i*X
13 V=I2*Z
14 pcnt=norm(V)/2400*100
15 disp(V,pcnt)
16
17 Im=2400/1600
18 Ii=2400/10000
19 Io=Ii-%i*Im
20 pf=cos(atan(imag(Io)/real(Io)))
21 disp(Io,pf)
```

Scilab code Exa 8.3 `Problem3`

```
1  P=200E3
2  V1=11000
3  V2=415
4  f=50
5  N2=80
6
7  N1=V1/V2*N2
8  a=N1/N2
9  disp(a)
10
11 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)
```

```
 9  I1=V/2/Rs
10
11  Il=I1*a
12  disp(Il)
13  Vl=V/2/a
14  disp(Vl)
```

Scilab code Exa 8.7 `Problem7`

```
 1  f=50
 2  a=1100/220
 3  Rhv=0.125
 4  Xhv=0.625
 5  Rlv=0.005
 6  Xlv=0.025
 7
 8  Zhv=Rhv+%i*Xhv
 9  Zlv=Rlv+%i*Xlv
10
11  Z1=Zhv+a*a*Zlv
12  disp(Z1)
13  Z2=Z1/a/a
14  disp(Z2)
15
16  Zpu1=Z1*0.05/1.1/1.1
17  disp(Zpu1)
18  Zpu2=Z2*0.05/0.22/0.22
19  disp(Zpu2)
```

Scilab code Exa 8.8 `Problem8`

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

```
3  r1 =0.05
4  r2 =0.004
5  x1 =0.025
6  x2 =0.016
7  R1 =1667
8  Xm =417
9
10  /////As seen from the LV side
11
12  Zlv=r2+%i*x2+1/a/a*(r1+%i*x1)
13  disp(Zlv)
14
15  RiLV=R1/a/a
16  disp(RiLV)
17  XmLV=Xm/a/a
18  disp(XmLV)
19
20
21  Zpu=Zlv*0.6/0.6/0.6
22  disp(Zpu)
23  Ri=RiLV*0.6/0.6/0.6
24  disp(Ri)
25  Xm=XmLV*0.6/0.6/0.6
26  disp(Xm)
```

Scilab code Exa 8.9 Problem9

```
1  P=50E3
2  a=2200/220
3
4  /////OC Parameters
5  Poc=405
6  Ioc=5
7  Voc=220
8
```

```
 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

```
 1  P =25000
 2  V1 =2200
 3  V2 =220
 4  a=V1/V2
 5  f =50
 6  r1 =2
 7  r2 =0.025
 8  x1 =7
 9  x2 =0.07
10  Xm =16000
11
12  Im=V2/Xm
13  disp("pf=0, 90 degree lag Po=0", Im)
14
15  R=r1+a*a*r2
16  X=x1+a*a*x2
17  Z=sqrt(R*R+X*X)
18  Ifl=P/V1
19  Vsc=Z*Ifl
20  Vsc_percent=Vsc/V1*100
21  disp(Vsc,Vsc_percent)
22  Im=Vsc/Xm
23  Im_percent=Im/Ifl*100
24  disp(Im,Im_percent)
25
26  Sc_pf=cos(atan(X/R))
27  disp(Sc_pf)
28
29  ////////////Per unit
30  ZBpu=1000*2.2*2.2/25
31  r1pu=r1/193.6
32  r2pu=a*a*r2/193.6
33  x1pu=x1/193.6
34  x2pu=a*a*x2/193.6
35
36  Rpu=r1pu+r2pu
37  Xpu=x1pu+x2pu
38
```

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```
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

```
1  P =100000
2  N1 =400
3  N2 =100
4  a= N1 / N2
5  r1 =0.3
6  r2 =0.015
7  x1 =1.1
8  x2 =0.055
9  V1 =2400
10
11 R= r1 + a * a * r2
12 disp (R)
13 X= x1 + a * a * x2
14 disp (X)
15
16 I1 = P / V1
17 pf =0.8
18 theta = acos (pf)
19 Vd = I1 *( R * cos (theta) + X * sin (theta))
20 VR = Vd / V1 *100
21 V2 =( V1 - Vd)/a
22 disp (VR , V2)
23 Vd = I1 *( R * cos (theta) - X * sin (theta))
24 VR = Vd / V1 *100
25 V2 =( V1 - Vd)/a
26 disp (VR , V2)
27
28 pf = cos (atan (R / X))          ///// wrong in the book
29 disp (" leading ", pf)
```

