Scilab Textbook Companion for
Basic Electrical And Electronics Engineering
by R. R. Singh[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.

Contents

List of Scilab Codes

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Chapter 1

Basic Circuit Concepts

Scilab code Exa 1.2 Find Resistance

```
1 //Chapter 1,Example 1.2,Pg 1.10
2 clc;
3 l=2000*10^3 //length of the cable in metres
4 d=0.7*10^-2 //diameter of the cable in metres
5 p=(1/58)*10^-6 //ohms per m for 1sq mm cross
      sectional area
6 A=(%pi*d^2)/4
7 R=(p*l)/A
8 printf("\n Resistance = %.2f ohms \n",R)
```

Scilab code Exa 1.3 Resistance

```
1 //Chapter1,Example1.3,Pg1.10
2 printf("\n Diameter of wire=d\n")
3 printf("\n Length of wire=l\n")
4 printf("\n Resistance of wire = 4pl/A\n")
5 printf("\n For another wire diameter =2d\n")
6 printf("\n length =4l\n")
```

```
7  printf (" \n  Hence  Resistance  =  4pl/A")
8  printf (" \n  Hence  Resistance  =  R\n")
```

Scilab code Exa 1.4 `Resistance`

```
1   //Chapter1 , Example1.4 , Pg1.10
2   clc;
3   l1=100 //length of the wire in metres
4   A1=0.1*10^-6 //area of the wire in metres
5   p=50*10^-8 //resistivity of the wire in ohm metre
6   R1=p*l1/A1
7   printf (" \n  Resistance  before  drawing  out  the  wire  =
        %1f  ohms\n",R1)
8   printf (" \n  Volume  of  the  wire  before  drawing  out=
        Volume  of  the  wire  after  drawing  out  \n")
9   A2=A1/3
10  l2=3*l1
11  R2=p*l2/A2
12  printf (" \n  Resistance  after  drawing  out  =  %1f  ohms  \
        n",R2)
13  a=R2/R1
14  printf (" \n  The  Ratio  of  the  resistances  is  =  %1f  \n"
        ,a)
```

Scilab code Exa 1.5 `Resistance`

```
1   clc;
2   //Chapter 1, Example 1.5 , Pg 1.11
3   printf (" \n  For  silver  wire  R1  =  (p1  X  l1)/A1  \n")
4   printf (" \n  For  Manganin  wire  R2=  (p1  X  l2)/A2  \n")
5   printf ("R2/R1  =  (p2  X  l2  X  A1)/(p1  X  l1  X  A2)\n")
6   R1=2 //resistance of silver wire in ohms
```

```
 7 d1=1 //assuming the diameter of the silver wire to
      be 1 unit
 8 d2=d1/3
 9 l1=1 //assuming the length of the silver wire to be
      1 unit
10 l2=l1/3
11 p1=1 //assuming the resistivity of silver wire is 1
      unit
12 p2=30*p1
13 A1=%pi*d1^2/4
14 A2=%pi*d2^2/4
15 R2=p2*l2/A2
16 Rone=p1*l1/A1
17 R=R2/Rone
18 R2=R1*R
19 printf("\n Resistance of manganin wire = %.0f ohms\n
      ",R2)
```

Scilab code Exa 1.6 `Resistance`

```
 1 //Chapter 1,Example 1.6,Pg 1.11
 2 clc;
 3 R10=80 //Resistance at 10 degrees Celsius
 4 R60=96.6 //Resistance at 60 degrees Celsius
 5 disp("R10=R0(1 + 10a0)")
 6 disp("R60=R0(1 + 60a0)")
 7 disp("Divide both the equations")
 8 disp("96.6/80 = (1 +60a0)/(1+10a0)")
 9 a0=(96.6-80)/(4800-966)
10 at=a0/(1+a0*60)
11 printf("\n Temp coeff at 60 degrees= %1f per degree
      C\n",at)
```

Scilab code Exa 1.7 `Resistance`

```
1  //Chapter1,Example 1.7,Pg1.12
2  function[at]=a0toat(a0)
3      t=temp;
4      at=a0/(1+a0*t)
5  endfunction
6  function[a0]=attoa0(at)
7      t=temp;
8      a0=at/(1-at*t)
9  endfunction
10 clc;
11 at=1/254.5 //given
12 temp=20 //temperature
13 a00=attoa0(at) //storing the returned temperature
       coefficient in variable a00
14 printf("\n Temp coeff = %.6f per degree C \n",a00)
15 temp=60
16 at1=a0toat(a00)
17 printf("\n Temp coeff at 60 degress = %8f per degree
       C \n",at1)
```

Scilab code Exa 1.8 `Resistance`

```
1  //Chapter 1,Example 1.8,Pg 1.12
2  clc;
3  disp("We know that R1 = R0(1+a0t)")
4  disp("At t1=20 degree C, R1=45 ohms")
5  R0=45/(1+0.004*20)
6  disp("At t2, R2=48.5 ohms")
7  disp("Therefore, we can calculate t2 as follows")
8  disp("45/48.5 = (1+0.004*20)/(1+0.004t2)")
9  t2=(48.5-R0)/(0.004*R0)
10 printf("\n Therefore t2= %.0f degree C \n",t2)
```

Scilab code Exa 1.9 `Resistance`

```
1  //Chapter 1, Example 1.9,Pg 1.13
2  clc;
3  disp("We know that Rt = R0(1+a0*t)")
4  disp("At t1=20 degree C, R1=18 ohms")
5  disp("18=R0(1+20*a0)")
6  disp("At t2=50 degree C R2=20 ohms")
7  disp("20=R0(1+50a0)")
8  a0=20-18/(900-400) //Divide both the equations
9  printf("\n a0=%.3f per degree c \n",a0)
10 t=(21+1.68-18)/0.072
11 printf("\n Therefore temp t = %.0f degrees C \n",t)
```

Scilab code Exa 1.10 `Resistance`

```
1  //Chapter 1,Example 1.10,Pg1.13
2  clc;
3  Ra0=120
4  Rb0=180
5  Aa=0.0035
6  Ab=0.008
7  A=(Ra0*Aa+Rb0*Ab)/(Ra0+Rb0)
8  printf("\n The series combination of the two = %.4f
       per degree C\n",A)
```

Scilab code Exa 1.11 `Resistance`

```
1  //Chapter1,Example1.11,Pg1.14
```

```scilab
2  function [R2] = myfunction(R1)
3      temp1=t1
4      temp2=t2
5      a=a0
6      R2=R1*(1+a0*(temp2-temp1))
7  endfunction
8  function[alpha]=coefficient(a1)
9      temp1=t1
10     temp2=t2
11     alpha=a1/(1+a1*(temp2-temp1))
12     endfunction
13 clc;
14 t1=30
15 t2=50
16 a0=0.003
17 A1=coefficient(a0)
18 r1=myfunction(150)
19 a0=0.002
20 A2=coefficient(a0)
21 r2=myfunction(350)
22 printf("\n Series combination=%.0f ohms \n",r1+r2)
23 printf("\n Parallel combination=%.2f ohms \n",r1*r2
       /(r1+r2))
24 printf("\n For first coil a50=%.4f per degree C \n",
       A1)
25 printf("\n For second coil a50=%.5f per degree C \n"
       ,A2)
```

Scilab code Exa 1.12 Resistance

```scilab
1 //Chapter1,Example1.12,Pg1.17
2 clc;
3 disp("When a wire is bent in the form of a circle,
       its resistance gets divided between any two
       points on its diameter as the resistance is
```

```
      directly  proportional  to  its  length.  The  two
      parts  can  be  considered  as  two  resistors  of  6ohms
       in  parallel")
4 R=6*6/(6+6)
5 printf("\n  Hence  equivalent  resistance  R=%.0f  ohms  \
      n",R)
```

Scilab code Exa 1.14 `Resistance`

```
1 //Chapter1 ,Example  1.14 ,Pg1.18
2 clc;
3 disp("Refer  to  the  figure  shown  in  the  problem")
4 R=1/((1/25)+(1/50)+(1/50))+2+8
5 printf("\n  Equivalent  resistance  between  A  and  B  =  %
      .1f  ohms  \n",R)
```

Scilab code Exa 1.15 `Resistance`

```
1 //Chapter1 ,Example1.15 ,Pg1.19
2 clc;
3 disp("Refer  to  the  figure  shown  in  the  problem")
4 R1=4*4/(4+4) //Equivalent  resistance  of  the  upper
      triangular  network
5 R2=3*3/(3+3) //Equivalent  resistance  of  the
      triangular  network  on  right
6 R3=2*(R1+R2)/(2+R1+R2)
7 R=2*(R3+1)/(2+R3+1)
8 printf("\n  Equivalent  resistance  =%.2f  ohms  \n",R)
9 I=30/R
10 printf("\n  Current=%.1f  A  \n",I)
```

Scilab code Exa 1.16 `Resistance`

```
1  //Chapter1 , Example 1.16 , Pg1.20
2  clc;
3  disp(" Refer to the figure given in the problem")
4  R1=4*4/(4+4)  //Equivalent resistance of the upper
       triangle shown in the figure obtained by the
       reduction of the upper left and right triangular
       resistance networks
5  R2=3*3/(3+3)
6  R3=(2*(R1+R2))/(2+R1+R2)
7  R=1/((1/5)+(1/2)+(1/(R3+1)))
8  printf("\n Equivalent resistance =%.2 f ohms \n",R)
9  I=50/R
10 printf("\n Current = %.2 f A \n",I)
```

Scilab code Exa 1.18 `Resistance`

```
1  //Chapter1 , Example 1.18 ,Pg 1.23
2  clc;
3  I=30/15
4  disp(" Refer to the diagram given in the question")
5  printf("\n Current through the 15 ohm resistor is
       given by I= 30/15 = %.0 f A \n",I)
6  printf(" Current through the 5 ohm resistance = 5+2=
       %.0 f A" ,5+2)
7  disp(" Applying KVL to the closed path and thus
       obtaining the result we can say")
8  disp(" −5(7)−R( I )+100−30=0")
9  R=(100-30-35)/2
10 printf("\n R= %.1 f ohms \n",R)
```

Scilab code Exa 1.19 `Resistance`

```
1  //Chapter 1,Example 1.19,Pg 1.24
2  clc;
3  disp("Refer to the figure shown in the diagram")
4  disp("Assign branch currents as shown in the figure"
       )
5  disp("I2-I3=13")
6  disp("-20I1+8I2=0")
7  disp("-12I1-16I2=0")
8  disp("By solving the equations we can obtain the
       result as follows")
9  A=[0 1 -1;-20 8 0;-12 0 -16]
10 B=[13;0;0]
11 I=A\B
12 printf("\n I1= %.0f A \n",I(1,:))
13 printf("\n I2= %.0f A \n",I(2,:))
14 printf("\n I3= %.0f A \n",I(3,:))
```

Scilab code Exa 1.21 Resistance

```
1  //Chapter 1,Example 1.21,Pg1.26
2  clc;
3  disp("Refer to the figure shown in the question")
4  disp("Let the branch current be as follows")
5  disp("IOA=x")
6  disp("IOB=1-x")
7  disp("IAB=y")
8  disp("IBC=1-x-y")
9  disp("IAC=x+y")
10 A=[3 -3;9 12]
11 B=[2;4]
12 XY= A\B
13 x=XY(1,1)
14 y=XY(2,1)
15 IOA=x
16 IOB=1-x
```

```
17  IAB=y
18  IBC=1-x-y
19  IAC=x+y
20  printf("\n IOA=%.2f A \n",IOA)
21  printf("\n IOB=%.2f A \n",IOB)
22  printf("\n IAB=%.3f A \n",IAB)
23  printf("\n IBC=%.3f A \n",IBC)
24  printf("\n IAC=%.3f A \n",IAC)
```

Scilab code Exa 1.22 Resistance

```
1  //Chapter 1,Example1.26,Pg1.22
2  clc;
3  disp("Refer to the figure shown in the question")
4  I1=2/5
5  I2=4/8
6  printf("\n I1= %.1f A \n",I1)
7  printf("\n I2=%.1f A \n",I2)
8  Vxy=3*I2-3*I1-4
9  printf("\n Vxy=%.1f V",Vxy)
```

Scilab code Exa 1.23 Resistance

```
1  //Chapter 1,Example 1.23,Pg1.27
2  clc;
3  disp("Refer to the figure shown in the diagram")
4  I1=20/15 //Voltage in the loop divided by the sum of
       resistances
5  I2=15/10 //Voltage in the loop divided by the sum of
       resistances
6  printf("\n I1=%.2f A \n",I1)
7  printf("\n I2=%.1f A \n",I2)
8  Vab=5*I1-6*I2+5+15 //By applying KVL to the loop
```

```
9  printf("\n Vab=%.2f V",Vab)
```

Scilab code Exa 1.24 Resistance

```
1  //Chapter 1,Example1.24,Pg1.27
2  clc;
3  disp("Refer to the figure shown in the problem")
4  I1=5/2 //The 3ohms resistance gets shorted hence
       current flows only through the 2 ohms resistor
5  I2=2
6  printf("\n I1=%.1f A \n",I1)
7  printf("\n I2=%.0f A \n",I2)
8  Vab=2*I1-8+5*I2
9  printf("\n Vab=%.0f V \n",Vab)
```

Scilab code Exa 1.25 Resistance

```
1  //Chapter 1,Example1.25,Pg1.28
2  clc;
3  disp("Refer to the figure shown in the problem")
4  I1=10/8 //Voltage divided by the sum of the
       resistances
5  I2=5 //Current in the second loop is indicated by a
       current source of 5A
6  printf("\n I1=%.2f A \n",I1)
7  printf("\n I2=%.0f A \n",I2)
8  //Apply KVL to the path from A to B
9  Vab=3*I1+8-3*I2
10 printf("\n Vab=%.2f V \n",Vab)
```

Scilab code Exa 1.26 `Resistance`

```
1  //Chapter1,Ex1.26,Pg1.29
2  function [current1] = voltagetocurrent(voltage1)
3      resistance1=R
4      current1=voltage1/resistance1
5  endfunction
6  function[voltage2]=currenttovoltage(current2)
7      resistance2=R
8      voltage2=current2*resistance2
9  endfunction
10 clc;
11 disp("Refer to the figure shown in the question")
12 R=5 //Resistance in ohms
13 I1=voltagetocurrent(20) //Converting voltage source
       with series resistance to current source with
       parallel resistance
14 I=I1+3 //Total of the current sources in the circuit
15 R=1/((1/30)+(1/50)+(1/5)+(1/6)) //Equivalent
       resistance in the circuit
16 V1=currenttovoltage(I) //Converting current source
       with parallel resistance to voltage source with
       series resistance
17 printf("\n Equivalent resistance in network = %.2f
       ohms \n",R)
18 printf("\n Equivalent voltage source in network = %
       .2f V \n",V1)
```

