

Scilab Textbook Companion for
Basic Electrical and Electronics Engineering-i
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May 19, 2015

¹Funded by a grant from the National Mission on Education through ICT, <http://spoken-tutorial.org/NMEICT-Intro>. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website <http://scilab.in>

Book Description

Title: Basic Electrical and Electronics Engineering-i

Author: S. K. Bhattacharya and Debashis De

Publisher: Dorling Kindersley, India

Edition: 1

Year: 2011

ISBN: 978-81-317-5604-1

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

DC Networks and Network Theorems

Scilab code Exa 1.1 Convert Voltage source

```
1 //Example 1_1
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Vs=20;//V
8 Rse=5;//ohm(Internal Resistance)
9 //Source Conversion
10 Is=Vs/Rse;//A
11 Rsh=Rse;//ohm(same)
12 disp(Is,"Equivalent current source(A)");
13 disp(Rsh,"Internal resistance in parallel(ohm)")
```

Scilab code Exa 1.2 Conversion of a Voltage source

```

1 //Example 1_2
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Is=100; //A
8 Rsh=10; //ohm
9 //Source Conversion
10 Vs=Is*Rsh; //V
11 disp(Vs,"Equivalent voltage source(V)");
12 Rse=Rsh; //ohm
13 disp(Rse,"Internal resistance in series(ohm)");

```

Scilab code Exa 1.3 Calculate the current

```

1 //Example 1_3
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Vs=12; //V
8 Req=2+4*(2+2)/(4+(2+2)); //ohm
9 I=Vs/Req; //A
10 I1=I; //A(Current in first 2 ohm resistance)
11 disp(I1,"Current in first 2 ohm resistance(A)");
12 I2=I/2; //A(Current in 4 ohm resistance)
13 disp(I2,"Current in 4 ohm resistance(A)");
14 I3=I/2; //A(Current in remaining 2 ohm resistances)
15 disp(I3,"Current in remaining 2 ohm resistances(A)");
    ;

```

Scilab code Exa 1.4 Calculate the current

```
1 //Example 1_4
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Vs=6; //V
8 //Point A & C, B & D are shorted
9 RAB=(4*4/(4+4)); //ohm
10 RDC=(4*4/(4+4)); //ohm
11 Req=RAB*RDC/(RAB+RDC); //ohm
12 Is=Vs/Req; //A
13 disp(Is,"Current supplied by the battery(A)");
```

Scilab code Exa 1.5 Calculate the current

```
1 //Example 1_5
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 //Point B & C are shorted
8 RAB=(4*4/(4+4)); //ohm
9 RBD=(4*4/(4+4)); //ohm
10 Req=RAB+RBD; //ohm
11 disp(Req,"Equivalent Resistance(ohm)");
```

Scilab code Exa 1.6 Calculate the branch current

```
1 //Example 1_6
```

```

2  clc;
3  clear;
4  close;
5  format('v',6);
6  //given data :
7  format('v',6);
8  I=2; //A
9  //3*I1+8*I2=6 from loop ABCA
10 //7*I1-5*I2=0 from loop ADCA
11 A=[3 8;7 -5]; //coefficient matrix
12 B=[6;0]; //coefficient matrix
13 X=A^-1*B; //Matrix multiplication
14 I1=X(1); //A
15 I2=X(2); //A
16 I3=I-I1-I2; //A
17 disp(I3,"Current in branch AB & BC(A)");
18 disp(I1,"Current in branch AD & DC(A)");
19 disp(I2,"Current in branch AC(A)");

```

Scilab code Exa 1.7 Calculate the current

```

1  //Example 1_7
2  clc;
3  clear;
4  close;
5  format('v',5);
6  //given data :
7  //11*I2+8*I3=4 from loop GDAG
8  //8*I2+11*I3=6 from loop HDAH
9  A=[11 8;8 11]; //coefficient matrix
10 B=[4;6]; //coefficient matrix
11 X=A^-1*B; //Matrix multiplication
12 I2=X(1); //A
13 I3=X(2); //A
14 I8=I2+I3; //A

```

```
15 disp(I8," Current in 8 ohm resistor (A)");
```

Scilab code Exa 1.8 Calculate the current

```
1 //Example 1_8
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 //6*I1-3*I2=2 from mesh 1
8 //-6*I1+14*I2=4 from mesh 2
9 A=[6 -3;-6 14];//coefficient matrix
10 B=[2;4];//coefficient matrix
11 X=A^-1*B;//Matrix multiplication
12 I1=X(1);//A
13 I2=X(2);//A
14 disp(I1," Current in 2ohm & 4ohm resistor (A)");
15 disp(I2," Current in 3ohm & 5ohm resistor (A)");
16 I6ohm=I1-I2;//A(Current in 6ohm resistor)
17 disp(I6ohm," Current in 6ohm resistor (A)");
```

Scilab code Exa 1.9 Determine unknown voltage

```
1 //Example 1_9
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 //9*I1-2*I2-3*I3=24-V from mesh 1
8 //I1-6*I2+3*I3=0 from mesh 2
9 //3*I1+6*I2-11*I3=-V from mesh 3
```

```

10 d=[9 -2 -3;1 -6 3;3 6 -11];
11 delta=det(d); //determinant
12 //d1=[24-V -2 -3;0 -6 3;-V 6 -11];
13 //delta1=det(d1);determinant
14 //Putting I1=delta1/delta=0
15 V=(24*(66-18))/((66-18)+(-6-18)); //V
16 disp(V,"Unknown Voltage (V)");

```

Scilab code Exa 1.10 Voltage at nodes

```

1 //Example 1_10
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 VD=10; //V
8 VE=6; //V
9 R1=3; R2=4; R3=14; R4=8; R5=12; //ohm
10 //Ohm's current law
11 //I1=(VD-VB)/R1; I2=VB/R4; I3=(VK-VC)/R2; //A
12 //Where VK=VB-3; //V
13 //KCL at Node B : 17*VB-6*VC=98
14 //KCL at Node C : 21*VB-34*VC=27
15 A=[17 -6;21 -34]; //Coefficient Matrix
16 B=[98;27]; //Coefficient Matrix
17 X=A^-1*B; //solution
18 VB=X(1); //V
19 VC=X(2); //V
20 I2=VB/R4; //A
21 disp(I2,"Current through the 8 ohm resistor (A) : ");

```

Scilab code Exa 1.11 Value of current


```

1 //Example 1_11
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 VA=24;//V
8 VC=12;//V
9 R1=6;R2=6;R3=6;//ohm
10 //Considering VA only , making VC short circuit
11 I=VA/(R1+R2*R3/(R2+R3));//A//from source VA
12 I1A=I*R2/(R1+R2);//A//through BD from VA only
13 //Considering VC only , making VA short circuit
14 I=VC/(R3+R1*R2/(R1+R2));//A//from source VC
15 I1C=I*R2/(R1+R2);//A//through BD from VA only
16 IBD=I1A+I1C;//A
17 disp(IBD,"Current IBD in the Circuit(A) : ");