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Scilab code Exa 8.14 Problem14

```
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  pf =0.8
16  theta=acos(pf)
17  V1=V2+I*(R*cos(theta)+X*sin(theta))
18  Pi=75*V1*V1/V2/V2
19  Pc=I*I*R
20  Pl=Pi+Pc
21  P0=P*pf
22  effi=P0/(P0+Pl)*100
23  disp(effi)
24
25  V1=V2
26  Pi=75
27  pf2=X/sqrt(R*R+X*X)
28  I=P0/V1/pf2
29  Pc=I*I*R
30  Pl=Pi+Pc
31  P0=P*pf
32  effi=P0/(P0+Pl)*100
33  disp(effi)
34
35  I=sqrt(Pi/R)
36  Load=V2*I
```

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

Scilab code Exa 8.15 Problem15

```
 1  P=15E3
 2  a=3000/250
 3
 4  /////OC Parameters
 5  Poc=105
 6  Ioc=0.62
 7  Voc=250
 8
 9  /////SC Parameters
10  Psc=360
11  Isc=5.2
12  Vsc=157
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  //////////Per unit
32  ZB=3.12/5.2
33  GiPU=Gi*ZB
34  BmPU=Y0*ZB
35  RPU=R/ZB/1000
36  XPU=X/ZB/1000
37  disp(GiPU)
38  disp(BmPU)
39  disp(RPU)
40  disp(XPU)
41
42
43  pf=0.8
44  theta=acos(pf)
45  V2=250*a
46  I=P/V2
47  Vd=I*(R*cos(theta)-X*sin(theta))
48  VR=-Vd/V2*100
49  disp(VR)
50  Pi=105
51  Pc=I*I*R
52  Pl=Pi+Pc
53  P0=P*pf
54  effi=P0/(Pl+P0)*100
55
56  pf2=cos(atan(R/X))
57  disp("leading", pf2)
58
59
60  IPU=sqrt(Pi/P/RPU)
61  effi_max=IPU
62  disp(effi_max)
```

Scilab code Exa 8.16 `Problem16`

```
1  v1 =2500
2  v2 =250
3  P =25000
4  Pc =130
5  Pcfl =320
6  pf =0.8
7
8  V2 =2750
9
10 P0 =P*pf
11 Pl =Pcfl+Pc
12 effi =P0/(P0+Pl)*100
13 disp(effi)
14
15 I2 =P/v2
16 I1 =I2+P/v1
17 kVA =I1*v1/1000
18 P0 =kVA*pf*1000
19 effi =P0/(P0+Pl)*100
20 disp(effi)
```

Scilab code Exa 8.17 `Problem17`

```
1  a =10
2  Load =120000
3  V =400
4
5  I =Load/V/sqrt(3)
6  Vll =a*V/sqrt(3)
7  Ill =sqrt(3)*I/a
8  all =Vll/V
9  disp(Vll,Ill,all)
10
```

```
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

```
1  P =50000
2  lr =0.9
3
4  P0=P*1*0.9
5  effi =0.974
6  Pl =(1- effi )/ effi *P0
7  Pi=Pl /2
8  Pcfl =Pi/lr/lr
9
10 pf =0.8
11 P0=P*pf
12 Pl=Pi+Pcfl
13 effi =P0 /( P0+Pl )*100
14 disp ( effi )
15
16 P0=P /2* lr
17 Pl=Pi+Pcfl /2/2
18 effi =P0 /( P0+Pl )*100
19 disp ( effi )
20
21 // // // // // calculation  mistakes  in  the  book
```

Scilab code Exa 8.21 `Problem21`

```
1  P =500E3
2  effi =0.95
3
4  A =[1 ,1;1 ,0.6*0.6]
5  Pa= inv (A) *[P*(1 - effi )/ effi ;P*0.6*(1 - effi )/ effi ]
6  Pi=Pa (1)
7  disp (Pi)
8  Pc=Pa (2)
9  disp (Pc)
10
11 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
```