Scilab code Exa 1.27 `Resistance`

```
1  //Chapter1,Example1.27,Pg1.30
2  clc;
3  disp("Since the 5 ohms resistor is connected in
       parallel with 20V source,it becomes redundant")
4  I=20.00/6.00 //Converting 20V in series with 6 ohms
```

```
      to  current  source  in  parallel  with  6  ohms
5  I=I+10
6  printf("\n  Total  current  in  circuit  =  %.2f  A  \n",I)
7  printf("Equivalent  resistance  =  %.0f  ohms  \n",6)
```

Scilab code Exa 1.28 Resistance

```
1  //Chapter1 , Example1.28 , Pg30
2  function [current1] = voltagetocurrent(voltage1)
3      resistance1=R
4      current1=voltage1/resistance1
5  endfunction
6  function[voltage2]=currenttovoltage(current2)
7      resistance2=R
8      voltage2=current2*resistance2
9  endfunction
10  clc;
11  disp("Refer  to  the  figure  shown  in  the  diagram")
12  R=3 //Resistance  in  ohms
13  I1=voltagetocurrent(6) //Converting  voltage  source
       with  series  resistance  to  current  source  with
       parallel  resistance
14  R=2
15  I2=voltagetocurrent(4)
16  R=1
17  I3=voltagetocurrent(3)
18  R1=2*2/(2+2) //Equivalent  resistance  of  upper
       portion
19  R2=3*1/(3+1) //Equivalent  resistance  of  lower
       portion
20  I11=1+I2 //Total  current  of  upper  portion
21  I12=-I1+I3 //Total  current  of  lower  portion
22  R=R1
23  V1=currenttovoltage(I11)
24  R=R2
```

21

```
25  V2 = currenttovoltage ( I12 )
26  V = V1 + V2
27  R = R1 + R2
28  printf ( " \n  Total  voltage  source  =  %.2 f  V  \n " , V )
29  printf ( " \n  Total  equivalent  resistance  =  %.2 f  ohms  \
        n " , R )
```

Scilab code Exa 1.29 Resistance

```
1  // Chapter1 , Example1.29 , Pg1.32
2  function  [ current1 ]  =  voltagetocurrent ( voltage1 )
3      resistance1 = R
4      current1 = voltage1 / resistance1
5  endfunction
6  function [ voltage2 ]= currenttovoltage ( current2 )
7      resistance2 = R
8      voltage2 = current2 * resistance2
9  endfunction
10 clc ;
11 disp ( " Refer  to  the  diagram  shown  in  the  figure " )
12 R =3  // Resistance  in  ohms
13 I = voltagetocurrent ( 10 )
14 I = I +10  // Total  current  in  the  circuit
15 R =3*2/(3+2)
16 V = currenttovoltage ( 13.33 )
17 I =(50 -16) /(5+1.2)  // Current  in  the  circuit
18 P =50* I  // Power  delivered  by  the  50V  source
19 printf ( " \n  Power  delivered  by  the  50V  source=%.0 f  W
        \n " , P )
```

Scilab code Exa 1.30 Resistance

```
1  // Chapter1 , Example1.30 , Pg1.32
```

```
2  function [current1] = voltagetocurrent(voltage1)
3      resistance1=R
4      current1=voltage1/resistance1
5  endfunction
6  function[voltage2]=currenttovoltage(current2)
7      resistance2=R
8      voltage2=current2*resistance2
9  endfunction
10 clc;
11 disp("Refer to the figure shown in the problem")
12 R=2 //Resistance in ohms
13 V=currenttovoltage(5) //Converting current source
      with parallel resistance to voltage source with
      series resistance
14 V=V-6 //Equivalent resistance in the closed path
15 I=voltagetocurrent(V) //Converting voltage source
      with series resistance to current source with
      parallel resistance
16 I=I+2 //Total current provided by combination of
      current sources in circuit
17 I4=I*2/(2+4) //Current through the 4 ohm resistance
18 printf("\n Current through the 4 ohm resistance = %
      .2f A \n",I4)
```

Scilab code Exa 1.31 `Resistance`

```
1 //Chapter1 ,Example1.31 ,Pg1.33
2 function [current1] = voltagetocurrent(voltage1)
3      resistance1=R
4      current1=voltage1/resistance1
5  endfunction
6  function[voltage2]=currenttovoltage(current2)
7      resistance2=R
8      voltage2=current2*resistance2
9  endfunction
```

```
10  clc;
11  disp("Refer to the figure shown in the diagram")
12  disp("Since nodes 1 and 2 are maintained at the same
          voltage by the sources, the connection between
        nodes 1 and nodes 2 is removed. Now the two
        voltage sources have resistors in series and
        source transformation can be applied")
13  R=4 //Resistance in ohms
14  I=voltagetocurrent(18) //Converting voltage source
        with series resistance to current source with
        parallel resistance
15  R=4*2/(4+2) //Since the 4 ohm and 2 ohm resistances
        are in parallel
16  V=currenttovoltage(I) //Converting current source
        with parallel resistance to voltage source with
        series resistance
17  Va=(6+(5.985/2.33))/((1/3)+(1/2.33)+(1/6))
18  printf("\n Voltage at node A = %.2f V \n",Va)
```

Chapter 2

DC CIRCUITS

Scilab code Exa 2.1 Equivalent resistance

```scilab
1  //Chapter 2,Ex 2.1,Pg 2.4
2  function [resistance_1] = deltatostar(R)
3      resistance1=R1
4      resistance2=R2
5      resistance_1= (resistance1*resistance2)/R
6  endfunction
7  clc;
8  disp("Refer to the diagram shown in the figure")
9  R1=4.5 //Resistance in ohms
10 R2=7.5 //Resistance in ohms
11 R3=3 //Resistance in ohms
12 R=R1+R2+R3
13 Ra=deltatostar(R) //Converting the given delta
       network to star network
14 R2=3 //Resistance in ohms
15 Rb=deltatostar(R) //Converting delta network to star
       network
16 R1=7.5
17 Rc=deltatostar(R) //Converting delta network to star
       network
18 R_1= 1/((1/(Rb+Rb+4)) + (1/(Rc+Rc+3)))
```

```
19  R_eq=(2*Ra) + R_1 // Equivalent resistance of the
        entire network
20  printf("\n The equivalent resistance R = %.2f ohms \
        n",R_eq)
```

Scilab code Exa 2.2 Equivalent resistance

```
1  //Chapter 2,Ex 2.2,Pg 2.5
2  function [resistance_1] = deltatostar(R)
3  resistance1=R1
4  resistance2=R2
5  resistance_1= (resistance1*resistance2)/R
6  endfunction
7  clc;
8  disp("Refer to the diagram shown in the problem")
9  R1=10 //Resistance in ohms
10 R2=10 //Resistance in ohms
11 R3=10 //Resistance in ohms
12 R=R1+R2+R3
13 Ra=deltatostar(R) //Converting the delta network to
        star network of resistances. All the resistances
        in the star network will be the same as the
        resistances in the delta network have the same
        value
14 R_1= 1/(1/(Ra+10) + 1/(Ra+10))
15 R_eq=Ra+R_1
16 printf("\n The equivalent resistance R= %.0f ohms\n"
        ,R_eq)
```

Scilab code Exa 2.3 Equivalent resistance

```
1  //Chapter 2,Ex 2.3,Pg 2.7
2  function [resistance_1] = startodelta(R)
```

```
3      resistance_1= (R1*R + R2*R + R1*R2)/R
4  endfunction
5  clc;
6  disp("Refer to the diagram shown in the figure")
7  R1=6 //One of the Resistances of the star network to
         be converted into delta
8  R2=4 //One of the Resistances of the star network to
         be converted into delta
9  R3=3
10 //To find out individual resistances of the star
         network
11 Ra=startodelta(R3)
12 R3=4
13 R2=3
14 Rb=startodelta(R3)
15 R3=6
16 R1=4
17 Rc=startodelta(R3)
18 R_1= 1/((1/Ra) + (1/9))
19 R_2= 1/((1/Rb)+(1/1.5))
20 R_eq= 1/((1/6) + (1/(R_2+0.9)))
21 printf("\n Equivalent resistance R= %.2f ohms\n",
         R_eq) //Equivalent resistance of the circuit
```

Scilab code Exa 2.4 Equivalent resistance

```
1  //Chapter 2,Ex2.4,Pg 2.8
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  R=6+6+6 //Total resistance of the delta network in
         the left part of the circuit
5  r1=6*6/(R) //Delta to star conversion
6  R=15+15+15 //Total resistance of the delta network
         in the right part of the circuit
7  r2=15*15/R
```

```
8  R_1 =1/(1/( r1 +41+ r2 ) + 1/( r1 +17+ r2 ))
9  R_eq=R_1+r1+r2
10 printf("\n The  equivalent  resistance  R = %.0 f  ohms\n
       ",R_eq)
```

Scilab code Exa 2.6 Equivalent resistance

```
1  //Chapter2 ,  Ex2.6 ,Pg  2.11
2  function  [R]  =  deltatostar (R1 ,R2 ,R3 ,n)
3       Rtotal =R1+R2+R3
4       if(n ==1)
5            R=R1*R2/ Rtotal
6       elseif (n ==2)
7            R=R2*R3/ Rtotal
8       else
9            R=R1*R3/ Rtotal
10               end
11 endfunction
12 clc ;
13 disp("Refer  to  the  diagram  shown  in  the  figure")
14
15 r1=deltatostar (20 ,5 ,15 ,1)  //Converting  delta  network
       to  star  network
16 r3=deltatostar (20 ,5 ,15 ,2)
17 r2=deltatostar (20 ,5 ,15 ,3)
18 r1 '=r1
19 R1=r3+2
20 R2=r2+30
21 r1=deltatostar (R1 ,R2 ,30 ,1)
22 r2=deltatostar (R1 ,R2 ,30 ,2)
23 r3=deltatostar (R1 ,R2 ,30 ,3)
24 Req =1/(1/( r1 '+r1 +10)  +  1/(15+ r3 ))  +  r2
25 printf("\n The  equivalent  resistance  R= %.2 f  ohms\n"
       ,Req)
```

Scilab code Exa 2.7 Equivalent resistance

```
1  //Chapter 2,Ex2.7,Pg2.13
2  function [r_1] = startodelta(r1,r2,r3) //Function
       that converts star network to equivalent delta
       network
3      r_1=ones(1:3)
4      Rtotal=(r1*r3 + r2*r3 + r1*r2)
5      r_1(1)=Rtotal/r1
6      r_1(2)=Rtotal/r2
7      r_1(3)=Rtotal/r3
8  endfunction
9  function[r_2]=deltatostar(r1,r2,r3) //Function that
       converts delta network to equivalent star network
10     Rtotal=r1+r2+r3
11     r_2=ones(1:3)
12     r_2(1)=r1*r2/Rtotal
13     r_2(2)=r2*r3/Rtotal
14     r_2(3)=r1*r3/Rtotal
15     endfunction
16 clc;
17 disp("refer to the figure shown in the diagram")
18 R=startodelta(8,5,3)
19 R_1=R(2)*5/(R(2)+5) //Parallel combination of
       resistances
20 R_2=R(3)*4/(R(3)+4) //Parallel combination of
       resistances
21 R1=deltatostar(R_1,R(1),R_2)
22 Req=1/(1/(6+R1(1)) + 1/(4+R1(2))) +R1(3)
23 printf("\n The equivalent resistance R= %.2f ohms\n"
       ,Req)
```

Scilab code Exa 2.9 Find current

```
1 //Chapter 2,Ex2.9,Pg 2.18
2 clc;
3 disp("Refer to the diagram shown in the figure")
4 A=[10 -3 -6;-3 10 0;-6 0 10]
5 B=[10; -5; 25]
6 I=A\B
7 printf("\n Current through the 5 ohms resistor=%.2f
     A\n",I(2))
```

Scilab code Exa 2.10 Find current through 2ohm resistor

```
1 //Chapter 2,Ex2.10,Pg 2.19
2 clc;
3 disp("Refer to the diagram shown in the figure")
4 A=[7 -1 0 ;-1 6 -3; 0 -3 13]
5 B=[10; 0; -20]
6 I=A\B
7 printf("\n Current through the 2 ohms resistor=%.2f
     A\n",I(2))
```

Scilab code Exa 2.11 Determine current through 5 ohm resistor

```
1 //Chapter 2,Ex2.11,Pg 2.20
2 clc;
3 disp("Refer to the diagram shown in the figure")
4 A=[3 -1 -2 ;-1 8 -3; -2 -3 10]
5 B=[8; 10; 12]
6 I=A\B
7 printf("\n Current through the 5 ohms resistor=%.2f
     A\n",I(3))
```

Scilab code Exa 2.12 Find current supplied by the battery

```
1 // Chapter 2, Ex2.12, Pg 2.21
2 clc;
3 disp("Refer to the diagram shown in the figure")
4 A=[8 -1 -4 ;-1 8 -5; -4 -5 15]
5 B=[4; 0; 0]
6 I=A\B
7 printf("\n Current supplied by battery=%.2f A\n",I
    (1))
```

Scilab code Exa 2.13 Determine voltage

```
1 // Chapter 2, Ex2.13, Pg 2.22
2 clc;
3 disp("Refer to the diagram shown in the figure")
4 A=[1 -2 -5 ;0 -6 1; 1 1 -10]
5 B=[20; 0; 0]
6 VI=A\B
7 printf("\n Current supplied by battery=%.1f A\n",VI
    (1))
```

Scilab code Exa 2.14 Find current through 2ohm resistor

```
1 // Chapter 2, Ex2.14, Pg 2.22
2 clc;
3 disp("Refer to the diagram shown in the figure")
4 A=[1 0 0 ;0 18 -6; 0 6 -11]
5 B=[6; 108; 9]
```

```
6  I = A \ B
7  printf ("\n Current  through  2 ohms  resistor=%.0f A\n"
       ,I(3))
```

Scilab code Exa 2.15 Find current through 10 ohm resistor

```
 1  // Chapter  2, Ex2.15 , Pg2.23
 2  clc ;
 3  disp ("Refer  to  the  diagram  shown  in  the  figure")
 4  a =[11  -10  0;0  -1  1;2  -3  -3]
 5  b =[2;4;0]
 6  i = a \ b
 7  printf ("\n  I1  =  %.2f  A\n",i(1))
 8  printf ("\n  I2  =  %.2f  A\n",i(2))
 9  printf ("\  I3=%.2f  A\n",i(3))
10  printf ("\n Current  through  10  ohms  resistor  =  %.2f A
       \n",i(1)-i(2))
```

Scilab code Exa 2.16 Find current in 3 ohm resistor

```
 1  // Chapter  2, Ex2.16 , Pg2.24
 2  clc ;
 3  disp ("Refer  to  the  diagram  shown  in  the  figure")
 4  a =[1  0  -1;-1  4  -4;1  -6  3]
 5  b =[7;-7;0]
 6  i = a \ b
 7  printf ("\n  I1  =  %.1f  A\n",i(1))
 8  printf ("\n  I2  =  %.1f  A\n",i(2))
 9  printf ("\  I3=%.0f  A\n",i(3))
10  printf ("\n Current  through  3 ohms  resistor  =  %.1f A\
       n",i(2)-i(3))
```