```

Scilab code Exa 1.12 Calculate the current

```

1 //Example 1_12
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 VA=75;//V
8 VB=64;//V
9 R1=5;R2=5;R3=4;R4=20;R5=12;//ohm
10 //Considering VA only , making VB short circuit
11 I=VA/(R1+(R3*R5/(R3+R5)+R2)*R4/(R4+R3*R5/(R3+R5)+R2)
    );//A//from source VA
12 I1A=I*R4/(R4+R2+R3*R5/(R3+R5));//A//through AB from
    VA only
13 //Considering VB only , making VA short circuit

```

```

14 I=VB/(R3+(R1*R4/(R1+R4)+R2)*R5/(R5+R1*R4/(R1+R4)+R2)
    );//A//from source VB
15 I1B=I*R5/(R5+(R1*R4/(R1+R4)+R2));//A//through AB
    from VB only
16 IAB=I1A-I1B;//A//total current through R2=5 ohm
17 disp(IAB,"Current I in the Circuit is equal to IAB(A
    ) : ");

```

Scilab code Exa 1.13 Calculate the current

```

1 //Example 1_13
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=20;//V
8 I=2;//V
9 R1=2;R2=4;R3=8;//ohm
10 //Considering current source only, making Voltage
    source short circuit
11 I1=I*R1/(R1+R3);//A//through B to A
12 //Considering Voltage source only, making current
    source open circuit
13 I2=V/(R1+R3);//A//through A to B
14 IAB=I2-I1;//A//total current through R2=5 ohm
15 disp(IAB,"Current through 8ohm resistor(A) : ");

```

Scilab code Exa 1.14 Calculate the current

```

1 //Example 1_14
2 clc;
3 clear;

```

```

4  close;
5  format('v',5);
6  //given data :
7  V1=40; //V
8  V2=44; //V
9  R1=2; //ohm
10 R2=4; //ohm
11 R3=6; //ohm
12 I1=poly(0,'I1');
13 I2=poly(0,'I2');
14 //From Mesh ABEFA //eq1=V1-R1*I1+R2*I2-V2;
15 // -R1*I1+R2*I2=V2-V1; // eqn (1)
16 //From Mesh BCDED //eq2=-R2*I2-R3*(I1+I2)+V2;
17 //R3*I1+(R2+R3)*I2=V2; // eqn (2)
18 A=[-R1 R2;R3 (R2+R3)]; // coefficient matrix
19 B=[V2-V1;V2]; // coefficient matrix
20 X=A^-1*B; //
21 I1=X(1); //A
22 disp(I1,"Current I1(A)");
23 I2=X(2); //A
24 disp(I2,"Current I2(A)");
25 I=I1+I2; //A
26 disp(I,"Total Current I(A)");

```

Scilab code Exa 1.15 Calculate the current

```

1 //Example 1_15
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=2; //V
8 R1=1; //ohm
9 R2=2; //ohm

```

```

10 R3=3; //ohm
11 R4=2; //ohm
12 R5=4; //ohm
13 //Mesh ABDA: -I1-R5*I3+R4*I2=0
14 //Mesh BCDB: -R2*(I1-I3)+R3*(I2+I3)+R5*I3=0
15 //Mesh ABCA: -I1-R2*(I1-I3)+V=0
16 A=[-R1 R4 -R5;-R2 R3 R3+R2+R5;-R3 0 R2]; //
    coefficient matrix
17 B=[0;0;-V]; //coefficient matrix
18 X=A^-1*B; //
19 I3=X(3); //A
20 disp(I3,"Current through galvanometer , I3(A)");

```

Scilab code Exa 1.16 Determine Current Is

```

1 //Example 1_16
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 R1=4; //ohm
8 R2=6; //ohm
9 R3=8; //ohm
10 //I1=I2+IS //eqn (1)
11 //I2+I3=V1/4 //eqn (2)
12 Vo=16; //V
13 //VAC+VAB=Vo : V1+R1*I2=Vo ///eqn (3)
14 //I1=V1/R2; //eqn (4)
15 I3=Vo/R3; //A
16 //V1/4-I2=I3 //eqn (5)
17 //solving eqn (3) & eqn (5)
18 A=[1 R1;1/4 -1];
19 B=[Vo;I3];
20 X=A^-1*B;

```

```

21 V1=X(1); //V
22 I2=X(2); //A
23 I1=V1/6; //A
24 Is=I1-I2; //A
25 disp(Is, "Current Is (A)");

```

Scilab code Exa 1.17 Determine Load Current

```

1 //Example 1_17
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=12; //V
8 V2=10; //V
9 R1=2; //ohm
10 R2=1; //ohm
11 R3=10; //ohm
12 //Node A : I1=(V1-VA)/2
13 //Node B : I2=(V2-VB)/2
14 //IL=VB/R3; //A
15 //IL=I1+I2
16 VA=10; VB=10 //V
17 I1=(V1-VA)/2; //A//from Node A
18 I2=(V2-VB)/2; //A//from Node B
19 IL=VB/R3; //A
20 disp(I1, "Current by Battery A, IA(A)");
21 disp(I2, "Current by Battery B, IA(A)");
22 disp(IL, "Load Current(A)");

```

Scilab code Exa 1.18 Voltage at nodes

```

1 //Example 1_18
2 clc;
3 clear;
4 close;
5 format('v',8);
6 //given data :
7 V1=10; //V
8 V2=3; //V
9 V3=6; //V
10 R1=3; //ohm
11 R2=4; //ohm
12 R3=14; //ohm
13 R4=8; //ohm
14 R5=12; //ohm
15 //Node B :  $(V1-VB)/R1=VB/R4+(VB-VC-V2)/R2$ 
16 //  $VB(1/R4+1/R1+1/R2)+VC*(-1/R2)=V2/R2+V1/R1$  //eq (1)
17 A1=[(1/R4+1/R1+1/R2) (-1/R2)]; // Coefficient Matrix
18 B1=[V2/R2+V1/R1]; // Coefficient Matrix
19 //Node C:  $VC/R5=(VB-VC-V2)/R2+(V3-VC)/R3$ 
20 //  $VB*(-1/R2)+VC(1/R2+1/R5+1/R3)=V3/R3-V2/R2$  //eq (2)
21 A2=[(-1/R2) (1/R2+1/R5+1/R3)]; // Coefficient Matrix
22 B2=[V3/R3-V2/R2]; // Coefficient Matrix
23 A=[A1;A2];B=[B1;B2]; // Coefficient Matrix
24 X=A^-1*B; //solution of matrix
25 VB=X(1); //V
26 VC=X(2); //V
27 I2=VB/R4; //A
28 disp(I2,"Current through 8 ohm resistor (A)");

```

Scilab code Exa 1.19 Calculate the current

```

1 //Example 1_19
2 clc;
3 clear;
4 close;

```

```

5  format('v',5);
6  //given data :
7  E1=2.05; //V
8  E2=2.15; //V
9  V3=6; //V
10 R1=0.05; //ohm
11 R2=0.04; //ohm
12 R3=1; //ohm
13 //Considering E1 only, Make E2 short circuit
14 I1=E1/(R1+R2*R3/(R2+R3)); //A
15 disp(I1,"Current supplied by battery1(A)");
16 I1dash=I1*R2/(R2+R3); //A
17 format('v',6);
18 //Considering E2 only, Make E1 short circuit
19 I2=E2/(R2+R1*R3/(R1+R3)); //A
20 disp(I2,"Current supplied by battery2(A)");
21 I2dash=I2*R1/(R1+R3); //A
22 I=I1dash+I2dash; //A
23 disp(I,"Current through 1ohm resistance, Load
      current(A)");