```
 3  v2=400
 4
 5  Vl=400
 6  Vp=Vl/sqrt(3)
 7
 8  a=ceil(v1/Vp)
 9  disp(a)
10
11  Il=P/sqrt(3)/Vl
12  Ip=Il
13  disp(Il,Ip)
14
15  Il=P/sqrt(3)/v1
16  Ip=Il/sqrt(3)
17  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
```

```
 5  m=S/3/P
 6  gammaa=%pi/3/m
 7  Kb=sin(m*gammaa/2)/m/sin(gammaa/2)
 8  coilpitch=17
 9  polepitch=S/2
10  spa=(polepitch-coilpitch)*gammaa
11  Kp=cos(spa/2)
12
13  N=S*2
14  Nc=N/2
15  Coilsperphase=Nc/3
16  Nph=Coilsperphase/2
17  Eline=2300
18  flux=Eline/sqrt(3)/4.44/Kb/Kp/f/Nph
19  disp(flux)
```

Scilab code Exa 9.10 `Problem10`

```
 1  f=50
 2  ns=1000
 3  P=120*f/ns
 4  disp(P)
 5  s=(ns-940)/ns
 6  disp(s*100)
 7  nrr=ns-940
 8  disp(nrr)
 9  nrs=1000
10  disp(nrs)
11  s=2*s
12  n=1000*(1-s)
13  disp(n)
```

Scilab code Exa 9.11 `Problem11`

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

Scilab code Exa 9.12 Problem12

```
1  P =8
2  f1 =60
3  f2 =50
4  If1 =5
5  If2 = f1 / f2 * If1
6  disp ( If2 )
7  nA2 =120* f2 / P
8  disp ( nA2 )
```

Scilab code Exa 9.13 Problem13

```
1  f1 =60
2  f2 =50
3  P1 =12
4  P2 = f2 / f1 * P1
5  disp ( P2 )
6  nset =120* f1 / P1
7  disp ( nset )
```

Scilab code Exa 9.14 Problem14

```
1  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

```
1   P =4
2   A =4
3   ra =0.145
4   l =0.21
5   Z =2*33*11
6   K = Z * P /2/ %pi / A
7   disp ( K )
8
9   Ap =2* %pi * ra / P *0.7* l
10  Barc =0.8
11  flux = Ap * Barc
12  n =1200
13  Ea = K * flux *2* %pi * n /60
14  disp ( Ea )
15
16  Ia =240
17  Ic = Ia / A
18  disp ( Ic )
19
20  T = K * flux * Ia
21  disp ( T )
22  Pg = Ea * Ia
23  disp ( Pg )
```

Scilab code Exa 10.3 Problem3

```
1   P =5000
2   Vt =215
3   n =1000
4   Ra =0.4
5   Ia = P / Vt
6   Eag = Vt + Ra * Ia
7   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

```
1  n1 =1000
2  V =230
3  Ia =75
4  Ra =0.1
5  Ea1 = V - Ia * Ra
6  Rf =275
7  If = V / Rf
8  Ke = Ea1 / If / n1
9
10 n2 =1200
11 Ia =125
12 Ea2 = V - Ia * Ra
13 If2 = Ea2 / Ke / n2
14 Rf2 = V / If2
15 Rfext = Rf2 - Rf
16 disp ( Rfext )
```

Scilab code Exa 10.8 Problem8

```
1  V =115
2  Ia1 =25
3  Ra =0.3
4
5  n1 =1450
6  Ea1 = V - Ia1 * Ra
7  Ke = Ea1 / n1
8
9  n2 =1200
10 Ea2 = Ke * n2
11 Ia2 =3/4* Ia1
12 Raext =( V - Ea2 )/ Ia2 - Ra
13 disp ( Raext )
14 effia = Ea2 / V *100      /// calculation  mistake  in  the
       book  at  this  point
15 disp ( effia )
```

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```
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`

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```
 1  V =300
 2  Ea=V
 3  n1 =1200
 4  n2 =1100
 5  Kaphi =Ea/2/%pi/n1*60
 6
 7  T=350
 8  Ia=T/Kaphi
 9  disp(Ia)
10  Ea=V*n2/n1
11  Pm=Ea*Ia
12  disp(Pm)
13
14  Ra=(V-Ea)/Ia
15  disp(Ra)
16
17  disp(T)
18  Ea=600-Ia*Ra
19  n=Ea*60/Kaphi/2/%pi
20  Pm=Ea*Ia
21  disp(Pm)
22  disp(n)
```