Scilab code Exa 2.17 Find current in 5 ohm resistor

```
1  //Chapter 2,Ex2.16,Pg2.24
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  a=[15 -10 -5;0 1 -1;-15 12 6]
5  b=[50;2;0]
6  i=a\b
7  printf("\n I1 = %.0f A\n",i(1))
8  printf("\n I2 = %.2f A\n",i(2))
9  printf("\ I3=%.2f A\n",i(3))
10 printf("\n Current through 5 ohms resistor = %.1f A\
       n",i(1)-i(3))
```

Scilab code Exa 2.19 Find voltage at nodes 1 and 2

```
1  //Chapter2,Ex2.20,Pg 2.26
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  a=[2 -1;-1 3]
5  b=[2;4]
6  v=a\b
7  printf("\n V1=%.0f V\n",v(1))
8  printf("\n V2=%.0f V\n",v(2))
```

Scilab code Exa 2.20 Find Va and Vb

```
1  //Chapter2,Ex2.20,Pg2.27
2  clc;
```

```
3 disp(" Refer  to  the  diagram  shown  in  the  figure ")
4 a=[8  -2;-3  9]
5 b=[50;85]
6 v=a\b
7 printf("\n  Va=%.2f  V\n",v(1))
8 printf("\n  Vb=%.2f  V\n",v(2))
```

Scilab code Exa 2.21 Calculate the current through the 5 ohm resistor

```
 1 //Chapter2 ,Ex2.21 ,Pg2.27
 2 clc;
 3 disp(" Refer  to  the  diagram  shown  in  the  figure ")
 4 a=[5  -2  0;10  -31  6;0  -4  9]
 5 b=[-24;300;160]
 6 v=a\b
 7 printf("\n  V1=%.2f  V\n",v(1))
 8 printf("\n  V2=%.2f  V\n",v(2))
 9 printf("\n  V3=%.2f  V\n",v(3))
10 printf("\n  Current  through  5  ohms  resistor  =  %.2f  A\
      n",(v(3)-v(2))/5)
```

Scilab code Exa 2.23 Find Va and Vb

```
1 //Chapter  23,Ex  2.23 ,Pg2.29
2 clc;
3 disp(" Refer  to  the  diagram  given  in  the  question ")
4 A=[4  -2;-2  3]
5 B=[5;4]
6 V=A\B
7 printf("\n  Va=%.2f  V\n",V(1))
8 printf("\n  Vb=%.2f  V\n",V(2))
```

Scilab code Exa 2.24 Find voltage across 5 ohm resistor

```
1  //Chapter 2,Example 2.24,Pg 2.30
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  A=[4 -2 -1;-50 71 -20;-5 -4 10]
5  B=[-24;0;180]
6  V=A\B
7  printf("\n Va=%.2f V\n",V(1))
8  printf("\n Vb=%.2f V\n",V(2))
9  printf("\n Vc=%.2f \n",V(3))
10 printf("\n Voltage across 5 ohms resistor=%.2f \n",V
       (3)-V(2))
```

Scilab code Exa 2.25 Find currents I1 I2 and I3

```
1  //Chapter2,Ex2.25,Pg2.30
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  A=[8 -1;-2 17]
5  B=[50;-500]
6  V=A\B
7  printf("\n V1=%.2f V \n",V(1))
8  printf("\n V2=%.2f V \n",V(2))
9  printf("\n I1=%.2f \n",-V(1)/2)
10 printf("\n I2=%.2f \n",(V(1)-V(2))/10)
11 printf("\n I3=%.2f \n",(V(2)+50)/2)
```

Scilab code Exa 2.26 Find currents and voltages

```scilab
1  //Chapter 2,Ex2.26,Pg 2.31
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  A=[0.5 -0.2;0.1 -0.4]
5  B=[34.2;-32.4]
6  V=A\B
7  printf("\n Va=%.2f V \n",V(1))
8  printf("\n Vb=%.2f V \n",V(2))
9  printf("\n I1=%.0f A \n",(120-V(1))/0.2)
10 printf("\n I2=%.0f A \n",(V(1)-V(2))/0.3)
11 printf("\n I3=%.0f A \n",(110-V(2))/0.1)
```

Scilab code Exa 2.27 Find current in the 10 ohm resistor

```scilab
1  //Chapter 2,Ex2.27,Pg 2.33
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  A=[1 0;-2 17]
5  B=[50;50]
6  V=A\B
7  printf("\n V1=%.0f V \n",V(1))
8  printf("\n V2=%.2f V \n",V(2))
9  printf("\n Current in the 10 ohms resistor = %.2f A\
       n",V(2)/10)
```

Scilab code Exa 2.28 Find V1 and V2

```scilab
1  //Chapter 2,Example 2.28,Pg 2.33
2  clc;
3  disp("Refer to diagram shown in the diagram")
4  A=[6 -5 0;-10 17 -5;0 0 1]
5  B=[-20;0;20]
6  V=A\B
```

```
7  printf("\n Va=%.2f V \n",V(1))
8  printf("\n Vb=%.2f V \n",V(2))
9  printf("\n Vc=%.0f V \n",V(3))
10 printf("\n V1=%.2f V \n",V(1)-V(2))
11 printf("\n V2=%.2f V \n",V(2)-V(3))
```

Scilab code Exa 2.29 Find voltage across the 100 ohm resistor

```
1  //Chapter 2,Ex2.29,Pg 2.33
2  clc;
3  disp("Refer to the figure shown in the diagram")
4  A=[1 0 0;-1 3 -1;-2 -5 10]
5  B=[60;12;24]
6  V=A\B
7  printf("\n Voltage across the 100 ohms resistor=%.2f
       V\n",V(3))
```

Scilab code Exa 2.30 Find current through the 4 ohm resistor

```
1  //Chapter 2,Ex2.30,Pg2.34
2  clc;
3  disp("Refer to the figure shown in the diagram")
4  A=[1 -1;2 1]
5  B=[6;28]
6  V=A\B
7  printf("\n V1=%.2f V\n",V(1))
8  printf("\n V2=%.2f V\n",V(2))
9  printf("\n Current through the 4 ohms resistor=%.2f\
      n",V(2)/4)
```

Scilab code Exa 2.31 Find current through the 4 ohm resistor

```
1  //Chapter 2,Example 2.31,Pg2.35
2  clc;
3  disp("Refer to the figure shown question")
4  A=[1 0 -1;2 -2 1;-5 7 0]
5  B=[8; -12; 80]
6  V=A\B
7  printf("\n V1=%.0f V \n",V(1))
8  printf("\n V2=%.0f V \n",V(2))
9  printf("\n V3=%.0f V \n",V(3))
10 printf("\n Current through the 4 ohms resistor= %.0f
       A \n",V(3)/4)
```

Scilab code Exa 2.42 Find the current between the 2 ohm resistor connected btw A a

```
1  //Chapter 2,Ex2.42,Pg2.53
2  clc;
3  disp("Refer to the diagram shown in the question")
4  A=[14 -12;-12 16] //Apply KVL theorem to obtain the
       required result
5  B=[2;-4]
6  I=A\B
7  Vth=3*I(2)+4 //Thevenin voltage
8  printf("\n Vth=%.1f \n",Vth)
9  R1=((2*12)/(2+12))+1
10 Rth=R1*3/(R1+3)
11 Iload=Vth/(Rth+2)
12 printf("\n Il=%.2f \n",Iload)
```

Scilab code Exa 2.43 Find the current through the 10 ohm resistor

```
1  //Chapter 2,Example2.43,Pg 2.54
```

```
 2 clc;
 3 disp("Refer to the diagram shown in the question")
 4 A=[7 -1;1 -6]
 5 B=[10;0]
 6 I=A\B
 7 Vth=(3*I(2))-20
 8 printf("\n Vth=%.2f V \n",Vth)
 9 R1=[((6*1)/(6+1))+2]
10 Rth=R1*3/(R1+3)
11 printf("\n Rth=%.2f A \n",Rth)
12 Il=Vth/(Rth+10)
13 printf("\n The value of load current = %.2f A \n",Il
     )
```

Scilab code Exa 2.44 Find the current through the 10 ohm resistor

```
 1 //Chapter 2,Example 2.44<pg2.55
 2 clc;
 3 disp("Refer to the diagram shown in the question")
 4 //It can found out by looking at the figure that I1
     =10A
 5 I2=100/50 //Applying KVL
 6 Vth=(5*10)-(20*I2)
 7 Rth=5+(20*30/(20+30))
 8 Iload=10/(Rth+10)
 9 printf("\n Rth=%.0f ohms\n",Rth)
10 printf("\n Il=%.2f A\n",Iload)
```

Scilab code Exa 2.45 Find the current through the 40 ohm resistor

```
 1 //Chapter 2,Ex45,Pg2.56
 2 //Since the 20 ohms resistor is connected across the
      25V source,the resistor becomes redundant
```

```
3  I =35/60
4  Vth =(10* I) -10
5  printf (" \n Vth=%.1 f V \n" ,Vth)
6  Rth =50*10/(50+10)
7  printf (" \n Rth=%.2 f ohms \n" ,Rth)
8  Il=Vth /(Rth+40)
9  printf (" \n Iload=%.2 f A \n" ,Il)
```

Scilab code Exa 2.46 Find the current through the 10 ohm resistor

```
1  //Chapter  2 ,Ex2.46 ,Pg2.57
2  clc ;
3  disp (" Refer to the diagram shown in the question ")
4  I1=50/10
5  I2=20/20
6  Vth =(4* I1) +2 -(15* I2)
7  printf (" \n Vth=%.0 f V \n" ,Vth)
8  Rth =(6*4/(6+4)) +(5*15/(5+15))
9  printf (" \n Rth=%.2 f ohms \n" ,Rth)
10 Il=7/(Rth+10)
11 printf (" \n Iload=%.2 f \n" ,Il)
```

Scilab code Exa 2.47 Find current through the 24 ohm resistor

```
1  //Chapter2 ,Ex2.47 ,Pg2.58
2  clc ;
3  disp (" Refer to the diagram shown in the question ")
4  I1=220/(30+50)
5  I2=220/(20+5)
6  printf (" \n I1=%.2 f A \n" ,I1)
7  printf (" \n I2=%.2 f A \n" ,I2)
8  Vth =(20* I2) -(30* I1)
9  printf (" \n Vth=%.1 f V \n" ,Vth)
```

```
10  Rth=(30*50/(30+50))+(20*5/(20+5))
11  printf("\n Rth=%.2f ohms \n",Rth)
12  Il=Vth/(Rth+24)
13  printf("\n Iload=%.0f A \n",Il)
```

Scilab code Exa 2.49 Find the current through the 20 ohm resistor

```
1   //Chapter 2,Ex2.49,Pg2.61
2   clc;
3   disp("Refer to the diagram shown in the question")
4   A=[30 -15;-15 20]
5   B=[-75;20]
6   I=A\B
7   printf("\n I1=%.1f A \n",I(1))
8   printf("\n I2=%.1f A \n",I(2))
9   Vth=45-(10*(I(1)-I(2)))  //Thevenin Voltage
10  printf("\n Vth =%.0f V \n",Vth)
11  //Converting the delta formed by the resistances
        into star network
12  R1=10*5/(10+5+5)
13  R2=10*5/(10+5+5)
14  R3=5*5/(10+5+5)
15  Rth=((R3+15)*2.5/(R3+15+2.5))+2.5
16  printf("\n Rth=%.2f ohms \n",Rth)
17  Il=Vth/(Rth+20)
18  printf("\n Iload=%.2f A \n",Il)
```

Scilab code Exa 2.50 Find the current through the 3 ohm resistor

```
1   //Chapter 2.Ex2.50,Pg 2.63
2   clc;
3   disp("Refer to the diagram shown in the figure")
```

```
 4  //Simultaneous  equations  have  been  found  by  applying
        Kirchoff's  Laws  to  the  meshes
 5  A=[1  0;-12  18]
 6  B=[6;42]
 7  I=A\B
 8  Vth=6*I(2)
 9  printf("\n  Vth=%.0f  V  \n ",Vth)
10  Rth=6*12/(6+12)  //Thevenin  resistance  of  the  network
11  Il=Vth/(Rth+3)
12  printf("\n  Iload=  %.2f  A  \n",Il)
```

Scilab code Exa 2.51 Find the current through the 30 ohm resistor

```
 1  //Chapter2,Ex2.51,Pg2.64
 2  clc;
 3  disp("Refer  to  the  diagram  shown  in  the  figure")
 4  A=[-1  1;15  100]
 5  B=[13;150]
 6  I=A\B
 7  printf("\n  I1=%.0f  A  \n",I(1))
 8  printf("\n  I2=%.0f  A  \n",I(2))
 9  Vth=(40*I(2))-50
10  printf("\n  Vth=%.0f  V  \n",Vth)
11  Rth=75*40/(75+40)
12  printf("\n  Rth=%.2f  ohms  \n",Rth)
13  Il=Vth/(Rth+30)
14  printf("\n  Iload=%.2f  A  \n",Il)
```

Scilab code Exa 2.53 Find the current through the 20 ohm resistor

```
 1  //Chapter  2,Ex2.53,Pg2.66
 2  clc;
 3  disp("Refer  to  the  diagram  shown  in  the  figure")
```

```
 4  //Applying Kirchoff's laws to mesh 1 and mesh 2 we
         can state the following
 5  I1=10/(10+4) //Current in amperes
 6  I2=2 //Current in amperes
 7  printf("\n I1=%.2f A \n",I1)
 8  printf("\n I2=%.0f \n",I2)
 9  vth=(4*I1)+(8*I2)
10  printf("Vth=%.2f V \n",vth)
11  //Calculation of Rth
12  //From the figure it can be seen that Rth can be
         easily calculated to be the following
13  Rth=(10*4/(10+4))+8
14  printf("\n Rth=%.2f ohms \n",Rth)
15  //Calculation of load current
16  Il=vth/(Rth+20)
17  printf("\n Iload=%.2f A \n",Il)
```

Scilab code Exa 2.54 Find the current through the 5 ohm resistor

```
 1  //Chapter 2,Ex2.54,Pg2.67
 2  clc;
 3  disp("Refer to the diagram shown in the figure")
 4  //Remove the 5 ohms resistor from the network and
         apply Kirchoff's laws
 5  A=[14 -2;-2 5]
 6  B=[150;50]
 7  I=A\B
 8  printf("\n I1=%.2f A \n",I(1))
 9  printf("\n I2=%.2f A \n",I(2))
10  //Calculation of Thevenin Voltage
11  Vth=100-(10*I(1))
12  printf("\n Vth=%.2f V \n",Vth)
13  //Calculation of Thevenin Current
14  Rth=10*3.2/(10+3.2)
15  printf("\n Rth=%.2f ohms \n",Rth)
```

```
16 // Calculation of load current
17 Il=Vth/(Rth+5)
18 printf("\n Iload =%.2 f A \n",Il)
```