```

Scilab code Exa 1.20 Determine Current

```

1  //Example 1_20
2  clc;
3  clear;
4  close;
5  format('v',5);
6  //given data :
7  V=20; //V
8  I=2; //A
9  V3=6; //V
10 R1=2; //ohm
11 R2=4; //ohm
12 R3=8; //ohm

```

```

13 //Considering current source only , Make Voltage
    source short circuit
14 I1dash=I*R1/(R1+R3);//A
15 //Considering Voltage source only , Make Current
    source opent circuit
16 I1dash2=V/(R1+R3);//A
17 I=I1dash2-I1dash;//A
18 disp(I,"Current through 8 ohm resistor from A to B(A
    )");

```

Scilab code Exa 1.21 Range of current

```

1 //Example 1_21
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=90;//V
8 V2=50;//V
9 V3=100;//V
10 R1=60;//ohm
11 R2=40;//ohm
12 R3=30;//ohm
13 R4=60;//ohm
14 R=6:36;//ohm
15 //Open circuit AB
16 I1=V1/(R1+R3);//A
17 I2=V3/(R2+R4);//A
18 //Potential of point A
19 VA=I1*R3+V2;//V
20 //Potential of point B
21 VB=I2*R4;//V
22 VOC=VA-VB;//V
23 Req=R1*R3/(R1+R3)+R2*R4/(R2+R4);//ohm

```



```

24 Imin=VOC/(Req+max(R)); //A
25 Imax=VOC/(Req+min(R)); //A
26 disp("The current through resistor R will vary from
      "+string(Imin)+" A to "+string(Imax)+" A.");

```

Scilab code Exa 1.22 Calculate the current

```

1 //Example 1_22
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V1=24; //V
8 V2=12; //V
9 R1=4; //ohm
10 R2=5; //ohm
11 R3=3; //ohm
12 R4=5; //ohm
13 R5=3; //ohm
14 RL=10; //ohm
15 //Open circuit AB
16 I=V1/(R1+R2+R3); //A
17 //Potential of point A
18 VBQ=0; //V//there is no current
19 VPS=0; //V//there is no current
20 VQP=I*(R2+R3); //V
21 VSA=V2; //V
22 //Potential of point A with respect to B
23 VAB=VBQ+VQP+VPS-VSA; //V
24 VOC=VAB; //V
25 Req=R1*(R2+R3)/(R1+R2+R3)+R4+R5; //ohm
26 //Thevenin equivalent current
27 I=VOC/(Req+RL); //A
28 disp(I,"Current flowing through load resistance(A)")

```

;

Scilab code Exa 1.23 Calculate the current

```
1 //Example 1_23
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V1=12;//V
8 I=2;//A
9 R1=2;//ohm
10 R2=4;//ohm
11 R3=3;//ohm
12 R4=3;//ohm
13 R5=5;//ohm
14 //Converting current source into Voltage source
15 V2=I*R3;//V//Converted source
16 //writing KVL equation for the loop
17 I1=poly(0,'I1');
18 eqn=-R1*I1+V1-R2*I1-R3*I1-V2;//KVL equation
19 I1=roots(eqn);//A
20 VSR=V2+R3*I1;//V
21 VRA=0;//V//there is no current
22 //Potential of point A with respect to B
23 VAB=VSR+VRA;//V
24 VOC=VAB;//V
25 Req=(R1+R2)*R3/(R1+R2+R3)+R4;//ohm
26 //Thevenin equivalent current
27 I=VOC/(Req+R5);//A
28 disp(I,"Current flowing through 5 ohm Resistance(A)");
```

Scilab code Exa 1.24 Determine Current

```
1 //Example 1_24
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V1=6; //V
8 V2=15; //V
9 R1=6; //ohm
10 R2=3; //ohm
11 R3=4; //ohm
12 R4=6; //ohm
13 //writing KVL equation for the loop
14 I=poly(0, 'I');
15 eqn=V2-R2*I-R1*I-V1; //KVL equation
16 I=roots(eqn); //A
17 VCD=V2-R2*I; //V
18 //Potential of point A with respect to B
19 VAB=VCD; //V
20 VOC=VAB; //V
21 Req=R1*R2/(R1+R2)+R3; //ohm
22 //Thevenin equivalent current
23 I=VOC/(Req+R4); //A
24 disp(I,"Current flowing through terminal AB(A)");
```

Scilab code Exa 1.25 Calculate the current

```
1 //Example 1_25
2 clc;
3 clear;
```

```

4  close;
5  format('v',6);
6  //given data :
7  V1=2; //V
8  R1=10; //ohm
9  R2=20; //ohm
10 R3=40; //ohm
11 R4=30; //ohm
12 R5=15; //ohm
13 //solution
14 VBC=R4/(R4+R1)*V1; //V
15 VDC=R5/(R2+R5)*V1; //V
16 VBD=VBC-VDC; //V
17 Vth=VBD; //V
18 Req=R1*R4/(R1+R4)+R2*R5/(R2+R5); //ohm
19 //Thevenin equivalent current
20 IL=Vth/(Req+R3); //A
21 IL=IL*1000; //mA
22 disp(IL,"Current through BD, from B to D(mA)");

```

Scilab code Exa 1.26 Calculate the branch current

```

1  //Example 1_26
2  clc;
3  clear;
4  close;
5  format('v',5);
6  //given data :
7  E1=140; //V
8  R1=30; //ohm
9  R2=70; //ohm
10 E2=85; //V
11 RL=[5 15 50]; //ohm
12 //solution
13 //writing KVL equation for the loop

```

```

14 I=poly(0, 'I');
15 eqn=E1-R1*I-R2*I-E2; //KVL equation
16 I=roots(eqn); //A
17 Vth=E1-I*R1; //V
18 Req=R1*R2/(R1+R2); //ohm
19 //Thevenin equivalent current
20 IL1=Vth/(Req+RL(1)); //A//for RL=5 ohm
21 IL2=Vth/(Req+RL(2)); //A//for RL=15 ohm
22 IL3=Vth/(Req+RL(3)); //A//for RL=50 ohm
23 disp(IL1,"RL=5 ohm, branch current I2(A)");
24 disp(IL2,"RL=15 ohm, branch current I2(A)");
25 disp(IL3,"RL=50 ohm, branch current I2(A)");

```

Scilab code Exa 1.27 Calculate the current

```

1 //Example 1_27
2 clc;
3 clear;
4 close;
5 format('v',4);
6 //given data :
7 V1=20; //V
8 V2=4; //V
9 R1=500; //ohm
10 R2=1000; //ohm
11 R3=100; //ohm
12 R4=800; //ohm
13 RL=1000; //ohm
14 //solution
15 VCB=-R2/(R4+R2)*V1; //V
16 //writing KVL equation for the loop
17 I=poly(0, 'I');
18 eqn=V1-R1*I-V2-R3*I; //KVL equation
19 I=roots(eqn); //A
20 VCA=-I*R1; //V