Scilab code Exa 10.11 `Problem11`

```
 1  V =300
 2  Ea=V
 3  n1 =1200
 4  n2 =1100
 5  Kaphi =Ea/2/%pi/n1*60
 6
 7  T=350
 8  Ia=T/Kaphi
 9  Ea=V*n2/n1
10
```

```
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
```

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```
 9  Ia=I-If
10  Pk=Pin-Ia*Ia*Ra
11
12  I=215
13  Ia=I-If
14  Pl=Ia*Ia*Ra+Pk
15  Pin=V*I
16  effi=(Pin-Pl)/Pin
17  disp(effi)
18
19  Ia=sqrt(Pk/Ra)
20  Il=Ia+If
21  Pl=2*Pk
22  Pin=V*Il
23  effi=(Pin-Pl)/Pin
24  disp(effi)
```

Scilab code Exa 10.16 `Problem16`

```
 1  V=250
 2  Rf=125
 3  Ra=0.2
 4  If=V/Rf
 5  I=16
 6  Ia0=I-If
 7  Pk=V*Ia0-Ia0*Ia0*Ra+V*If
 8
 9  I=152
10  Ia=I-If
11  Pl=Ia*Ia*Ra+Pk
12  Pin=V*I
13  effi=(Pin-Pl)/Pin
14  disp(effi)
15
16  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`

```
1  V=250
2  Ia=200
3  Ra=0.22
4
5  Ea=V-Ia*Ra
6  Pm=Ea*Ia
7  Prl=600
8  Pmout=Pm-Prl
9  n=1250
10 wm=2*%pi*n/60
11 Tl=Pmout/wm
12 disp(Tl)
13
14 Rf=125
15 Psh=V*V/Rf
16 Pein=V*Ia+Psh
17 effi=Pmout/Pein
18 disp(effi)
```

Scilab code Exa 10.20 `Problem20`

```
1  P=25000
2  n=1600
3  V=250
4  If=1.5
5  Rf=V/If
6  disp(Rf)
7
8  Ra=0.1
```

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```
 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`

```
1  V=400
2  Ia=50
3  n=500
4  Ra=0.5
5  Ea=V-Ia*Ra
6  Tdev=Ea*Ia/2/%pi/n*60
7
8  Iastart=75
9  Rs=V/Iastart-Ra
10 disp(Rs)
11 Tstart=Tdev*(Iastart/Ia)^2
12 disp(Tstart)
13
14 n2=200
15 Ea200=Ea*n2/n
16 Rs=(V-Ea200)/Iastart-Ra
17 disp(Rs)
```

Scilab code Exa 10.23 `Problem23`

```
1  n1=1200
2  Rfcrit=260/4
3  n2=1600
4  Vfactor=n2/n2
5  Vnl=395
6  disp(Vnl)
```

Scilab code Exa 10.24 `Problem24`

```
1
2  Ia=500
3  Ra=0.05
4  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`

```
1  P =1000000
2  Vrated =6600
3  If =60
4  Xs_unsat =4700/ sqrt (3) /98
5  disp ( Xs_unsat )
6  Xs_adj = Vrated / sqrt (3) /143
7  disp ( Xs_adj )
8
9  Ia=P/ sqrt (3) / Vrated
10 pf =0.8
11 theta =- acos ( pf )
12 Ia=Ia *( exp (%i* theta ))
13 Ef= norm ( Vrated +%i* Xs_adj * Ia* sqrt (3) )
14 disp ( Ef )
15 VR= Ef / Vrated -1
16 disp ( VR )
```

Scilab code Exa 11.2 `Problem2`

```
 1  P =45000
 2  V =440
 3  pf =0.8
 4  Ia=P/sqrt(3)/V*exp(%i*acos(pf))
 5  Vt=V/sqrt(3)
 6  Rs =0.2
 7  Xs =1.8
 8  Ef=norm(Vt-Ia*(Rs+%i*Xs))
 9  If =Ef/85
10  Pein=pf*P
11  Rf =35
12  Fl=If*If*Rf
13  Pin=Pein+Fl
14  Pcu=norm(3*Ia*Ia*Rs)
15  Pshaft=Pein-Pcu
16  Prl=1500
17  Pshaft_net=Pshaft-Prl
18  effi=Pshaft_net/Pin
19
20  disp(Pshaft_net)
21  disp(If)
22  disp(effi)
```

Scilab code Exa 11.3 `Problem3`