Scilab code Exa 2.55 Find the current through the 10 ohm resistor

```
1  // Chapter 2, Ex2.55, Pg2.68
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  // Calculation of Vth
5  // The network is divided into meshes and Kirchoff's
       laws are applied to the meshes to obtain
       simultaneous equations
6  A=[4 -2;-1 4]
7  B=[-25;10]
8  I=A\B
9  printf("\n I1=%.0 f A \n",I(1))
10 printf("\n I2=%.0 f A \n",I(2))
11 Vth=(2*I(1))+(2*I(2))
12 printf("\n Vth=%.0 f V \n",Vth)
13 // Calculation of Rth
14 // Convert star resistances formed by 2 ohms, 2 ohms
       and 1 ohm into an equivalent delta network
15 R1=2*2/(2+2+1)
16 R2=R1 //R1=R2 since the resistances are of equal
       value
17 R3=2*1/(2+1+2)
18 Rth=8*(2*(4*1/(4+1)))/(8+(2*(4*1/(4+1))))
19 printf("\n Rth=%.2 f ohms \n",Rth)
20 // Calculation of load current
21 Il=Vth/(Rth+10)
22 printf("\n Il=%.2 f A \n",Il)
```

Scilab code Exa 2.56 Find current through the 1 ohm resistor

```
1  //Chapter 2,Ex2.56,Pg2.71
2  clc;
3  disp("Refer to the diagram shown in the question")
4  //Remove the 1 ohm resistor from the meshes 1 and 2,
        then we can say the following about the current
5  I1=-3 //Current in amperes
6  I2=1 //Current in amperes
7  printf("\n I1=%.0f A \n",I1)
8  printf("\n I2=%.0f A \n",I2)
9  //Calculation of Vth
10 Vth=4-2*(I1-I2)
11 printf("\n Vth=%.2f V \n",Vth)
12 //Calculation of Rth
13 //It can be easily deduced by looking at the diagram
        that Rth=2 ohms
14 Rth=2
15 //Calculation of load current
16 Il=Vth/(Rth+1)
17 printf("\n Il=%.0f A \n",Il)
```

Scilab code Exa 2.57 Find current in the 10 ohm resistor

```
1  //Chapter2,Ex2.57,Pg2.73
2  clc;
3  disp("Refer to the diagram shown in the question")
4  A=[1 0 0;0 -1 1;0 -5 -15]
5  B=[2;4;0]
6  I=A\B
7  printf("\n I1=%.0f A \n",I(1))
8  printf("\n I2=%.0f A \n",I(2))
9  printf("\n I3=%.0f A \n",I(3))
10 printf("\n In=%.0f A \n",(I(1)-I(2)))
11 //Calculation of Rn
```

```
12  //Replace the voltage sources by open circuit and
        current sources by short circuit
13  Rn=1*(5+15)/(1+5+15)
14  printf("\n Rn=%.2f ohms \n",Rn)
15  Il=(5*Rn)/(10+Rn) //Using current division formula
16  printf("\n Il = %.2f A \n",Il)
```

Scilab code Exa 2.58 Find current in the 10 ohm resistor

```
1   //Chapter 2,Ex2.58,Pg 2.74
2   clc;
3   disp("Refer to the diagram shown in the figure")
4   A=[7 -2;-2 10]
5   B=[20;-12]
6   I=A\B
7   printf("\n I2= %.2f A \n",I(2))
8   printf("\n In=%.2f A \n",-I(2))
9   //Calculation of Rn
10  Rn=(5*2/(5+2))+8
11  printf("\n Rn=%.2f ohms \n",Rn)
12  //Calculation of Il
13  Il=0.67*(Rn/(Rn+10)) //Current is short circuit
        current calculated
14  printf("\n Il=%.2f A \n",Il)
```

Scilab code Exa 2.59 Find the current through the 10 ohm resistor

```
1   //Chapter 2,Ex2.59,Pg2.75
2   clc;
3   disp("Refer to the diagram shown in the figure")
4   A=[70 -20;-20 20]
5   B=[40;0]
6   I=A\B
```

```
7  printf("\n I1=%.0f A \n",I(1))
8  printf("\n I2 =%.1f A \n",I(2))
9  printf("\n In = %.1f A \n",I(2))
10 //Calculation of Rn
11 Rn=(50*20/(50+20)) //Resistance of 40 ohms gets
       shorted because it is connected across a short
       circuit
12 printf("\n Rn=%.2f ohms \n",Rn)
13 //Calculation of Il
14 Il=(1.5*14.28/(14.28+10))
15 printf("\n Il=%.2f A \n",Il)
```

Scilab code Exa 2.60 Find current through 10 ohm resistor

```
1  //Chapter 2,Ex2.60,Pg2.76
2  clc;
3  disp("Refer to diagram shown in the question")
4  A=[-7 1 0;-1 6 -3;0 3 -3]
5  B=[-10;0;20]
6  I=A\B
7  printf("\n I3=%.2f A \n",I(3))
8  printf("\n In= %.2f A \n",-I(3))
9  Rn=[(6*1/(6+1)+2)]*3/(3+[(6*1/(6+1)+2)])
10 printf("\n Rn=%.2f A \n",Rn)
11 //Calculation of Il
12 Il=13.17*(1.46/(1.46+10))
13 printf("\n Il=%.2f A \n",Il)
```

Scilab code Exa 2.61 Find current in the 10 ohm resistor

```
1  //Chapter2 ,Ex2.61 ,Pg2.77
2  clc;
3  disp("Refer to the diagram shown in the figure")
```

```
4  A =[20 -20 0;-20 60 -20;0 -20 50]
5  B =[10;40;-100]
6  I = A \ B
7  printf ("\n I1=%.2f A \n",I(1))
8  printf ("\n In=%.2f A \n",I(1))
9  // Calculation of Rn
10 Rn =[(20*30/(20+30))+20]*20/(20+[(20*30/(20+30))+20])
11 printf ("\n Rn=%.1f ohms \n",Rn)
12 // Calculation of Il
13 Il=I(1)*Rn/(Rn+10)
14 printf ("\n Il=%.2f A \n",Il)
```

Scilab code Exa 2.62 Nortons equivalent

```
1  // Chapter 2,Ex2.62,Pg2.77
2  clc ;
3  disp ("Refer to the diagram shown in the figure")
4  A =[90 -60 0;-60 100 -30;0 30 -30]
5  B =[120;40;-10]
6  I = A \ B
7  printf ("\n I3=%.2f A \n",I(3))
8  printf ("\n In=%.2f A \n",-I(3))
9  // Calculation of RN
10 Rn =[(30*60/(30+60))+10]*30/(30+[(30*60/(30+60))+10])
11 printf ("\n Rn=%.0f ohms \n",Rn)
```

Scilab code Exa 2.63 Find current through the 8 ohm resistor

```
1  // Chapter 2,Ex2.63,Pg2.79
2  clc ;
3  disp ("Refer to the diagram shown in the figure")
4  A =[-1 1;12 0]
5  B =[2;55]
```

```
 6  I = A \ B
 7  printf(" \n  I1=%.2f  A  \n", I(1))
 8  printf(" \n  I2=%.2f  A  \n", I(2))
 9  printf(" \n  In=%.2f  A  \n", I(2))
10  // Calculation  of  Rn
11  Rn = 12 * 4 / ( 12 + 4 )
12  printf(" \n  Rn=%.0f  ohms  \n", Rn)
13  // Calcuation  of  Il
14  Il = 6.58 * Rn / ( Rn + 8 )
15  printf(" \n  Il=%.2f  A  \n", Il)
```

Scilab code Exa 2.64 Find current through the 1 ohm resistor

```
 1  // Chapter  2 , Ex2.64 , Pg2.80
 2  clc ;
 3  disp(" Refer  to  the  diagram  shown  in  the  figure ")
 4  A = [0  -5  -2;0  4  -2;-2  -2  4]
 5  B = [-2; -1;0]
 6  I = A \ B
 7  printf(" \n  I1=%.2f  A  \n", I(1))
 8  printf(" \n  I2=%.2f  A  \n", I(2))
 9  printf(" \n  I3=%.2f  A  \n", I(3))
10  printf(" \n  In=%.2f  A  \n", I(3))
11  // Calculation  of  Rn
12  Rn = ( 2 * 3 / ( 2 + 3 ) ) + ( 2 * 2 / ( 2 + 2 ) )
13  printf(" \n  Rn=%.1f  ohms  \n", Rn)
```

Scilab code Exa 2.65 Find max power

```
 1  // Chapter  2 , Ex2.65 , Pg2.82
 2  clc ;
 3  disp(" Refer  to  the  diagram  shown  in  the  figure ")
 4  I = -3/4
```

```
 5  printf("\n I=%.2f A \n",I)
 6  Vth=6+2*I-10
 7  printf("\n Vth=%.1f V \n",Vth)
 8  //Calculations Rth
 9  Rth=(2*2/(2+2))+2
10  printf("\n Rth=%.0f ohms \n",Rth)
11  //Value of Rl
12  Pmax=(Vth*Vth/(4*Rth))
13  printf("\n Pmax=%.2f W \n",Pmax)
```

Scilab code Exa 2.66 Find max power

```
 1  //Chapter 2,Ex2.66,Pg2.83
 2  clc;
 3  disp("Refer to the diagram shown in the question")
 4  //Calculation og Vth
 5  A=[-1 1;-6 -5]
 6  B=[4;2]
 7  I=A\B
 8  printf("\n I1=%.0f A \n",I(1))
 9  printf("\n I2=%.0f A \n",I(2))
10  Vth=8-I(1)
11  printf("\n Vth=%.0f V \n",Vth)
```

Scilab code Exa 2.67 Find max power

```
 1  //Chapter 2,Ex2.67,Pg2.84
 2  clc;
 3  disp("Refer to the diagram shown in the question")
 4  A=[1 0;5 -10]
 5  B=[50;0]
 6  I=A\B
 7  printf("\n I1=%.0f A \n",I(1))
```

```
8  printf(" \n I2=%.0f A \n",I(2))
9  Vth=3*I(2)
10 printf(" \n Vth=%.0f V \n",Vth)
11 //Calculation of Rth
12 Rth=(7*3/(7+3))
13 printf(" \n Rth=%.1f \n",Rth)
14 //For maximum power transfer the value of the load
      resistance should be equal to the value of the
      Thevenin resistance
15 Pmax=(Vth*Vth)/(4*Rth)
16 printf(" \n Pmax=%.2f W \n",Pmax)
```

Scilab code Exa 2.68 Find Rl and calculate maximum power

```
1  //Chapter 2,Example2.68,Pg2.85
2  clc;
3  disp("Refer to the diagram shown in the figure")
4  A=[-1 1;5 2]
5  B=[6;10]
6  I=A\B
7  printf(" \n I1=%.2f A \n",I(1))
8  printf(" \n I2=%.2f A \n",I(2))
9  //Calculation of Vth
10 Vth=2*I(2)
11 printf(" \n Vth=%.2f V \n",Vth)
12 //Calculation of Rth
13 Rth=(5*2/(5+2))+3+4
14 printf(" \n Rth=%.2f ohms \n",Rth)
15 //For maximum power transfer the load resistance
      should be equal to the Thevenin resistance
16 Pmax=(Vth*Vth/(4*Rth))
17 printf(" \n Pmax=%.2f W \n",Pmax)
```

Scilab code Exa 2.69 `Find Rl and calculate max power`

```
1  //Chapter 2, Example2.69,Pg2.85
2  clc ;
3  disp("Refer to the diagram shown in the figure")
4  A=[15 -5;0 1]
5  B=[120;-6]
6  I=A\B
7  printf("\n I1=%.0f A \n",I(1))
8  printf("\n I2=%.0f A \n",I(2))
9  Vth=120-10*I(1)  //Thevenin Voltage
10 printf("\n Vth =%.0f V \n",Vth)
11 //Calculation of Rth
12 Rth=(10*5/(10+5))
13 printf("\n Rth=%.2f ohms \n",Rth)
14 //For maximum power transfer load resistance should
       be equal to thevenin resistance
15 Pmax=(Vth*Vth/(4*Rth))
16 printf("\n Pmax=%.2f W \n",Pmax)
```

Scilab code Exa 2.70 `Find Rl and max power`

```
1  //Chapter 2,Ex2.70,Pg2.87
2  clc ;
3  disp("Refer to the diagram shown in the question")
4  A=[1 0;-25 41]
5  B=[3;0]
6  I=A\B
7  printf("\n I1= %.0f A \n",I(1))
8  printf("\n I2= %.0f A \n",I(2))
9  Vth=-20+10*I(2)+6*I(2)
10 printf("\n Vth=%.2f V \n",Vth)
11 //Calculation of Rth
12 Rth=(25*16/(25+16))
13 printf("\n Rth= %.2f ohms \n",Rth)
```

```
14  //For maximum power transfer the load resistance
        should be equal to the Thevenin resistance
15  Pmax=(Vth*Vth/(4*Rth))
16  printf("\n Pmax=%.2f W \n",Pmax)
```

Scilab code Exa 2.71 Max power

```
 1  //Chapter 2,Ex2.71,Pg2.88
 2  clc;
 3  disp("Refer to the diagram shown in the question")
 4  A=[-1 1 0;1 10 -10;0 -10 15]
 5  B=[1;5;0]
 6  I=A\B
 7  printf("\n I1=%.2f A \n",I(1))
 8  printf("\n I2=%.2f A \n",I(2))
 9  printf("\n I3=%.2f A \n",I(3))
10  //Calculation of Vth
11  Vth=3*I(3)
12  printf("\n Vth=%.2f V \n",Vth)
13  //Calculation of Rth
14  Rth=[(10*1/(10+1))+2]*3/(3+[(10*1/(10+1))+2]) + 5
15  printf("\n Rth=%.2f ohms \n",Rth)
16  //Calculation of Pmax
17  Pmax=(Vth*Vth/(4*Rth))
18  printf("\n Pmax=%.2f W \n",Pmax)
```

Chapter 3

AC Fundamentals

Scilab code Exa 3.1 Mean value of current

```
1 //Chapter 3,Ex3.1,Pg3.4
2 clc;
3 Im=15/(sin(2*%pi*3.375*0.001*40))
4 printf("\n Im=%.0f A \n",Im)
```

Scilab code Exa 3.2 Time at which current attain a particular value

```
1 //Chapter 3,Ex3.2,Pg3.4
2 clc;
3 //(a)
4 //Given that f=50c/s and Im=100A
5 i=100*sin(2*%pi*50*(1/600))
6 printf("\n Instantaneous value of current i=%.0f A \
      n",i)
7 //(b)
8 t=(asin(60*%pi)/180)/(100*180)
9 printf("\n t=%.4f sec \n",t)
```