```

```

21 //Potential at point B with respect to A
22 VBA=VCB-VCA; //V
23 VOC=VBA; //V
24 Vth=VOC; //V
25 Req=R1*R3/(R1+R3)+R2*R4/(R2+R4); //ohm
26 //Thevenin equivalent current
27 IL=Vth/(Req+RL); //A
28 IL=IL*1000; //mA
29 disp(IL,"Current through 1000 ohm resistor (mA)");

```

Scilab code Exa 1.28 Calculate the current

```

1 //Example 1_28
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=15; //V
8 V2=4; //V
9 R1=4; //ohm
10 R2=3; //ohm
11 R3=2; //ohm
12 R4=5; //ohm
13 I1=6; //A
14 RL=R4; //ohm
15 //solution
16 Req=R1*R3/(R1+R3)+R2; //ohm
17 //Converting current source into Voltage source
18 V2=I1*R3; //V//Converted source
19 //writing KVL equation for the loop
20 I=poly(0,'I');
21 eqn=V1-R1*I-R3*I-V2; //KVL equation
22 I=roots(eqn); //A
23 //Potential at point A with respect to B

```

```

24 VAB=V2+R3*I; //V
25 //Thevenin equivalent current
26 I=VAB/(Req+RL); //A
27 disp(I,"Current through 5 ohm resistor(A)");

```

Scilab code Exa 1.29 Calculate the current

```

1 //Example 1_29
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=12; //V
8 V2=24; //V
9 R1=4; //ohm
10 R2=4; //ohm
11 R3=4; //ohm
12 RL=5; //ohm
13 //solution by Norton Theorem
14 //Short Circuit AB
15 I=V1/(R1*R3/(R1+R3)); //A
16 ISC1=I*R3/(R1+R3); //A
17 ISC2=V2/R3; //A
18 ISC=ISC1+ISC2; //A
19 Req=R1*R3/(R1+R3); //ohm
20 //Norton equivalent current
21 IL=ISC*Req/(Req+RL); //A
22 disp(IL,"By Nortons theorem , Current through load
    resistance(A)");
23 //solution by Thevenin Theorem
24 Rth=Req; //ohm
25 //Loop PQRS, Applying KVL
26 //V1-I1*R1-I2*R1=0
27 A1=[-R1 -R1]; //Coefficient Matrix

```

```

28 B1=[-V1]; // Coefficient Matrix
29 //Loop NTRS, Applying KVL
30 //V2-I2*R3-R2*I2-R1*I1-R1*I2=0
31 A2=[-R3-R2-R1 -R1]; // Coefficient Matrix
32 B2=[-V2]; // Coefficient Matrix
33 A=[A1;A2]; // Coefficient Matrix
34 B=[B1;B2]; // Coefficient Matrix
35 X=A^-1*B; //soolution matrix
36 I1=X(1); //A
37 I2=X(2); //A
38 VOC=V2-R3*I2; //A
39 IL=VOC/(Rth+RL); //A
40 disp(IL,"By Thevenins theorem, Current through load
    resistance(A)");

```

Scilab code Exa 1.30 Determine Current

```

1 //Example 1_30
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 I1=10; //A
8 V2=12; //V
9 R1=2; //ohm
10 R2=2; //ohm
11 R3=6; //ohm
12 R4=6; //ohm
13 //solution by Norton Theorem
14 RL=R4; //ohm
15 //Short Circuit AB
16 ISC1=I1*R1/(R1+R2); //A//by current source
17 ISC2=V2/R3; //A///by voltage source
18 ISC=ISC1+ISC2; //A

```



```

19 Req=(R1+R2)*R3/(R1+R2+R3); //ohm
20 //Norton equivalent current
21 I=ISC*Req/(Req+RL); //A
22 disp(I,"By Nortons theorem, Current through 6 ohm
    resistance connected across AB(A)");
23 //solution by Thevenin Theorem
24 Rth=Req; //ohm
25 //Converting current source into Voltage source
26 V1=I1*R1; //V//Converted source
27 //Applying KVL
28 I=poly(0, 'I'); //A
29 eqn=V1-R1*I-R2*I-R3*I-V2; //
30 I=roots(eqn); //A
31 VOC=V2+R3*I; //A
32 I=VOC/(Rth+RL); //A
33 disp(I,"By Thevenins theorem, Current through 6 ohm
    resistance connected across AB(A)");
34 //Unit of current is given wrong in the book.

```

Scilab code Exa 1.31 Norton and Thevenin theorem

```

1 //Example 1_31
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=12; //V
8 V2=6; //V
9 V3=24; //V
10 R1=4; //ohm
11 R2=2; //ohm
12 R3=6; //ohm
13 R4=3; //ohm
14 R5=12; //ohm

```

```

15 R6=16; //ohm
16 //solution by Norton Theorem
17 RL=R6; //ohm
18 //Thevenin theorem
19 //Loop 1 applying KVL
20 //V1-(R1+R2)*I1+V2-R3*(I1+I2);
21 A1=[-R1-R2-R3 -R3]; // Coefficient Matrix
22 B1=[-V1-V2]; // Coefficient Matrix
23 //Loop 2 applying KVL
24 //V3-R4*I2+V2-R3*(I1+I2)-R5*I2;
25 A2=[-R3 -R4-R3-R5]; // Coefficient Matrix
26 B2=[-V3-V2]; // Coefficient Matrix
27 A=[A1;A2]; // Coefficient Matrix
28 B=[B1;B2]; // Coefficient Matrix
29 X=A^-1*B; //soolution matrix
30 I1=X(1); //A
31 I2=X(2); //A
32 VOC=-R5*I2+V3; //V
33 Rth=((R1+R2)*R3/(R1+R2+R3)+R4)*R5/((R1+R2)*R3/(R1+R2
    +R3)+R4+R5); //ohm
34 I=VOC/(Rth+RL); //A
35 disp(I,"By Thevenin Theorem, current through 16 ohm
    resistor (A)");
36 //solution by Norton Theorem
37 //Converting Voltage sources into current sources
38 I1=V1/(R1+R2); //A
39 I2=V2/R3; //A
40 I3=V3/R5; //A
41 Req=Rth; //ohm
42 //Combining I1 & I2 | parallel & opposite
43 I1=I1-I2; //A
44 I2=0; //A
45 ISC1=I1/2; //A//considering I1 only
46 ISC2=I3; //A//considering I3 only
47 ISC=ISC1+ISC2; //A
48 //Norton equivalent current
49 I=ISC*Req/(Req+RL); //A
50 disp(I,"By Nortons theorem, current through 16 ohm

```

```
resistor(A)");
```

Scilab code Exa 1.32 Value of maximum power

```
1 //Example 1_32
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=12; //V
8 R1=2; //ohm
9 R2=2; //ohm
10 R3=2; //ohm
11 R4=2; //ohm
12 R5=2; //ohm
13 //calculating Open circuit voltage :
14 I=V/(R1+R2+R3); //V
15 VCD=I*R3; //V
16 VAB=VCD; //V //Open circuit voltage
17 Req=(R1+R2)*R3/(R1+R2+R3)+R4+R5; //ohm
18 RL=Req; //ohm //For maximum Power transfer
19 disp(RL,"For maximum Power transfer , RL(ohm)");
20 PLmax=VAB^2/4/RL; //W
21 disp(PLmax,"Value of maximum Power(W)");
```