```
 1  V =12500
 2  Xs =8
 3
 4  Vt=V/sqrt(3)
 5  Ef=Vt
 6
 7  Ef=Vt*1.2
 8  Ia=(Ef-Vt)/Xs
 9  theta=%pi/2
10  pf =0
```

```
11  Pe =0
12  Qe =-sqrt(3)*V*Ia
13  disp(Ia)
14  disp(Pe)
15  disp(Qe)
16  disp(pf)
17
18  Ef=Vt*0.8
19  Ia=(Vt-Ef)/Xs
20  theta=-%pi/2
21  pf=0
22  Pe=0
23  Qe=sqrt(3)*V*Ia
24  disp(Ia)
25  disp(Pe)
26  disp(Qe)
27  disp(pf)
```

Scilab code Exa 11.4 `Problem4`

```
1   Pe =10000000
2   V=12500
3   Xs=8
4   Vt=V/sqrt(3)
5   Ef=Vt*1.2
6
7   delta=asin(Pe/3/Vt/Ef*Xs)
8   Ia=(Ef*exp(%i*delta)-Vt)/%i/Xs
9   pf=real(Ia)/norm(Ia)
10  Qe=-sqrt(3)*V*imag(Ia)
11
12  disp(norm(Ia))
13  disp(pf)
14  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
```

```
29  Ef =300/ sqrt (3)
30  Ia=(Vt -Ef )/%i/Xs
31  kVAR=sqrt (3) *400* norm (Ia)
32  disp (norm (Ia))
33  disp (real (Ia)/norm (Ia))
34  disp (kVAR)
35  L=Vt/norm (Ia)/2/%pi/f
36
37  kVAR =6000
38  Ia=kVAR/sqrt (3)/400*%i
39  Ef =Vt -%i*Xs*Ia
40  disp (Ef*sqrt (3))
```

Scilab code Exa 11.12 `Problem12`

```
 1  P =1000000
 2  V =6600
 3  Xs =25
 4  pf =0.8
 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  delta=asin (norm (Xs*Ia*cos (theta)/Ef))
10  Vt=norm (Ia)*Xs*sin (%pi -asin (pf)-delta)/sin (delta)
11  Vl=Vt*sqrt (3)
12  disp (Vl)
```

Scilab code Exa 11.13 `Problem13`

```
 1
 2
 3  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

```
 1  V=400
 2  P0=1210
 3  I0=8.7
 4  Ri=(V/sqrt(3))^2/P0*3
 5  disp(Ri)
 6  pf=P0/sqrt(3)/V/I0
 7  theta0=acos(pf)
 8  Xm=Ri/tan(theta0)
 9  disp(Xm)
10
11  P1=6050
12  V1=200
13  I1=47.8
14  R=P1/3/I1/I1
15  R1=0.42
16  disp(R1)
17  R2=R-R1
18  disp(R2)
19  Z=V1/sqrt(3)/I1
20  X=sqrt(Z*Z-R*R)
21  disp(X)
22
23  ns=750
24  n=710
25  ws=ns*2*%pi/60
26  s=1-n/ns
27  Z=R1+R2/s+%i*X
28  I2=V/sqrt(3)/Z
29  I0=I0*exp(-%i*theta0)
30  I1=I0+I2
31  disp(norm(I1))
32  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
```

```
9  T=2*100.6/((R2/s)^2+X2^2)*R2/s    //some mistake in
       the book at this point. (What is V1/a)
10 T=105
11 disp(T)
12
13 R2ext=X2-R2
14 disp(R2ext)
```