Scilab code Exa 3.3 Time at which current attain a particular value

```
1  clc ;
2  f =50  // Frequence in hertz
3  Irms =20  // Rms current in amperes
4  Im = Irms * sqrt (2)
5  disp (" ( i )")
6  printf ("\n Im=%02f A \n" , Im )
7  t =0.0025  // Time in seconds
8  i = Im * sin (2*%pi *f *t )
9  disp (" ( ii )")
10  printf ("\n i=%.0 f \n" ,i )
11  t =0.0125
12  i = Im * sin (2*%pi *f *t )
13  disp (" ( iii )")
14  printf ("\n i=%.0 f \n" ,i )
15  i1 =14.14/ Im
16  disp ( i1 )
17  i2 = asin ( i1 )
18  i2 = i2 *180/ %pi
19  disp ( i2 )
20  i = i2 /(2*180* f )
21  printf ("\n i=%.2 f \n ms" ,i *10^3)
```

Scilab code Exa 3.4 Time at which current attain a particular value

```
1  clc ;
2  f =60
3  Im =110
4  disp (" ( i )")
5  t1 =90/ Im
6  t2 = asin ( t1 )
```

```
7  disp ( t2 )
8  t2=t1 *180/ %pi
9  disp ( t2 )
10 t=t1 /21600
11 printf ( ” \n t=%.2 f ms \n” ,t *10^3)
```

Scilab code Exa 3.5 Time at which current attain a particular value

```
1  //Example 5, Chapter 3
2  clc ;
3  f =50 //Frequency in hertz
4  Im =9.2 //Current in amperes
5  // ( i )
6  t =0.002
7  i = Im * sin (2* %pi *f *t )
8  printf ( ” \n Instantaneous value of current=%.2 f A \n”
      ,i )
9  // ( ii )
10 t =0.0045
11 t =(1/(4*f ))+0.0045
12 i = Im * sin (2* %pi *f *t )
13 printf ( ” \n Instantaneous Value=%.2 f A \n” ,i )
```

Scilab code Exa 3.6 Time at which current attain a particular value

```
1  //Example6 , Chapter 3
2  clc ;
3  f =50
4  Irms =20
5  // ( i )
6  Im = Irms * sqrt (2)
7  i =10* sqrt (2)
8  ans = asin ( i / Im )
```

```
9  ans=ans*180/%pi
10 t= ans/(2*180*f)
11 printf("\n t=%.0f ms \n",t*10^3)
12 //(ii)
13 t=(1/(4*f))+t
14 printf("\n t=%.2f ms \n",t)
```

Scilab code Exa 3.8 Time at which current attain a particular value

```
1  //Example 8,Chapter 3
2  clc;
3  f=50
4  Irms=10 //Current in amperes
5  //(i)
6  Im=Irms*sqrt(2)
7  disp('14.14 sin(18000t)')
8  //(ii)
9  t=0.0025
10 t=(1/(4*f)) + t
11 printf("\n t=%.1f ms \n",t*10^3)
12 i=14.14*sin(18000*7.5*10^-3)
13 printf("\n i=%.0f A \n",i)
14 //(ii)
15 t=0.0075
16 t=(1/(2*f))+t
17 printf("\n t=%.1f ms \n",t*10^3)
18 i=14.14*sin(18000*t*10^-3)
19 printf("\n i=%.0f A \n",i)
```

Scilab code Exa 3.10 Time at which current attain a particular value

```
1  //Example 10,Chapter 3
2  //(i)
```

```
 3  clc ;
 4  Ieff =7.071/ sqrt (2)
 5  Irms = Ieff
 6  Im =5* sqrt (2)
 7  //( ii )
 8  f =(157.08) /(2*%pi)
 9  T =(1/f)
10  printf ("\n T=%.2 f  s  \n",T)
11  //( iii )
12  t =( asin ((7.071/7.071) ) +0.785) /157.08
13  printf ("\n t=%.3 f  s  \n",t)
```

Scilab code Exa 3.15 Form factor Frequence and Crest Factor

```
 1  //Example  15 ,Chapter  3
 2  clc ;
 3  f =(314/(2*%pi) )
 4  printf ("\n  f=%.0 f  Hz  \n",f)
 5  disp ('For  a  sinusoidal  waveform ')
 6  disp ('Vavg=2Vm/ pi ')
 7  disp ('Vrms=Vm/ sqrt (2) ')
 8  //( ii )
 9  disp ('kf=Vrms/Vavg ')
10  kf =%pi /(2* sqrt (2) )
11  printf ("\n  kf=%.2 f  \n",kf)
12  //( iii )
13  disp ('kp=Vm/Vrms ')
14  kp = sqrt (2)
15  printf ("\n  kp=%.3 f  \n",kp)
```

Scilab code Exa 3.16 RMS value and maximum value

```
 1  //Example  16 ,Chapter  3
```

```
2 kf =1.2 //Form factor
3 kp =1.5 //Peak factor
4 Vavg =10
5 //( i )
6 Vrms = kf * Vavg
7 printf (" \n  Vrms=%.0 f  V  \n" , Vrms )
8 //( ii )
9 Vm = kp * Vrms
10 printf (" \n  Vm=%.0 f  V  \n" , Vm )
```

Scilab code Exa 3.17 Average value and RMS value of voltage

```
1 //Example  17 , Chapter  3
2 kf =1.15
3 kp =1.5
4 Vm =4500
5 //( i )
6 Vrms = Vm / kp
7 printf (" \n  Vrms=%.0 f  V  \n" , Vrms )
8 //( ii )
9 Vavg = Vrms / kf
10 printf (" \n  Vavg=%.1 f  V  \n" , Vavg )
```

Chapter 4

Three Phase Circuits

Scilab code Exa 4.1 Calculation of Z

```
1  //Chapter 4,Ex4.1,Pg 4.8
2  funcprot(0)
3  function [polar] = rect2polar(x,y) //Function to
       convert rectangular coordinates to polar
       coordinates
4      polar=ones(1,2)
5      polar(1)=sqrt((x^2)+(y^2))
6      polar(2)=atan(y/x)
7      polar(2)=(polar(2)*180)/%pi
8  endfunction
9  function [rect] = polar2rect(r,theta) //Function to
       convert polar coordinates to rectangular
       coordinates
10     rect=ones(1,2)
11     theta=(theta*%pi)/180
12     rect(1)=r*cos(theta)
13     rect(2)=r*sin(theta)
14 endfunction
15 clc;
16 //Refer to the data given in the question
17 Vl=440 //Supply voltage
```

```
18  f=50 //Freq in hertz
19  Vph=Vl/sqrt(3) //Phase voltage
20  printf("\n Vph=%.2f V \n",Vph)
21  Zbarph=rect2polar(8,10) //Converting Zbarph from
        rectangular coordinates to polar coordinates
22  printf("\n r=%.2f \n",Zbarph(1))
23  printf("\n theta=%.2f \n",Zbarph(2))
24  Iph=Vph/Zbarph(1) //Phase current
25  printf("\n Iph=%.2f A \n",Iph)
26  Il=Iph //Line current
27  P=sqrt(3)*Il*Vl*cos(Zbarph(2)*%pi/180)
28  P=P*(10^-3) //Active power
29  Q=sqrt(3)*Vl*Il*sin(Zbarph(2)*%pi/180)
30  Q=Q*(10^-3) //Reactive power
31  printf("\n P=%.2f kW \n",P)
32  printf("\n Q=%.2f kVAR \n",Q)
```

Scilab code Exa 4.2 Calculation of Z

```
1  funcprot(0)
2  function [polar] = rect2polar(x,y)
3      polar=ones(1,2)
4      polar(1)=sqrt((x^2)+(y^2))
5      polar(2)=atan(y/x)
6      polar(2)=(polar(2)*180)/%pi
7  endfunction
8  function [rect] = polar2rect(r,theta)
9      rect=ones(1,2)
10     theta=(theta*%pi)/180
11     rect(1)=r*cos(theta)
12     rect(2)=r*sin(theta)
13 endfunction
14 //Refer to the data given in the question
15 clc;
16 Vl=230 //Line voltage in volts
```

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```
17  f=50 //freq in hertz
18  Vph=Vl
19  Zbarph=rect2polar(8,-6)
20  r=Zbarph(1)
21  printf("\n r=%.0f \n",r)
22  phi=Zbarph(2)
23  printf("\n phi=%.2f degrees \n",Zbarph(2))
24  pf=cos(phi*%pi/180)
25  printf("\n Power factor=%.1f (leading) \n",pf)
26  Iph=Vph/Zbarph(1)
27  printf("\n Iph=%.0f A \n",Iph)
28  Il=sqrt(3)*Iph
29  printf("\n Il=%.2f A \n",Il)
30  Q=sqrt(3)*Vl*Il*sin(phi*%pi/180)
31  Q=Q*(10^-3)
32  printf("\n Reactive power Q=%.2f kVAR \n",Q)
```

Scilab code Exa 4.3 Calculation of active power reactive power and total power

```
1   //Chapter4 ,Ex4.3 ,Pg4.9
2   funcprot(0)
3   function [polar] = rect2polar(x,y)
4       polar=ones(1,2)
5       polar(1)=sqrt((x^2)+(y^2))
6       polar(2)=atan(y/x)
7       polar(2)=(polar(2)*180)/%pi
8   endfunction
9   function [rect] = polar2rect(r,theta)
10      rect=ones(1,2)
11      theta=(theta*%pi)/180
12      rect(1)=r*cos(theta)
13      rect(2)=r*sin(theta)
14  endfunction
15  //Refer to the data given in the question
16  clc;
```

```
17  R=8 // Resistance in ohms
18  L=0.02 // Inductance in Henry
19  Vl=230 // Line voltage in volts
20  f=50
21  Vph=Vl/sqrt(3) // Phase voltage
22  printf("\n Vph=%.2f V \n",Vph)
23  Xl=2*%pi*f*L
24  Zbarph=rect2polar(R,Xl) // Converting rectangular
        coordinates to polar coordinates
25  r=Zbarph(1)
26  phi=Zbarph(2)
27  printf("\n Zph=%.2f ohms \n",r)
28  printf("\n phi=%.2f degrees \n",phi)
29  phi=phi*%pi/180 // Converting degrees to radians
30  printf("\n Power factor =%.2f (lagging) \n",cos(phi)
        )
31  Iph=Vph/r
32  printf("\n Iph=%.2f A \n",Iph)
33  Il=Iph
34  P=sqrt(3)*Vl*Il*cos(phi)
35  P=P*(10^-3)
36  printf("\n Active power =%.2f kW \n",P)
37  Q=sqrt(3)*Vl*Il*sin(phi)
38  Q=Q*(10^-3)
39  printf("\n Reactive power Q=%.2f kVAR \n",Q)
40  S=sqrt(3)*Vl*Il
41  S=S*(10^-3)
42  printf("\n Total power =%.3f kVA \n",S)
```

Scilab code Exa 4.4 Calculation of P

```
1  funcprot(0)
2  function [polar] = rect2polar(x,y) // Function to
       convert rectangular coordinates to polar
       coordinates
```

```
3        polar=ones(1,2)
4        polar(1)=sqrt((x^2)+(y^2))
5        polar(2)=atan(y/x)
6        polar(2)=(polar(2)*180)/%pi
7   endfunction
8   function [rect] = polar2rect(r,theta) //Function to
         convert polar coordinates to rectangular
         coordinates
9        rect=ones(1,2)
10       theta=(theta*%pi)/180
11       rect(1)=r*cos(theta)
12       rect(2)=r*sin(theta)
13  endfunction
14  clc
15  R=8 //Resistance in ohms
16  L=0.02 //Inductance in henry
17  Vl=400 //Line voltage
18  f=50 //Freq in hertz
19  Xl=2*%pi*f*L
20  Zbarph=rect2polar(R,Xl)
21  r=Zbarph(1)
22  phi=Zbarph(2)
23  printf("\n Zph=%.2f ohms \n",r)
24  printf("\n phi=%.2f degrees \n",phi)
25  phi=phi*%pi/180 //Converting degrees to radians
26  Iph=Vl/r
27  printf("\n Iph=%.2f A \n",Iph)
28  Il=sqrt(3)*Iph
29  printf("\n Il=%.2f A \n",Il)
30  P=sqrt(3)*Vl*Il*cos(phi) //Active power
31  printf("\n P=%.2f kW \n",P*(10^-3))
```

Scilab code Exa 4.5 Calculation of different powers for line and phase voltages

```
1   funcprot(0)
```

```scilab
2  function [polar] = rect2polar(x,y) //Function to
      convert  rectangular  coordinates  to  polar
      coordinates
3      polar=ones(1,2)
4      polar(1)=sqrt((x^2)+(y^2))
5      polar(2)=atan(y/x)
6      polar(2)=(polar(2)*180)/%pi
7  endfunction
8  function [rect] = polar2rect(r,theta) //Function to
      convert  polar  coordinates  to  rectangular
      coordinates
9      rect=ones(1,2)
10      theta=(theta*%pi)/180
11      rect(1)=r*cos(theta)
12      rect(2)=r*sin(theta)
13  endfunction
14  clc;
15  //Refer  to  the  data  given  in  the  question
16  R=9 //resistance  in  ohms
17  Xl=12 //Reactance  in  ohms
18  f= 50// Frequence  of  supply  in  hertz
19  Vl=440 //Supply  voltage  in  V
20  Vph=Vl //For  delta  connected  load
21  Zbarph=rect2polar(9,12)
22  r=Zbarph(1)
23  phi=Zbarph(2)
24  printf("\n Zph=%.2f  ohms  \n",r)
25  printf("\n phi=%.2f  degrees  \n",phi)
26  phi=phi*%pi/180 //Converting  degrees  to  radians
27  Iph=Vph/r
28  printf("\n Iph=%.2f  A  \n",Iph)
29  Il=sqrt(3)*Iph
30  printf("\n  Il=%.1f  A  \n",Il)
31  printf("\n Power  factor  =%.1f  (lagging)  \n",cos(phi)
      )
32  S=sqrt(3)*Vl*Il //Total  power
33  printf("\n S=%.2f  kVA  \n",S*(10^-3))
34  P=sqrt(3)*Vl*Il*cos(phi)
```

```
35  printf("\n P=%.2f kW \n",P*(10^-3))
36  Q=sqrt(3)*Vl*Il*sin(phi)
37  printf("\n Q=%.2f kVAR \n",Q*(10^-3))
38  //If the coils were in star connection
39  Vph=Vl/sqrt(3)
40  printf("\n Vph=%.2f V \n",Vph)
41  Iph=Vph/r
42  Il=Iph
43  printf("\n Iph=%.2f A \n",Iph)
44  pf=cos(phi)
45  printf("\n Power factor=%.1f (lagging) \n",pf)
46  S=sqrt(3)*Vl*Il
47  printf("\n total power=%.2f kVA \n",S*(10^-3))
48  P=sqrt(3)*Iph*pf
49  printf("\n P=%.2f kVA \n",P*(10^-3))
50  Q=sqrt(3)*Vl*Iph*(sqrt(1-pf^2))
51  printf("\n Q=%.2f kVAR \n",Q*(10^-3))
```

Scilab code Exa 4.6 Calculation of different powers for line and phase voltages