Scilab code Exa 1.33 Value of load resistance

```
1 //Example 1_33
2 clc;
3 clear;
4 close;
5 format('v',5);
```

```

6 //given data :
7 V1=12; //V
8 R1=3; //ohm
9 R2=3; //ohm
10 I2=6; //A
11 //Converting current sources into Voltage sources
12 V2=I2*R2; //V
13 //writing KVL equation for the loop
14 I=poly(0, 'I');
15 eqn=V1-R1*I-R2*I-V2; //KVL equation
16 I=roots(eqn); //A
17 VOC=V2+R2*I; //V
18 Req=R1*R2/(R1+R2); //ohm
19 RL=Req; //ohm//For maximum Power transfer
20 disp(RL, "For maximum Power transfer , RL(ohm)");
21 I=VOC/(Req+RL); //A
22 PLmax=I^2*RL; //W
23 disp(PLmax, "Value of maximum Power(W)");
24 Ri=Req; //ohm
25 Eta=1/(1+Ri/RL)*100; //%
26 disp(Eta, "Power Transfer Efficiency (%)");

```

Scilab code Exa 1.34 Value of load resistance

```

1 //Example 1_34
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=48; //V
8 R1=4; //ohm
9 R2=20; //ohm
10 R3=12; //ohm
11 R4=12; //ohm

```

```

12 V2=12; //V
13 //Open circuit AB
14 I1=V1/(R1+R2); //A
15 I2=V1/(R3+R4); //A
16 VR1=V1*R1/(R1+R2); //V//across 4 ohm resistance
17 VR2=V1*R2/(R1+R2); //V//across 20 ohm resistance
18 VR3=V1*R3/(R3+R4); //V//across 12 ohm resistance
19 VCE=VR2; //V
20 VCD=VR3; //V
21 VBC=V2+VR3; //V
22 //POTential of A wih respect to B
23 VOC=VCE-VBC; //V
24 Rth=R1*R2/(R1+R2)+R3*R4/(R3+R4); //ohm
25 Ri=Rth; //ohm
26 RL=Ri; //ohm//For maximum Power transfer
27 disp( RL, "For maximum Power transfer , RL(ohm)");
28 I=VOC/(Rth+RL); //A
29 PL=I^2*RL; //W
30 disp( PL, "Value of maximum Power(W)");
31 //Answer in the textbook is wrong.

```

Scilab code Exa 1.35 Value of load resistance

```

1 //Example 1_35
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=12; //V
8 R1=4; //ohm
9 R2=6; //ohm
10 R3=6; //ohm
11 R4=6; //ohm
12 //Current by the source while -AB open circuit

```

```

13 I=V/(R2*R3*R4/(R2*R3+R3*R4+R2*R4)+R1); //A
14 //Voltage across AB
15 VOC=I*(R2*R3*R4/(R2*R3+R3*R4+R2*R4)); //V\
16 //Thevenin equivalent Resistance
17 Rth=(R2*R3*R4/(R2*R3+R3*R4+R2*R4)*R1/(R2*R3*R4/(R2*
    R3+R3*R4+R2*R4)+R1)); //ohm
18 Ri=Rth; //ohm
19 RL=Ri; //ohm//For maximum Power transfer
20 disp( RL, "For maximum Power transfer , RL(ohm)");
21 I=VOC/(Rth+RL); //A
22 PL=I^2*RL; //W
23 disp( PL, "Value of maximum Power(W)");
24 Eta=RL/(RL+Ri)*100; //%
25 disp( Eta, "Power Transfer Efficiency (%)");

```

Scilab code Exa 1.36 Calculate equivalent resistance

```

1 //Example 1_36
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 R1=3; //ohm
8 R2=6; //ohm
9 R3=3; //ohm
10 R4=3; //ohm
11 R5=6; //ohm
12 R6=3; //ohm
13 R25=R2*R5/(R2+R5); //ohm
14 RBC=R25; //ohm
15 RAB=R4; //ohm
16 RAC=R6; //ohm
17 RA=RAB*RAC/(RAB+RAC+RBC); //ohm
18 RB=RAB*RBC/(RAB+RAC+RBC); //ohm

```

```

19 RC=RAC*RBC/(RAB+RAC+RBC); //ohm
20 RPQ=(R1+RB)*(R3+RA)/(R1+RB+R3+RA)+RC; //ohm
21 disp(RPQ,"Equivalent Resistance across P & Q(ohm)");

```

Scilab code Exa 1.37 Calculate the current

```

1 //Example 1_37
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=12; //V
8 RAB=3; //ohm
9 RAC=3; //ohm
10 RBC=3; //ohm
11 RBD=3; //ohm
12 RCD=3; //ohm
13 RA=RAB*RAC/(RAB+RAC+RBC); //ohm
14 RB=RAB*RBC/(RAB+RAC+RBC); //ohm
15 RC=RAC*RBC/(RAB+RAC+RBC); //ohm
16 Req=RA+(RB+RBD)*(RC+RCD)/(RB+RBD+RC+RCD); //ohm
17 I=V/Req; //A
18 disp(I,"Current I supplied by the battery(A)");

```

Scilab code Exa 1.40 Find the voltage drop

```

1 //Example 1_40
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :

```

```

7 V=24; //V
8 R1=7; //ohm
9 R2=7; //ohm
10 R3=7; //ohm
11 R4=7; //ohm
12 R5=8; //ohm
13 R6=10; //ohm
14 RAB=(R5*R6/(R5+R6)+R4)*(R2+R3)/(R5*R6/(R5+R6)+R4+R2+
    R3)+R1; //ohm
15 I=V/RAB; //A
16 I2=I*(R2+R3)/(R2+R3+R5*R6/(R5+R6)+R4); //A
17 VPQ=I2*(R5*R6/(R5+R6)); //V
18 disp(VPQ,"Voltage drop across the 10 ohm resistor(V)
    ");
19 //Answer in the book is not accurate.

```

Scilab code Exa 1.41 Calculate equivalent resistance

```

1 //Example 1_41
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 R1=5; //ohm
8 R2=5; //ohm
9 R3=10; //ohm
10 R4=10; //ohm
11 RAB=(R1+R3)*(R2+R4)/(R1+R3+R2+R4); //ohm
12 disp(RAB,"Equivalent resistance(ohm)");

```

Scilab code Exa 1.42 Calculate the total current


```

1 //Example 1_42
2 clc;
3 clear;
4 close;
5 format('v',4);
6 //given data :
7 V=24; //V
8 R1=2; //ohm
9 R2=3; //ohm
10 R3=5; //ohm
11 R4=8; //ohm
12 R5=2; //ohm
13 R6=5; //ohm
14 R7=3; //ohm
15 R8=6; //ohm
16 R57=R5+R7; //ohm//in series
17 RAB=R3; //ohm
18 RAC=R57; //ohm
19 RBC=R6; //ohm
20 RA=RAB*RAC/(RAB+RAC+RBC); //ohm
21 RB=RAB*RBC/(RAB+RAC+RBC); //ohm
22 RC=RAC*RBC/(RAB+RAC+RBC); //ohm
23 Req=R1+RA+(RC+R8)*(RB+R4)/(RC+R8+RB+R4)+R2; //ohm
24 I=V/Req; //A
25 disp(I,"Total current by the battery(A)");