Scilab code Exa 12.13 `Problem13`

```
1  V=400
2  Poutmech =5000
3  Prl =285
4  Pm=Poutmech+Prl
5  s=1 -1445/1500
6  s2=1 -900/1500
7
8
9
10 p=poly([0,-(1-s)*V*V/Pm/s,1/s/s+1/s2/s2],"R2","coeff
       ")
11 r=roots(p)
12 R2=r(1)
13 X2=R2/s2
14
15 ws=2*%pi*1500/60
16 Tmax=3/ws*V*V/3*0.5/X2
17 disp(Tmax)
```

Scilab code Exa 12.14 `Problem14`

```
1  Pmout =20000
2  Pwfl =1500
```

```
 3  Pm = Pmout + Pwfl
 4  disp ( Pm )
 5  ns = 1500
 6  n = 1440
 7  s = 1 - n / ns
 8  Pg = Pm / ( 1 - s )
 9  disp ( Pg )
10  Pcu = s * Pg
11  disp ( Pcu )
```

Scilab code Exa 12.15 `Problem15`

```
 1  V1 = 400
 2  R1 = 2.28 * 3 / 2
 3  R1ac = 1.1 * 3.42
 4
 5  Y0 = 3.5 / sqrt (3) / V1
 6  Gi = (445/3) / V1 / V1
 7  Bm = sqrt ( Y0^2 - Gi^2 )
 8  Ri = 1 / Gi
 9  Xm = 1 / Bm
10
11  V2 = 200
12  Z = V2 / 16.7 * sqrt (3)
13  R = 2220 / 16.7 / 16.7
14  X = sqrt ( Z * Z - R * R )
15  R2 = R - R1ac
16
17  n = 935
18  ns = 1000
19  s = 1 - n / ns
20  Z = R1ac + R2 / s + %i * X
21  I2 = V1 / Z
22  Ii = V1 / Ri - %i * V1 / Xm
23  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
```

```
 6  R4=160
 7  Rg=80
 8  s=8
 9
10  Eth=E*(R2/(R2+R4)-R1/(R1+R3))
11  Rth=R1*R3/(R1+R3)+R2*R4/(R2+R4)
12  Ig=Eth/(Rth+Rg)
13  D=s*Ig*1000000
14  disp(D)
```

Scilab code Exa 14.6 Problem6

```
 1  function Zeq=parallel(Z1,Z2)
 2      Zeq=Z1*Z2/(Z1+Z2)
 3  endfunction
 4
 5  f=1000
 6  w=2*%pi*f
 7
 8  ///AB
 9  R=2000
10  C=0.045E-6
11  Xc=1/%i/w/C
12  Z1=parallel(R,Xc)
13
14  ////BC
15  R=1000
16  C=0.45E-6
17  Xc=1/%i/w/C
18  Z2=R+Xc
19
20  ////AD
21  C=0.4E-6
22  Z3=1/%i/w/C
23
```

```
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 =8 E6
 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`

```
1  f =50
2  w=2*%pi*f
3
4  Z2 =1000
5  Z3 =16800
6
7  C=0.38E-6
8  Xc =1/%i/w/C
9  Z4 =833+Xc
10
11 Z1=Z2*Z3/Z4
12 Rx=real(Z1)
13 Lx=imag(Z1)/w
14
15 disp(Rx)
16 disp(Lx)
```

Scilab code Exa 14.18 `Problem18`

```
1  f =50
2  w=2*%pi*f
3  T=1/f
4
5  Iav =1/(T/2)*integrate('sin(w*t)','t',0,T/2)
6  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
```

```
10  Vol1=2*l*A1
11  disp(Vol1)
12
13  Il=P/sqrt(3)/V
14  A2=3*Il*Il*rho*l/Pl
15  Vol2=3*l*A2
16  disp(Vol2)
```

Scilab code Exa 15.3 Problem3

```
1  f=50
2  w=2*%pi*f
3  I=0.8
4  V=220
5  P=75
6  phi=acos(P/V/I)
7
8  phi_new=acos(0.9)
9  Ic=I*cos(phi)*(tan(phi)-tan(phi_new))
10  C=Ic/V/w
11  disp(C)
12
13  phi_new=acos(1)
14  Ic=I*cos(phi)*(tan(phi)-tan(phi_new))
15  C=Ic/V/w
16  disp(C)
```

Scilab code Exa 15.4 Problem4

```
1  Cond_cost=100
2  charge=60
3  phi2=asin(0.1*Cond_cost/charge)
4  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)
```