```
1  funcprot(0)
2  function [polar] = rect2polar(x,y) //Function to
       convert rectangular coordinates to polar
       coordinates
3      polar=ones(1,2)
4      polar(1)=sqrt((x^2)+(y^2))
5      polar(2)=atan(y/x)
6      polar(2)=(polar(2)*180)/%pi
7  endfunction
8  function [rect] = polar2rect(r,theta) //Function to
       convert polar coordinates to rectangular
       coordinates
9      rect=ones(1,2)
10     theta=(theta*%pi)/180
11     rect(1)=r*cos(theta)
```

```scilab
12        rect(2)=r*sin(theta)
13  endfunction
14  clc
15  //Refer to the data given in the question
16  Vl=415
17  R=15
18  L=0.1
19  f=50
20  C=177*(10^-6)
21  Vph=Vl/sqrt(3)
22  Xl=2*%pi*f*L
23  Xc=1/(2*%pi*f*C)
24  Zbarph=rect2polar(R,(Xl-Xc))
25  r=Zbarph(1)
26  printf("\n Zph=%.2f ohms \n",Zbarph(1))
27  phi=Zbarph(2)
28  printf("\n phi=%.2f degrees \n",Zbarph(2))
29  phi=phi*%pi/180
30  pf=cos(phi)
31  printf("\n Power factor=%.3f (lagging) \n",pf)
32  Iph=Vph/r;
33  Il=sqrt(3)*Iph
34  printf("\n Iph=%.1f A \n",Iph)
35  P=sqrt(3)*Vl*Il*cos(phi)
36  printf("\n P=%.2f kW \n",P*(10^-3))
37  Q=sqrt(3)*Vl*Il*sin(phi)
38  printf("\n Q=%.2f kVAR \n",Q*(10^-3))
39  S=sqrt(3)*Vl*Il
40  printf("\n Total power =%.2f kVA \n",S*(10^-3))
41  //If the same impedance is connected in delta
42  Vph=Vl
43  printf("\n Iph=%.2f A \n",Iph)
44  printf("\n Il=%.2f A \n",Il)
45  P=sqrt(3)*Vl*Il*cos(phi)
46  printf("\n P=%.2f kW \n",P*(10^-3))
```

Scilab code Exa 4.7 Calculation of different powers for line and phase voltages

```
1  funcprot(0)
2  function [polar] = rect2polar(x,y) //Function to
       convert rectangular coordinates to polar
       coordinates
3      polar=ones(1,2)
4      polar(1)=sqrt((x^2)+(y^2))
5      polar(2)=atan(y/x)
6      polar(2)=(polar(2)*180)/%pi
7  endfunction
8  function [rect] = polar2rect(r,theta) //Function to
       convert polar coordinates to rectangular
       coordinates
9      rect=ones(1,2)
10     theta=(theta*%pi)/180
11     rect(1)=r*cos(theta)
12     rect(2)=r*sin(theta)
13 endfunction
14 clc
15 //Refer to the data given in the question
16 L=50*(10^-3) //load inductance in mH
17 R=50 //Resistance in ohms
18 C=50*(10^-6) //Capacitance in microfarads
19 Vl=550 //Line voltage in volts
20 w=800 //Angular frequency
21 Vph=Vl //For delta connected load,phase voltage=line
       voltage
22 Xl=w*L
23 Xc=1/(w*C)
24 printf("\n Xl=%.0f ohms \n",Xl)
25 printf("\n Xc=%.0f ohms \n",Xc)
26 Zbarph=rect2polar(10,20)
27 r=Zbarph(1)
```

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```
28  printf("\n Zph=%.2f \n",r)
29  printf("\n phi=%.2f \n",Zbarph(2))
30  Iph=Vph/r
31  printf("\n Iph=%.2f A \n",Iph)
32  pf=cos(Zbarph(2)*%pi/180)
33  printf("\n Power factor=%.3f (lagging) \n",pf)
34  Il=sqrt(3)*Iph
35  P=sqrt(3)*Vl*Il*pf
36  printf("\n P=%.2f kW \n",P*(10^-3))
37  Q=sqrt(3)*Vl*Il*sin(Zbarph(2)*%pi/180)
38  printf("\n Q=%.1f kVAR \n",Q*(10^-3))
39  S=sqrt(3)*Vl*Il
40  printf("\n S=%.2f kVA \n",S*(10^-3))
```

Scilab code Exa 4.8 Calculation of P

```
1  funcprot(0)
2  function [polar] = rect2polar(x,y) //Function to
       convert rectangular coordinates to polar
       coordinates
3      polar=ones(1,2)
4      polar(1)=sqrt((x^2)+(y^2))
5      polar(2)=atan(y/x)
6      polar(2)=(polar(2)*180)/%pi
7  endfunction
8  function [rect] = polar2rect(r,theta) //Function to
       convert polar coordinates to rectangular
       coordinates
9      rect=ones(1,2)
10     theta=(theta*%pi)/180
11     rect(1)=r*cos(theta)
12     rect(2)=r*sin(theta)
13 endfunction
14 clc
15 //Refer to the data given in the question
```

```
16 Vl=440 //Line voltage
17 P=50*(10^3) //Active power in watts
18 Il=90 //Load current in amperes
19 Vph=Vl //For delta connected load phase voltage=line
         voltage
20 Iph=Il/sqrt(3)
21 printf("\n Iph=%.2f A \n",Iph)
22 //Since P, Il and Vl have been given, the power
       factor can be calculated easily
23 pf=P/(sqrt(3)*Vl*Il)
24 printf("\n Power factor=%.2f (lagging) \n",pf)
25 S=sqrt(3)*Vl*Il
26 printf("\n S=%.2f kVA \n",S*(10^-3))
```

Scilab code Exa 4.9 Calculation of active power reactive power and total power

```
 1 funcprot(0)
 2 function [polar] = rect2polar(x,y) //Function to
      convert rectangular coordinates to polar
      coordinates
 3     polar=ones(1,2)
 4     polar(1)=sqrt((x^2)+(y^2))
 5     polar(2)=atan(y/x)
 6     polar(2)=(polar(2)*180)/%pi
 7 endfunction
 8 function [rect] = polar2rect(r,theta) //Function to
      convert polar coordinates to rectangular
      coordinates
 9     rect=ones(1,2)
10     theta=(theta*%pi)/180
11     rect(1)=r*cos(theta)
12     rect(2)=r*sin(theta)
13 endfunction
14 clc
15 //Refer to the data given in the question
```

```
16  Il=15 //Current in amperes
17  P=11*(10^3) //Active power in kilowatts
18  S=15*(10^3)
19  Vl=S/(sqrt(3)*Il)
20  printf("\n Vl=%.2f V \n",Vl)
21  Vph=Vl/sqrt(3)
22  printf("\n Vph=%.2f V \n",Vph)
23  pf=P/S //Power factor
24  printf("\n Power factor=%.3f \n",pf)
25  phi=acos(pf)
26  phi=phi*180/%pi
27  printf("\n phi=%.2f degrees \n",phi)
28  Q=sqrt(3)*Vl*Il*sin(phi*%pi/180)
29  printf("\n Q=%.1f kVAR \n",Q*10^-3)
30  //For star connected load,Il=Iph
31  Zph=Vph/Il
32  printf("\n Zph=%.2f ohms \n",Zph)
33  R=Zph*pf
34  printf("\n R=%.2f ohms \n",R)
35  Xl=Zph*sqrt(1-(pf^2))
36  printf("\n Xl=%.2f ohms \n",Xl)
37  Vph=Vl //If the coils are connected in delta
38  Iph=Vph/Zph
39  Il=sqrt(3)*Iph
40  printf("\n Il=%.0f A \n",Il)
41  P=sqrt(3)*Vl*Il*pf
42  printf("\n P=%.2f kW \n",P*(10^-3))
43  Q=sqrt(3)*Vl*Il*sqrt(1-(pf^2))
44  printf("\n Q=%.2f kVAR \n",Q*(10^-3))
```

Scilab code Exa 4.11 Calculation of phase resistance and phase impedance

```
1  funcprot(0)
2  function [polar] = rect2polar(x,y) //Function to
       convert rectangular coordinates to polar
```

```
        coordinates
3       polar=ones(1,2)
4       polar(1)=sqrt((x^2)+(y^2))
5       polar(2)=atan(y/x)
6       polar(2)=(polar(2)*180)/%pi
7   endfunction
8   clc
9   //Refer to the data given in the question
10  Vl=208 //Line voltage
11  P=1800 //Active power
12  Il=10 //Line current
13  Vph=Vl/sqrt(3)
14  printf("\n Vph=%.2f V \n",Vph)
15  Iph=Il
16  Zph=Vph/Iph
17  printf("\n Zph=%.2f ohms \n",Zph)
18  //Since the active power,line voltage and line
        current are given, the power factor can be
        calculated easily
19  pf=P/(sqrt(3)*Vl*Il)
20  printf("\n Power factor=%.2f \n",pf)
21  phi=acos(pf)
22  phi=phi*180/%pi
23  printf("\n phi=%.0f degrees \n",phi)
24  Rph=Zph*pf
25  printf("\n Rph=%.2f ohms \n",Rph)
26  Xph=Zph*sqrt(1-pf^2)
27  printf("\n Xph=%.2f ohms \n",Xph)
```

Scilab code Exa 4.13 Calculation of phase resistance and phase reactance

```
1   //Chapter 4,Ex4.1,Pg 4.8
2   funcprot(0)
3   function [polar] = rect2polar(x,y) //Function to
        convert rectangular coordinates to polar
```

```
        coordinates
4       polar=ones(1,2)
5       polar(1)=sqrt((x^2)+(y^2))
6       polar(2)=atan(y/x)
7       polar(2)=(polar(2)*180)/%pi
8   endfunction
9   clc;
10  //Refer to the data given in the question
11  Vl=400 //Supply voltage
12  Il=34.65 //Current in Amperes
13  P=14.4*10^3 //Active power in volts
14  Vph=Vl
15  Iph=Il/sqrt(3)
16  printf("\n Iph=%.0f A \n",Iph)
17  Zph=Vph/Iph
18  printf("\n Zph=%.0f ohms \n",Zph)
19  //We can calculate the power factor easily from the
        given data
20  pf=P/(sqrt(3)*400*34.65)
21  printf("\n Power factor=%.1f \n",pf)
22  phi=acos(pf)
23  phi=phi*180/%pi
24  printf("\n phi=%.2f degrees \n",phi)
25  Rph=Zph*pf
26  printf("\n Rph=%.0f ohms \n",Rph)
27  Xph=Zph*sqrt(1-pf^2)
28  printf("\n Xph=%.0f ohms \n",Xph)
```

Scilab code Exa 4.14 Calculation of Q

```
1   funcprot(0)
2   function [polar] = rect2polar(x,y) //Function to
        convert rectangular coordinates to polar
        coordinates
3       polar=ones(1,2)
```

```
 4        polar (1) = sqrt (( x ^2) +( y ^2) )
 5        polar (2) = atan ( y / x )
 6        polar (2) =( polar (2) *180) /% pi
 7  endfunction
 8  clc
 9  // Refer  to  the  data  given  in  the  question
10  P =10.44*10^3  // Power  in  kWh
11  Vl =200  // Line  voltage
12  pf =0.5  // Leading  power  factor
13  Vph = Vl  // For  delta  connected  load
14  // Since  we  have  the  value  of  active  power , line
         voltage  and  power  factor  we  can  easily  calculate
         the  value  of  line  current
15  Il = P /( sqrt (3) * Vl * pf )
16  printf (" \n  Il=%.2 f  A  \n " , Il )
17  Iph = Il / sqrt (3)
18  printf (" \n  Iph=%.1 f  A  \n " , Iph )
19  Zph = Vph / Iph
20  printf (" \n  Zph=%.2 f  ohms  \n " , Zph )
21  Rph = Zph * pf
22  printf (" \n  Rph=%.3 f  ohms  \n " , Rph )
23  Xph = Zph *( sqrt (1 - pf ^2) )
24  printf (" \n  Xph=%.2 f  ohms  \n " , Xph )
25  Q = sqrt (3) * Vl * Il * sqrt (1 - pf ^2)
26  printf (" \n  Q=%.2 f  kVAR  \n " , Q *10^ -3)
```

Scilab code Exa 4.17 Calculation of active and reactive components of phase curren

```
1  funcprot (0)
2  function  [ polar ]  =  rect2polar ( x , y )  // Function  to
       convert  rectangular  coordinates  to  polar
       coordinates
3        polar = ones (1 ,2)
4        polar (1) = sqrt (( x ^2) +( y ^2) )
5        polar (2) = atan ( y / x )
```

```
 6        polar(2)=(polar(2)*180)/%pi
 7  endfunction
 8  clc
 9  Po=200*10^3 //Output Power
10  f=50 //frequency in hertz
11  Vl=440
12  n=91 //efficiency
13  pf=0.86
14  Vph=Vl //For a delta connected load
15  //Since the efficiency and output power have been
        given in the question, the input power can be
        easily calculated
16  Pi=(Po/n)*100
17  printf("\n Input power=%.2f kW \n",Pi*10^-3)
18  //Since the input power is now known we can
        calculate the line current
19  Il=Pi/(sqrt(3)*Vl*pf)
20  printf("\n Il=%.1f A \n",Il)
21  Iph=Il/sqrt(3)
22  printf("\n Iph=%.1f A \n",Iph)
23  apc=Iph*pf //Active component of phase current
24  printf("\n Active component of phase current=%.1f A
        \n",apc)
25  rpc=Iph*sqrt(1-pf^2)
26  printf("\n Reactive component of phase current=%.1f
        A \n",rpc)
```

Scilab code Exa 4.20 `Calculation of P`

```
1  clc
2  Vl=400 //Three phase supply voltage
3  Zph=100 //Impedance in ohms
4  Vph=Vl/sqrt(3) //For a star connected load
5  printf("\n Vph=%.2f V \n",Vph)
6  Iph=Vph/Zph
```

```scilab
7  printf("\n Iph=%.2f A \n",Iph)
8  Il=Iph
9  pf=1
10 P=sqrt(3)*Vl*Il*pf
11 printf("\n P=%.1f W \n",P)
12 Vph=Vl //For a delta connected load
13 Iph=Vph/Zph
14 printf("\n Iph=%.0f A \n",Iph)
15 Il=sqrt(3)*Iph
16 printf("\n Il=%.2f A \n",Il)
17 P=sqrt(3)*Vl*Il*pf
18 printf("\n P=%.2f W \n",P)
```