```

Scilab code Exa 1.43 Required Voltage

```

1 //Example 1_43
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 VAP=25; //V

```

```

8  RAP=15; //ohm
9  RAQ=5; //ohm
10 R3=5; //ohm
11 RBP=10; //ohm
12 RBQ=20; //ohm
13 RAB=RAP*RAQ/(RAP+RAQ)+RBP*RBQ/(RBP+RBQ); //ohm
14 disp(RAB,"Equivalent resistance across terminal AB(
    ohm)");
15 I=VAP/(RAP*RAQ/(RAP+RAQ)); //A
16 VBQ=(RBP*RBQ/(RBP+RBQ))*I; //V
17 V=VAP+VBQ; //V
18 disp(V,"Required Voltage(V)");

```

Scilab code Exa 1.45 Find the resistance

```

1  //Example 1_45
2  clc;
3  clear;
4  close;
5  format('v',5);
6  //given data :
7  RAB=4; //ohm
8  RAC=6; //ohm
9  RBC=2; //ohm
10 RBD=10; //ohm
11 RCD=14; //ohm
12 RA=RAB*RAC/(RAB+RAC+RBC); //ohm
13 RB=RAB*RBC/(RAB+RAC+RBC); //ohm
14 RC=RAC*RBC/(RAB+RAC+RBC); //ohm
15 Req=RA+(RB+RBD)*(RC+RCD)/(RB+RBD+RC+RCD); //ohm
16 disp(Req,"Total Resistance(ohm)");

```

Scilab code Exa 1.46 Find the resistance

```

1 //Example 1_46
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 RAD=20; //ohm
8 RAC=30; //ohm
9 RDC=50; //ohm
10 RDB=50; //ohm
11 RBC=45; //ohm
12 RAN=RAD*RAC/(RAD+RAC+RDC); //ohm
13 RDN=RAD*RDC/(RAD+RAC+RDC); //ohm
14 RCN=RAC*RDC/(RAD+RAC+RDC); //ohm
15 RAB=RAN+(RDN+RDB)*(RCN+RBC)/(RDN+RDB+RCN+RBC); //ohm
16 disp(RAB,"Total Resistance between terminal A & B(
    ohm)");

```

Scilab code Exa 1.47 Calculate the current

```

1 //Example 1_47
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=6; //V
8 V2=5; //V
9 V3=8; //V
10 R1=2; //ohm
11 R2=2; //ohm
12 R3=5; //ohm
13 R4=4; //ohm
14 //Node A :
15 VA=poly(0, 'VA');

```

```

16 I1=(V1-VA)/R1; //A
17 I2=(V2-VA)/R2; //A
18 I3=(V3+VA)/R3; //A
19 //KCL at Node A
20 eqn=I1+I2-I3;
21 VA=roots(eqn); //V
22 VB=-V3; //V
23 I3=(VA-VB)/R3; //A
24 disp(I3,"Current flowing through 5 ohm Resistance (A)
    ");

```

Scilab code Exa 1.48 Calculate the current

```

1 //Example 1_48
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=12; //V
8 V2=3; //V
9 V3=6; //V
10 R1=2; //ohm
11 R2=8; //ohm
12 R3=4; //ohm
13 R4=10; //ohm
14 R5=12; //ohm
15 //Node A // I1=I2+I3
16 VA=poly(0,'VA');
17 VB=poly(0,'VB');
18 I1=(V1-VA)/R1; //A
19 VK=VA-V2; //V
20 // I2=(VK-VB)/R3; //A
21 I3=VA/R2; //A
22 // 7*VA-2*VB=56 //eqn (1)

```

```

23 A1=[7 -2]; // Coefficient Matrix
24 B1=[56]; // Coefficient Matrix
25 //Node B //I2+I5=I4
26 I5=(V3-VB)/R5; //A
27 I4=VB/R4; //A
28 //15*VA-26*VB=15//eqn(2)
29 A2=[15 -26]; // Coefficient Matrix
30 B2=[15]; // Coefficient Matrix
31 A=[A1;A2]; // Coefficient Matrix
32 B=[B1;B2]; // Coefficient Matrix
33 X=A^-1*B; //solution Matrix
34 VA=X(1); //V
35 VB=X(2); //V
36 I3=VA/R2; //A
37 disp(I3,"Current through 8 ohm resistor (A)");

```

Scilab code Exa 1.49 Current in various branches

```

1 //Example 1_49
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 I1=1; //A
8 V3=12; //V
9 I4=0.5; //A
10 R1=10; //ohm
11 R2=10; //ohm
12 R3=20; //ohm
13 R4=20; //ohm
14 R5=20; //ohm
15 //Node B//I1=I2+I3
16 VB=poly(0,'VB');
17 VC=poly(0,'VC');

```

```

18 VD=poly(0, 'VD');
19 I2=(VB)/R1;//A
20 //I3=(VB-VC)/R1;//A
21 //2*VB-VC=10//eqn(1)
22 A1=[2 -1 0];//Coefficient Matrix
23 B1=[10];//Coefficient Matrix
24 //Node C //I3=I4+I5
25 I4=(VC-V3)/R3;//A
26 //I5=(VC-VD)/R4;//A
27 //2*VB-4*VC+VD=-12//eqn(2)
28 A2=[2 -4 1];//Coefficient Matrix
29 B2=[-12];//Coefficient Matrix
30 //Node D //I6=I5+I7
31 I6=VD/R5;//A
32 I7=I4;//A
33 //VC-2*VD=-10//eqn(3)
34 A3=[0 1 -2];//Coefficient Matrix
35 B3=[-10];//Coefficient Matrix
36 A=[A1;A2;A3];//Coefficient Matrix
37 B=[B1;B2;B3];//Coefficient Matrix
38 X=A^-1*B;//solution Matrix
39 VB=X(1);//V
40 VC=X(2);//V
41 VD=X(3);//V
42 I2=(VB)/R1;//A
43 I3=(VB-VC)/R1;//A
44 I5=(VC-VD)/R4;//A
45 I4=(-I3-I5);//A
46 I6=VD/R5;//A
47 disp("Current in various branches are : ");
48 disp(I2,"Current I2(A)");
49 disp(I3,"Current I3(A)");
50 disp(I4,"Current I4(A)");
51 disp(I5,"Current I5(A)");
52 disp(I6,"Current I6(A)");

```

Scilab code Exa 1.50 Calculate the current

```
1 //Example 1_50
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 I=8;//A
8 I4=6;//A
9 R1=3;//ohm
10 R2=2;//ohm
11 R3=4;//ohm
12 //Applying KCL//I=I1+I2
13 //I=V1/R1+V1/R2-V2/R2//eqn(1)
14 A1=[1/R1+1/R2 -1/R2];// Coefficient Matrix
15 B1=[I];// Coefficient Matrix
16 //Applying KCL//I2=I3+I4
17 //V1/R2-V2/R2-V2/R3=I4//eqn(2)
18 A2=[1/R2 -1/R2-1/R3];// Coefficient Matrix
19 B2=[I4];// Coefficient Matrix
20 A=[A1;A2];// Coefficient Matrix
21 B=[B1;B2];// Coefficient Matrix
22 X=A^-1*B;//solution Matrix
23 V1=X(1);//V
24 V2=X(2);//V
25 I1=V1/R1;//A
26 I2=V1/R2-V2/R2;//A
27 I3=(V2)/R3;//A
28 disp("Current in various branches are : ");
29 disp(I1,"Current I1(A)");
30 disp(I2,"Current I2(A)");
31 disp(I3,"Current I3(A)");
```

Chapter 2

Electromagnetism

Scilab code Exa 2.1 Inductance and coupling coefficient

```
1 //Ex_2_1
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 LTsc=1.6; //H(Series cumulative)
8 LTd=0.4; //H(differentially)
9 L1=0.6; //H
10 M=(LTsc-LTd)/4; //H(Mutual Inductance)
11 L2=LTsc-2*M-L1; //H
12 K=M/sqrt(L1*L2); //Coupling Coefficient
13 disp(M,"Mutual Inductance(H)");
14 disp(K,"Coupling Coefficient");
```

Scilab code Exa 2.2 Calculate the emf induced

```
1 //Ex_2_2
```



```

2  clc;
3  clear;
4  close;
5  format('v',6);
6  //given data :
7  l=0.5; //m
8  B=0.5; //Wb/m^2
9  I=50; //A
10 v=20; //m/s
11 F=B*l*I; //N
12 disp(F,"Force expereinced by the conductor(N)");
13 e=B*l*v; //V
14 disp(e,"emf induced(V)");

```

Scilab code Exa 2.3 Calculate Inductance and emf

```

1  //Ex_2_3
2  clc;
3  clear;
4  close;
5  format('v',6);
6  //given data :
7  N=100; //turns
8  l=0.5; //m
9  A=10/10000; //m^2
10 mur=2000; //relative permeability of iron
11 mu0=4*%pi*10^-7; //permeability
12 I=5; //A
13 t=10; //ms
14 L=mur*mu0*N^2*A/l*1000; //mH
15 disp(L,"Inductance of the coil(mH)");
16 E=L*2*I/t; //V
17 disp(E,"Induced emf in the coil(V)");

```

Scilab code Exa 2.4 Calculate Inductance and emf

```
1 //Ex_2_4
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 N1=500; //turns
8 N2=2000; //turns
9 K=50/100; //coefficient for 50% flux linked
10 diBYdt=10; //A/s
11 L1=200; //mH
12 fi1BYI1=L1/N1;
13 M=N2*fi1BYI1; //mH
14 e2=M*10^-3*diBYdt; //V
15 disp(M/1000,"Mutual Inductance of two coil(H)");
16 disp(e2,"Induced emf in the coil having 1000 turns(V)");
```

Scilab code Exa 2.5 Mutual and Self Inductance

```
1 //Ex_2_5
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 I1=5; //A
8 N1=500; //turns
9 fi1=1; //mWb
10 dt=10; //ms
```

```

11 e2=50; //V
12 K=60/100; //coefficient of coupling
13 di1=2*(I1); //A(as current changes from +5A to -5A)
14 M=e2*dt*10^-3/di1; //H
15 L1=N1*fi1/1000/I1; //H
16 L2=L1*M^2/K^2; //H
17 disp(M,"Mutual Inductance of two coil(H)");
18 disp(L1,"Self inductance of coil 1(H)");
19 disp(L2,"Self inductance of coil 2(H)");
20 //Answer is wrong in the book.

```

Scilab code Exa 2.6 Determine L1 L2 M and K

```

1 //Ex_2_6
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 N1=1000; //turns
8 N2=400; //turns
9 K1=75/100; //coefficient of coupling
10 I1=6; //A
11 I2=6; //A
12 fi1=0.8; //mWb
13 fi2=0.5; //mWb
14 L1=N1*fi1*10^-3/I1; //H
15 L2=N2*fi2*10^-3/I2; //H
16 M=N2*K1*fi1*10^-3/I1; //H
17 K=M/sqrt(L1*L2);
18 disp(L1,"Self inductance of coil 1(H)");
19 disp(L2,"Self inductance of coil 2(H)");
20 disp(M,"Mutual Inductance of two coil(H)");
21 disp(K,"Coefficient of coupling");

```

Scilab code Exa 2.7 Calculate flux density

```
1 //Ex_2_7
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 r=10; //cm
8 I=100; //A
9 d=5; //cm
10 mu0=4*%pi*10^-7; // permeability
11 Bc=mu0*I/2/(r/100); //Wb/m^2 or T
12 B=mu0*I*(r/100)^2/(2*((r/100)^2+(d/100)^2)^(3/2)); //
    Wb/m^2
13 disp(Bc,"Flux density at the centre(Wb/m^2)");
14 disp(B,"Flux density in the plane(Wb/m^2)");
15 //Answer is wrong in the book.
```

Scilab code Exa 2.8 MMF and current

```
1 //Ex_2_8
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 D=0.5; //m(mean diameter)
8 A=0.01; //m^2
9 fi=10/1000; //Wb
10 N=100; //turns
11 mmf1=10; //A-turn //(for Ni alloy)
```

```

12 mmf2=50; //A-turn //(for Si-steel alloy)
13 l=%pi*D; //m(total length)
14 lni=l/2; //m(length of Ni alloy)
15 lsi=l/2; //m(length of Si-steel)
16 mmf=mmf1*lni+mmf2*lsi; //A-turn /// total mmf
17 disp(mmf, "mmf required (A-turn)");
18 I=mmf/N; //A
19 disp(I, "Current (A)");

```

Scilab code Exa 2.9 Calculate the reluctance

```

1 // Ex_2_9
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 l=20/100; //m
8 A=1.5/10000; //m^2
9 mur=2000; //relative permeability
10 mu0=4*%pi*10^-7; //permeability
11 S=1/(mu0*mur*A); //AT/Wb
12 disp(S, "Reluctance of silicon steel (AT/Wb)");

```

Scilab code Exa 2.10 Calculate the amount of flux

```

1 // Ex_2_10
2 clc;
3 clear;
4 format('v',6);
5 close;
6 //given data :
7 D=25/100; //m

```

```

8 A=9/10000; //m^2
9 N=100; //turns
10 I=1.5; //A
11 l=%pi*D; //m
12 mur=2000; //relative permeability
13 mu0=4*%pi*10^-7; //permeability
14 fi=N*I/l*(mu0*mur*A); //Wb
15 disp(fi*1000,"Flux produced(mWb)");

```

Scilab code Exa 2.11 Calculate the current

```

1 // Ex_2_11
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 lg=0.01/100; //m(airgap)
8 li=39.99/100; //m(mean length)
9 mur=2000; //relative permeability
10 mu0=4*%pi*10^-7; //permeability
11 N=1000; //turns
12 A=9/10000; //m^2
13 fi=1; //mWb
14 S=li/(mu0*mur*A)+lg/(mu0*A); //AT/Wb
15 I=fi*10^-3*S/N; //A
16 disp(I,"Current required(A)");