Chapter 5

Single phase Transformer

Scilab code Exa 5.1 Example number 1

```
1  //Chapter5 , Ex5.1 , Pg5.4
2  clc ;
3  //( i )
4  V2=110*110/220  //  V2/V1 = E2/E1
5  printf("\n V2=%.0f V \n",V2)
6  //( ii )
7  printf("\n V2=%.0f V \n",0)
```

Scilab code Exa 5.2 Example number 2

```
1  //Chapter5 , Ex5.2 , Pg5.5
2  clc ;
3  //Given data: Flux required =4.13mWb, V1=110V f=50,
4  N1=110/(4.44*50*0.001*4.13)  //No. of turns= Voltage
       of operation /( Flux required *4.44* frequency of
       input signal )
5  printf("\n No. of turns=%.0f turns \n",N1)
```

Scilab code Exa 5.3 Example number 3

```
1  //Chapter 5,Ex5.3,Pg5.5
2  clc;
3  //Given f=50Hz V1=240V N1=80 N2=280 A=200sq cm
4  //V1 is approximately equal to E1 for a transformer
5  //(i)
6  B=240/(4.44*50*200*0.0001*80)  //E1=4.44fBmAN1
7  printf("\n Maximum flux density Bm=%.2f Wb/m2 \n",B)
8  //(ii)
9  E2=(280/80)*240  //Induced Emf E2=N2/N1*E1
10 printf("\n Induced EMF E2=%.0f V \n",E2)
```

Scilab code Exa 5.4 Example number 4

```
1  //Chapter 5,Ex5.4,Pg5.5
2  clc;
3  //Given E1=3200V E2=400V f=50Hz N2=111
4  //Part(i)
5  N1=(3200/400)*111  //E2/E1=N2/N1
6  printf("\n No of turns in primary=%.0f turns \n",N1)
7  //Part(ii)
8  I2=80*1000/400  //I2=KVA Rating*1000/V2 where I2=
       secondary current
9  printf("\n Secondary current I2=%.0f A \n",I2)
10 //Part(iii)
11 A=400/(4.44*50*1.2*111)  //Using the formula E=4.44
       BmAfN2
12 printf("\n Cross sectional area=%.4f sq m \n",A)
```

Scilab code Exa 5.5 Example number 5

```
1  //Chapter5,Ex5.5,Pg5.6
2  clc;
3  //Given: kVA rating=5kVA E1=240V E2=2400V f=50Hz Bm
       =1.2 Tesla
4  N1=240/8 //Since it is given that EMF per turn is 8
5  //(i)
6  printf("\n No. of turns in primary=%.0f \n",N1)
7  //(ii)
8  N2=(2400/240)*N1 //E2/E1=N2/N1
9  A=2400/(4.44*50*1.2*300) //using the formula E=4.44
       BmAfN2
10 printf("\n Cross sectional area=%.2f sq m \n",A)
11 //(iii)
12 I1=5*1000/240 //Using the formula I=kVA rating*1000/
       V1
13 printf("\n I1=%.2f A \n",I1)
14 I2=5*1000/2400
15 printf("\n I2=%.2f A \n",I2)
```

Scilab code Exa 5.6 Example 6

```
1  //Chapter5,Ex5.6,Pg5.6
2  clc;
3  //Given: kVA rating=250kVA f=50Hz N2/N1=0.1 E2=240V
4  //(i)
5  E1=240/0.1 //E2/E1=N2/N1
6  printf("\n Primary EMF E1=%.0f V \n",E1)
7  //(ii)
8  I1=250*1000/2400 //Using the formula I=kVA rating
       *1000/V
9  printf("\n I1=%.2f A \n",I1)
10 I2=250*1000/240
11 printf("\n I2=%.2f A \n",I2)
```

Scilab code Exa 5.7 Example 7

```
1  //Chapter 5,Ex5.7,Pg 5.8
2  clc;
3  W0=200 //Power
4  R1=3.5 //Primary resistance
5  V1=2300 //Primary voltage
6  I0=0.3 //no load current
7  cl=(I0^2)*R1
8  printf("\n Copper loss=%.3f W \n",cl)
9  coreloss=W0-cl //Core loss=Input power-copper loss
10 printf("\n Core loss=%.3f W \n",coreloss)
11 pf=W0/(V1*I0)
12 printf("\n Power factor = %.2f (lagging) \n",pf)
```

Scilab code Exa 5.8 Example number 8

```
1  //Chapter 5,Ex5.8,Pg 5.8
2  clc;
3  //Primary voltage=230V no-load primary current=5A pf
       =0.25 N1=200 f=50Hz
4  //(i)
5  fluxm=230/(4.44*50*200) //Using E=4.44fN1*fluxm
6  printf("\n Max flux in the core=%.5f Wb \n",fluxm)
7  //(ii)
8  W=230*5*0.25 //Using the formula W=V1*I0*powerfactor
9  printf("\n Core loss =%.1f W \n",W)
10 //(iii)
11 x=sqrt(1-(0.25^2)) //x=sin(phi)
12 Iu=5*x
13 printf("\n Magnetising current=%.2f A \n",Iu)
```

Scilab code Exa 5.9 Example number 9

```
1 //Chapter 5,Ex5.9,Pg 5.13
2 clc;
3 tr=4 //tr=N1/N2=4 which is given in the question
4 K=1/tr
5 Rp=50/(K^2) // Using the formula Equivalent
      resistance referred to primary=R'=R/(K^2)
6 printf("\n Rp=%.0f ohms \n",Rp)
```

Scilab code Exa 5.11 Example number 11

```
1 //Chapter 5,Ex5.10,Pg5.13
2 clc;
3 E1=6600 //Primary voltage
4 E2=400 //Secondary voltage
5 R1=2.5 //Primary resistance
6 X1=3.9 //Primary reactance
7 X2=0.025 //Secondary reactance
8 R2=0.01 //Secondary resistance
9 K=E2/E1
10 //Equivalent resistance referred to primary
11 R01=R1+(R2/(K^2))
12 printf("\n Equivalent resistance referred to primary
      =%.2f ohms \n",R01)
13 //Equivalent reactance referred to primary
14 X01=X1+(X2/(K^2))
15 printf("\n Equivalent reactance referred to
      secondary =%.2f ohms \n",X01)
16 //Equivalent resistance referred to secondary
17 R02=R2+((K^2)*R1)
```

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```
18  printf("\n Equivalent resistance referred to
        secondary=%.2f ohms \n",R02)
19  //Equivalent resistance referred to secondary
20  X02=X2+((K^2)*X2)
21  printf("\n Equivalent resistance referred to
        secondary=%.2f ohms \n",X02)
```

Scilab code Exa 5.12 Example number 12

```
1  //Chapter 5,Ex5.12,Pg5.14
2  clc;
3  E1=4400 //Primary EMF
4  R1=3.45 //Primary resistance in ohms
5  X1=5.2 //Primary reactance in ohms
6  E2=220 //Secondary EMF
7  R2=0.009 //Secondary resistance in ohms
8  X2=0.015 //Secondary reactance in ohms
9  K=E2/E1
10 I1=50*1000/E1 //Using the formula I1=kVA rating
        *1000/E
11 printf("\n Full load Primary current I1=%.2f A \n",
        I1)
12 I2=50*1000/220
13 printf("\n Full load secondary current I2=%.2f A \n"
        ,I2)
14 R01=R1+(R2/(K*K))
15 printf("\n Equivalent resistance referred to primary
        =%.2f ohms \n",R01)
16 X01=X1+(X2/(K*K))
17 printf("\n Equivalent reactance referred to primary
        =%.1f ohms \n",X01)
18 Z01=sqrt((R01^2)+(X01*X01))
19 printf("\n Equivalent impedance referred to primary=
        %.2f ohms \n",Z01)
20 R02=(K^2)*R01
```

```
21  printf("\n Equivalent resistance referred to
        secondary=%.2f ohms \n",R02)
22  X02=(K^2)*X01
23  printf("\n Equivalent reactance referred to
        secondary=%.3f ohms \n",X02)
24  Z02=(K^2)*Z01
25  printf("\n Equivalent impedance referred to
        secondary=%.2f ohms \n",Z02)
26  CL1=(I1^2)*R1 + (I2^2)*R2
27  printf("\n Copper losses with individual resistances
        =%.2f W \n",CL1)
28  CL2=(I1^2)*R01
29  printf("\n Copper loss with equivalent resistances=%
        .1f W \n",CL2)
```

Scilab code Exa 5.13 Example number 13

```
1  //Chapter 5,Ex5.13,Pg5.17
2  clc;
3  E2=440 //Secondary voltage
4  V2=400 //voltage at full load
5  //Given that power factor=0.8(lagging)
6  percentreg=((E2-V2)/E2)*100
7  printf("\n Percentage regulation=%.2f percent\n",
        percentreg)
```

Scilab code Exa 5.15 Example number 15

```
1  //Chapter 5,Ex5.16,Pg5.18
2  clc;
3  //Let x=cos(phi) and y=sin(phi)
4  x=0.8
5  y=0.6
```

```
6  vr =1
7  vx =5
8  //For 0.8 lagging power factor
9  percentreg=vr*x+vx*y
10 printf("\n Percentage regulation=%.1f percent \n",
       percentreg)
11 //For unity power factor
12 x=1
13 y=0
14 percentreg=vr*x+vx*y
15 printf("\n Percent regulation=%.0f percent \n",
       percentreg)
16 //For 0.8 leading pf
17 x=0.8
18 y=0.6
19 percentreg=vr*x-vx*y
20 printf("\n Percent regulation=%.1f percent \n",
       percentreg)
```

Scilab code Exa 5.17 Example number 17

```
1  //Chapter5,Ex5.17,Pg5.19
2  clc;
3  E1=230 //EMF in primary winding
4  E2=460 //EMF in secondary winding
5  R1=0.2 //Primary resistance
6  R2=0.75 //Secondary resistance
7  X1=0.5 //Reactance in ohms
8  X2=1.8 //Secondary reactance in ohms
9  I2=10 //secondary current in amperes
10 pf=0.8 //cos(phi)=0.8
11 K=E2/E1
12 printf("K=%.0f \n",K)
13 R02=R2+(K^2)*R1 //Effective secondary resistance
14 X02=X2+(K^2)*X1 //Effective secondary reactance
```

```
15  y=sqrt(1-(pf^2))  //sin(phi)=y
16  V2=E2-I2*((R02*pf)+(X02*y))
17  printf("\n Secondary terminal voltage=%.1f V \n",V2)
```

Scilab code Exa 5.18 Example number 18

```
1   //Example 5.18,Pg5.20
2   clc;
3   //Given Full load kVA=100kVA
4   //Wi=600W(iron loss)
5   //WCu=1.5kW(copper loss)
6   //(i)
7   x=1 //Full load
8   pf=0.8
9   n=(x*100*pf/((x*100*pf)+0.6+((x^2)*1.5)))*100
10  printf("\n Efficiency=%.2f percent \n",n)
11  //(ii)
12  x=0.5
13  pf=1
14  n=(x*100*pf/((x*100*pf)+0.6+((x^2)*1.5)))*100
15  printf("\n Efficiency=%.2f percent \n",n)
```

Scilab code Exa 5.19 Example number 19

```
1   //Ex5.19,Pg5.21
2   clc;
3   flkva=25 //Full load kVA
4   R1=1.8 //Primary resistance in ohms
5   R2=0.02 //Secondary resistance in ohms
6   E1=2200 //Primary EMF in volts
7   E2=220 //Secondary EMF in volts
8   Wi=1000 //Iron loss in watts
9   I2=flkva*1000/220
```

```
10  printf("\n I2=%.2 f A \n",I2)
11  K = E2 / E1
12  printf("\n K=%.1 f \n",K)
13  R02 = R2 +(K^2)*R1
14  printf("\n Effective secondary resistance=%.3 f ohms
        \n",R02)
15  Wcu =(I2^2)*R02
16  printf("\n Copper loss=%.2 f W \n",Wcu)
17  //(i)
18  x=1 //Full load
19  pf =1
20  n=(x*flkva*pf/((x*flkva*pf)+Wi/1000+((x^2)*Wcu/1000)
        ))*100
21  printf("\n Efficiency=%.2 f percent \n",n)
22  //(ii)
23  x=0.5
24  pf =0.8
25  n=(x*flkva*pf/((x*flkva*pf)+Wi/1000+((x^2)*Wcu/1000)
        ))*100
26  printf("\n Efficiency=%.2 f percent \n",n)
```

Scilab code Exa 5.20 Example number 20

```
1  //Ex5.20 ,Pg5.22
2  clc;
3  n1=98.135 //Given efficiency
4  n2=97.751 //Given efficiency
5  x=1 //Full load
6  pf=0.8 //Power factor
7  //Using the above data we have to solve 2
       simultaneous equations by substituting the values
        in the formula for calculating the efficiency
8  A=[1 1;1 0.25]
9  B=[3.8; 2.3]
10  W=A\B
```

```
11  printf(")\n Full  load  copper  loss =%.0f kW \n",W(2))
12  printf(")\n Iron  loss =%.1f kW \n",W(1))
```

Scilab code Exa 5.21 Example number 21

```
1  //Ex5.21 , Pg5.23
2  clc ;
3  //Given  x=1  and  pf=1  we  obtain  the  first  equation
4  //With  x=0.5  and  pf=1  we  obtain  the  second  equation
5  A=[1  1;1  0.25]
6  B=[52.2;26.1]
7  W=A\B
8  printf(")\n Copper  loss=%.1f kW \n",W(2))
9  printf(")\n Iron  loss=%.1f kW \n",W(1))
10  //Now  if  x=0.6  and  pf=1
11  n= (0.6*600*1/((0.6*600*1)+W(1)+((0.6^2)*W(2))))*100
12  printf(")\n Efficiency=%.2f percent \n",n)
```

Scilab code Exa 5.22 Example number 22

```
1  //Ex5.22 , Pg5.23
2  clc ;
3  flkva=150  //Given
4  Wi=1.4  //Iron  loss  in  kW
5  Wcu=1.6  //Copper  loss  in  kW
6  //(a)
7  lkva=flkva*sqrt(Wi/Wcu)
8  printf(")\n Load  kVA=%.2f kVA \n",lkva)
9  //For  maximum  efficiency  Wi=Wcu=1.4kW  and  pf=0.8
10  n= (lkva*0.8/((lkva*0.8)+Wi+Wcu))*100
11  printf(")\n Efficiency=%.2f percent \n",n)
12  //(b)
```

```
13 n= (0.5*flkva*0.8/((0.5*flkva*0.8)+Wi+(0.5^2)*Wcu))
      *100
14 printf("\n Efficiency=%.2f percent \n",n)
```

Scilab code Exa 5.23 Example number 23

```
1  //Example5.23,Pg5.24
2  clc;
3  flkva=100 //Full load kVA given
4  x=1 //Full load
5  pf=0.8 //Power factor lagging
6  A=[1 1;1 -0.64]
7  B=[2.474;0]
8  W=A\B
9  n= (x*flkva*pf/((x*flkva*pf) + W(1) +(x^2)*W(2)))
      *100
10 printf("\n Efficiency=%.2f percent \n",n)
```

Scilab code Exa 5.28 Example number 28

```
1  //Example5.28,Pg5.28
2  clc;
3  Wi=1 //Iron loss in kW
4  op=50*0.8*10+25*0.6*10+0*4
5  Wcu=1.2 //Copper loss in kW
6  Culoss=1*1.2*10+(25/50)*1.2*10+0 //Copper loss in
      the entire day considering the load cycle for a
      day as given in the question
7  Iloss=1*24
8  nallday= (op/(op+Iloss+Culoss))*100
9  printf("\n All day efficiency=%.2f percent \n",
      nallday)
```

Chapter 6

Electrical Machines

Scilab code Exa 6.1 Example 1

```
1 //Chapter6, Pg6.6, Ex6.1
2 clc;
3 P=6 //Number of poles in armature
4 phi=0.018 //Flux per pole in Wb
5 N=600 //Angular velocity in rpm
6 Z=840 //Number of conductors
7 A=P //For lap wound armature, number of parallel
     paths=number of poles
8 Eg=(phi*Z*N*P)/(60*A)
9 printf("\n Eg=%.1f V \n",Eg)
```

Scilab code Exa 6.2 Example number 2

```
1 //Pg6.6, Ex6.2
2 clc;
3 P=6 //Number of poles
4 A=2 //No of parallel paths
5 Z=300 //Number of conductors
```

```
6  N=1000 //Angular velocity
7  Eg=400 //Generated Emf
8  phi=(60*Eg*A)/(Z*N*P)
9  printf("\n phi=%.4f Wb\n",phi)
```

Scilab code Exa 6.3 Example number 3

```
1  //Pg6.7,Ex6.3
2  clc;
3  n=80 //Number of slots on armature
4  cps=10 //number of conductors per slot
5  Eg=400 //Generated EMF
6  N=1000 //Angular velocity
7  //part(i)
8  ctotal=n*cps
9  phi=(Eg*60)/(N*ctotal) //Since A=P
10 printf("\n phi=%.2f Wb \n",phi)
11 //part(ii)
12 Eg=220
13 N=(Eg*60)/(phi*ctotal)
14 printf("\n N=%.0f rpm \n",N)
```

Scilab code Exa 6.4 Example number 4

```
1  //Pg 6.7,Ex6.4
2  clc;
3  P=4 //Number of poles
4  V=200 //Supply voltage
5  Rf=80 //field resistance in ohms
6  Ra=0.1 //Armature resistance in ohms
7  Il=100 //Load current in amperes
8  //part(i)
9  If=V/Rf
```

```
10  printf(”\n  Il=%.1f A  \n”,Il)
11  Ia=Il+If
12  printf(”\n  Ia=%.1f A  \n”,Ia)
13  //part(ii)
14  A=P  //For  lap  wound  generator
15  cpp=Ia/4
16  printf(”\n  Current  per  armature  path=%.3f A  \n”,cpp)
17  //Current  per  armature  path=total  current  divided  by
        total  number  of  conductors
18  ///part(iii)
19  Eg=V+(Ia*Ra)+(0.1*2)  //Where  the  last  term  in  the
        addition  is  brush  drop
20  printf(”\n  Eg=%.2f V  \n”,Eg)
```

Scilab code Exa 6.5 Example number 5

```
 1  //Pg  6.5,ex6.8
 2  clc;
 3  V=250  //Terminal  voltage
 4  Il=450  //Load  current
 5  Rf=50  //Field  resistance  in  ohms
 6  Ra=0.05  //Armature  resistance  in  ohms
 7  P=4  //Number  of  poles
 8  phi=0.05  //Flux  per  pole  in  Wb
 9  If=V/Rf
10  printf(”\n  If=%.0f A  \n”,If)
11  Ia=Il+If
12  printf(”\n  Ia=%.0f A  \n”,Ia)
13  Eg=V+(Ia*Ra)
14  printf(”\n  Eg=%.2f V  \n”,Eg)
15  n=120  //Number  of  slots  in  armature
16  cpp=4  //Conductors  per  slot
17  Z=n*cpp  //Total  number  of  conductors  on  armature
18  A=P  //For  lap  wound  generator
19  N=(Eg*60*A)/(phi*Z*P)
```

```
20 printf(" \n N=%.0 f  rpm  \n",N)
```

Scilab code Exa 6.6 Example number 6

```
1  //Ex6.6,Pg6.8
2  clc;
3  V=230 //Supply voltage
4  Il=40 //Current in amperes
5  Ra=0.5 //Armature winding
6  Rf=115 //Resistance in ohms
7  //Generator operation
8  disp("Generator operation")
9  Il=40 //Load current in amperes
10 If=V/Rf
11 printf(" \n If=%.0 f  A  \n",If)
12 Ia=Il+If
13 printf(" \n Ia=%.0 f  A  \n",Ia)
14 Eg=V+(Ia*Ra)
15 printf(" \n Eg=%.0 f  V  \n",Eg)
16 //Motor operation
17 disp("Motor operation")
18 Il=40
19 If=2
20 Ia=Il-If
21 printf(" \n Ia=%.0 f  A  \n",Ia)
22 Eb=V-(Ia*Ra)
23 printf(" \n Eb=%.0 f  V  \n",Eb)
24 n=Eb/Eg
25 printf(" \n N2/N1=% .4 f  \n",n)
```

Scilab code Exa 6.7 Example number 7

```
1  //Ex6.7
```

```
 2  clc;
 3  V=100
 4  Il=200
 5  Rs=0.03
 6  Rf=60
 7  Ra=0.04
 8  Vsfw=Il*Rs
 9  printf("\n Voltage drop in series field winding =%.0
        f V \n",Vsfw)
10  If=(V+(Il*Rs))/Rf
11  printf("\n If=%.2f A \n",If)
12  Ia=Il+If
13  printf("\n Ia=%.2f A \n",Ia)
14  Eg=V+(Il*Rs)+(Ia*Ra)
15  printf("\n Generated EMF=%.2f V \n",Eg)
```

Chapter 7

Semiconductor devices and rectifiers

Scilab code Exa 7.1 Calculation of base current

```
1 //Chapter7 ,Pg7.4 ,Ex1
2 clc;
3 I=(20-4)/2.2*10^3 //Diode D1 will be forward biased
      and diode D2 will be reverse biased
4 printf("\n I=%.2f mA \n",I*10^-3)
```

Scilab code Exa 7.2 Calculation of alpha dc

```
1 //Chapter7 ,Pg7.4 ,Ex7.2
2 clc;
3 Bdc=90 //
4 Ic=15 //Collector current
5 Ib=Ic/Bdc
6 printf("\n Ib=%.2f uA \n",Ib*10^3)
7 Ie=Ib+Ic
8 printf("\n Emitter current Ie=%.2f mA \n",Ie)
```

```
9  Adc = Bdc /( Bdc +1)
10 printf ("\n  Adc=%.2 f  \n", Adc )
```

Scilab code Exa 7.4 Calculation of collector current

```
1 // Chapter  7, Ex7.4 , Pg7.15
2 clc ;
3 B =100
4 Icbo =4  // current  in  microamperes
5 Ib =40  // Current  in  microamperes
6 Ic = B * Ib +( B +1) * Icbo
7 printf ("\n  Ic=%.1 f  mA  \n", Ic *10^ -3)
```

Scilab code Exa 7.5 Calculation of emitter current

```
1 // Chapter7 , Ex7.5 , Pg7.15
2 clc ;
3 B =50
4 Ib =20  // Base  current  in  microamperes
5 Ic = B * Ib
6 printf ("\n  Ic=%.0 f  mA  \n", Ic *10^ -3)
7 Ie = Ic + Ib
8 printf ("\n  Ie=%.2 f  mA  \n", Ie *10^ -3)
```

Scilab code Exa 7.6 Calculation of base current

```
1 // Chapter  7, Ex7.6 , Pg  7.15
2 clc ;
3 a =0.9
4 Ie =10^ -3
```

```
5  Ic=a*Ie //a=Ic/Ie
6  Ib=Ie-Ic
7  printf("\n Ib=%.1f mA \n",Ib*10^3)
```

Scilab code Exa 7.7 Calculation of base current

```
1  //Chapter 7,Ex 7.7,Pg 7.15
2  clc;
3  a=0.98
4  Vce=0.2
5  Ic=2*10^-3
6  Vcc=12
7  Rc=4
8  b=a/(1-a)
9  printf("\n Beta=%.0f \n",b)
10 Ice=(Vcc-Vce)/Rc
11 printf("\n Ic=%.2f mA \n",Ic*10^3)
12 Ib=Ic/b
13 printf("\n Ib(sat)=%.2f uA \n",Ib*10^6)
```

Scilab code Exa 7.13 Calculation of Idc

```
1  //Chapter 7,Ex7.13,Pg7.30
2  clc;
3  Vrms=66.64
4  Rl=15
5  Vm=sqrt(2)*Vrms
6  printf("\n Vm=%.2f V \n",Vm)
7  Im=Vm/Rl
8  printf("\n Im=%.2f A \n",Im)
9  Idc=Im/%pi
10 printf("\n Idc=%.0f A \n",Idc)
```

Scilab code Exa 7.14 Calculation of peak value of current

```
1 //Chapter 7,Ex7.14,Pg7.30
2 clc;
3 Vdc=300
4 Rl=3000
5 Vm=Vdc*%pi/2 //For full wave rectifier
6 printf("\n Vm=%.2f V \n",Vm)
7 Vrms=Vm/sqrt(2) //RMS value of secondary voltage
8 Im=Vm/Rl //Peak diode current
9 printf("\n Im=%.2f A \n",Im)
```

Scilab code Exa 7.16 Calculation of Vrms

```
1 //Chapter 7,Ex7.16,Pg7.30
2 clc;
3 Vdc=50
4 Rl=800
5 Rf=25
6 Vm=(Vdc*%pi*(Rf+Rl))/Rl
7 printf("\n Vm=%.0f \n",Vm)
8 Vrms=Vm/sqrt(2)
9 printf("\n Vrms=%.2f V \n",Vrms)
```

Scilab code Exa 7.17 Calculation of percent regulation

```
1 //Chapter 7,Ex 7.17,Pg 7.31
2 clc;
3 Rf=1
```

```
4  Idc =100
5  Vrms =12.6
6  Rs =3
7  Vm=sqrt (2) *Vrms
8  printf ("\n Vm=%.2 f  V  \n" ,Vm)
9  Im=Idc *%pi
10 printf ("\n Im=%.3 f  mA  \n" ,Im)
11 //Let  us  use  the  formula  Im=Vm/(Rs+Rf+Rl)  to  obtain
       the  value  of  Rl
12 Rl =(17.82 - Im*(Rs+Rf))/Im
13 printf ("\n Rl=%.2 f  V  \n" ,Rl)
14 Vdc =Idc *Rl
15 printf ("\n Vdc=%.3 f  V  \n" ,Vdc)
16 Vnl=Vm/%pi
17 Vfl =Idc *Rl
18 percentreg =((Vnl -Vfl )/Vnl )*100
19 printf ("\n Percent  regulation=%.2 f  \n" ,percentreg
       *10^ -3)
```

Scilab code Exa 7.18 To find out voltage across conducting diode

```
1  //Chapter7 ,Example  7.18 ,Pg  7.32
2  clc ;
3  Vrms =20  //Root  mean  square  voltage
4  Rl =500  //Load  resistance  in  ohms
5  Rf =20  //diode  forward  resistance
6  Vm=sqrt (2) *Vrms
7  printf ("\n Vm=%.2 f  V  \n" ,Vm)
8  Im=Vm/(Rf+Rl)
9  printf ("\n Im=%.5 f  A  \n" ,Im)
10 Idc =2* Im/%pi
11 printf ("\n Idc=%.2 f  mA  \n" ,Idc *10^3)
12 Vdc =(2* Vm/%pi )-Idc *Rf
13 printf ("\n Vdc=%.2 f  V  \n" ,Vdc)
14 Irms =Im/sqrt (2)
```

```
15  printf("\n Irms=%.2f mA \n",Irms*10^3)
16  Pi=(Irms^2)*(Rf+Rl)
17  printf("\n Input power=%.3f W \n",Pi)
18  r=sqrt(((Irms/Idc)^2)-1)
19  printf("\n Ripple factor=%.3f \n",r)
20  vcd=Idc*Rf
21  printf("\n Voltage across conducting diode=%.4f V \n
        ",vcd)
22  disp("Voltage across non conducting diode=20V")
```

Scilab code Exa 7.19 `Percentage regulation`

```
1  //Chapter7.19,Ex7.19,Pg7.33
2  clc;
3  Vrms=40
4  Rf=1 //Diode forward resistance in ohms
5  Rl=19 //load resistance
6  Vm=sqrt(2)*Vrms
7  printf("\n Vm=%.2f V \n",Vm)
8  Im=Vm/(Rf+Rl)
9  Idc=(2*Im)/%pi
10  printf("\n Idc=%.1f A \n",Idc)
11  Pdc=(Idc^2)*Rl
12  printf("\n DC load power=%.1f W \n",Pdc)
13  Pac=((Im/sqrt(2))^2)*(Rf+Rl)
14  printf("\n Pac=%.2f W \n",Pac)
15  n=(Pdc/Pac)*100
16  printf("\n Efficiency=%.2f percent \n",n)
17  Vnl=(2*Vm)/%pi
18  Vfl=Idc*Rl
19  printf("\n Vfl=%.1f V \n",Vfl)
20  percentreg=((Vnl-Vfl)/Vnl)*100
21  printf("\n Percentage Regulation=%.2f percent \n",
        percentreg)
```

Scilab code Exa 7.21 Peak inverse voltage

```scilab
1  //Chapter7,Ex7.21,Pg7.36
2  clc;
3  Vrms=250
4  Rl=3000
5  IdcRf=1
6  Vm=Vrms*sqrt(2)
7  printf("\n Vm=%.2f V \n",Vm)
8  Vdc=(2*Vm/%pi)-IdcRf
9  printf("\n Vdc=%.3f V \n",Vdc)
10 Idc=Vdc/Rl
11 printf("\n Idc=%.4f A \n",Idc)
12 Pdc=(Idc^2)*Rl
13 printf("\n Pdc=%.2f W \n",Pdc)
14 Rf=1/Idc
15 printf("\n Rf=%.2f ohms \n",Rf)
16 Irms=Vm/((Rf+Rl)*sqrt(2))
17 printf("\n Irms=%.3f A \n",Irms)
18 Pac=(Irms^2)*(Rf+Rl)
19 printf("\n Pac=%.2f W \n",Pac)
20 PIV=2*Vm //Peak inverse voltage
21 printf("\n PIV=%.1f V \n",PIV)
```