```

Scilab code Exa 2.12 Calculate the current

```

1 // Ex_2_12
2 clc;
3 clear;

```

```

4  close;
5  format('v',7);
6  //given data :
7  Ac=10/10000;//m^2
8  Ao=5/10000;//m^2(outer limbs)
9  Lo=25;//cm(outer limbs)
10 Lc=16;//cm
11 N=1000;//turns
12 fic=1.2;//mWb
13 fio=1.2;//mWb
14 B=1.2;//Wb/m^2
15 mmf=750;//AT/m
16 Bc=fic*10^-3/Ac;//Wb/m^2
17 Bo=fio*10^-3/Ao;//Wb/m^2
18 mmf_total=mmf*Lo/100+mmf*Lc/100;//AT/m
19 I=mmf_total/N;//A
20 disp(I,"Current required(A)");

```

Scilab code Exa 2.13 Calculate the amount of flux

```

1  //Ex_2_13
2  clc;
3  clear;
4  close;
5  format('v',4);
6  //given data :
7  Ao=5/10000;//m^2(outer limbs)
8  li=100/100;//m(iron path)
9  A=10/10000;//m^2
10 lg=1/1000;//m(airgap)
11 I1=3;//A
12 I2=2;//A
13 N1=100;//turns
14 N2=50;//turns
15 mur=2000;//relative permeability

```

```

16 mu0=4*%pi*10^-7; // permeability
17 mmf=N1*I1-N2*I2; //AT
18 S=1/(mu0*A)*[li/mur+lg]; //AT/Wb
19 fi=mmf/S*1000; //mWb
20 disp(fi, "Flux available (mWb)");

```

Scilab code Exa 2.14 Calculate the amount of flux

```

1 // Ex_2_14
2 clc;
3 clear;
4 close;
5 format('v',10);
6 //given data :
7 N1=100; //turns
8 N2=80; //turns
9 I1=10; //A
10 I2=1.5; //A
11 li=40/100; //m
12 lg=1/1000; //m(airgap)
13 A=10/10000; //m^2
14 mur=2000; //relative permeability
15 mu0=4*%pi*10^-7; //permeability
16 mmf=N1*I1-N2*I2; //AT
17 S=1/(mu0*A)*[li/mur+lg]; //AT/Wb
18 fi=mmf/S; //Wb
19 disp(fi, "Flux produced (Wb)");

```

Scilab code Exa 2.15 Calculate the current

```

1 // Ex_2_15
2 clc;
3 clear;

```



```

4  close;
5  format('v',5);
6  //given data :
7  N=2000; //turns
8  lg=2/1000; //m(airgap)
9  lc=20/100; //m(mean diameter)
10 Ac=10/10000; //m^2(cross section central limb)
11 Ao=5/10000; //m^2(cross section outer limb)
12 B=[1 1.1 1.2 1.3 1.4]; //Wb/m^2
13 H=[550 650.750 820 870]; //AT/m
14 fi=1.1/1000; //Wb
15 Bc=fi/Ac; //Wb/m^2(For central limb)
16 Bo=fi/Ao; //Wb/m^2(For outer limb)
17 for i=1:5
18     if Bc==B(i) then
19         H=H(i); //AT/m
20 B=B(i); //Wb/m^2
21         break;
22     end;
23 end;
24 lo=%pi*lc/2; //m(outer limb, including airgap)
25 //H=NI/l
26 NIc=H*lc; //AT//NI for central limb
27 NIo=H*(lo-lg); //AT//NI for outer limb
28 mu0=4*%pi*10^-7; //permeability of air
29 Hg=B/mu0; //AT/m
30 NIag=Hg*lg; //AT//NI for airgap
31 NI=NIc+NIo+NIag; //AT//Total AT required
32 I=NI/N; //A
33 disp(I," Current I(A)");

```

Scilab code Exa 2.16 Calculate the flux

```

1 //Ex_2_16
2 clc;

```

```

3 clear;
4 close;
5 format('v',5);
6 //given data :
7 LA=75/100; //m
8 LB=25/100; //m
9 lg=2/100; //m(airgap)
10 mu_r1=1000; //relative permeability
11 mu_r2=1500; //relative permeability
12 mu0=4*pi*10^-7; //permeability of air
13 A=10*10^-4; //m^2//Area of core
14 N=1000; //turns
15 I=5; //A
16 S=LA/(mu0*mu_r1*A)+LB/(mu0*mu_r2*A)+lg/(mu0*A); //Wb/
    m^2
17 fi=N*I/S*1000; //mWb
18 disp(fi,"Flux produced in the air-gap(mWb)");

```

Scilab code Exa 2.17 Calculate the magnetizing current

```

1 //Ex_2_17
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 CD=10/100;BE=10/100;AF=10/100; //m
8 BC=8/100;ED=8/100;AB=8/100;EF=8/100; //m
9 BCDE=BC+CD+ED; //m
10 BAFE=AB+BE+EF; //m
11 A=2*2*10^-4; //m^2
12 mu_r=1200; //relative permeability
13 N=800; //turns
14 fi2=2*10^-3; //Wb
15 mu0=4*pi*10^-7; //permeability of air

```

```

16 S2=BAFE/(mu0*mu_r*A); //Wb/m^2
17 S1=BE/(mu0*mu_r*A); //Wb/m^2
18 fi1=fi2*S2/S1; //Wb
19 fi=fi1+fi2; //Wb
20 AT2=fi*S2; //AT//for portion BAFE
21 AT1=fi1*S1; //AT//for portion BCDE
22 AT=AT1+AT2; //AT//Toal AT required
23 NI=AT; //AT
24 I=NI/N; //A
25 disp(I,"Magnetizing current (A)");

```

Scilab code Exa 2.18 Flux density and magnetic pull

```

1 // Ex_2_18
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 lg=1/1000; //m// air-gap
8 li=20/100; //m// flux path
9 mu0=4*pi*10^-7; //permeability of air
10 mu_r=500; ///relative permeability
11 A=0.5*10^-4; //m^2// Area
12 I=50/1000; //A
13 N=8000; //turns
14 S=li/mu0/mu_r/A+2*lg/mu0/A; //AT/Wb
15 fi=N*I/S; //Wb
16 B=fi/A; //Wb/m^2
17 disp(B,"Flux Density (Wb/m^2)");
18 format('v',5);
19 F=B*A/2/mu0; //N
20 disp(F,"Magnetic Pull (N)");

```

Scilab code Exa 2.19 Calculate the magnetic field

```
1 //Ex_2_19
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 I=100;//A
8 r=1;//m
9 mu0=4*pi*10^-7;//permeability of air
10 B=mu0*I/2/pi/r;//Wb/m^2
11 disp(B,"Magnetic field produced(Wb/m^2)");
```

Scilab code Exa 2.20 Calculate the resultant force

```
1 //Ex_2_20
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 I1=100;//A
8 I2=10;//A
9 l=20/100;//m
10 r1=1/100;//m
11 r2=11/100;//m
12 mu0=4*pi*10^-7;//permeability of air
13 //Force of attraction between Conductor & AB
14 F1=mu0*I1*I2*l/2/pi/r1;//N
15 //Force of repulsion between Conductor & CD
16 F2=mu0*I1*I2*l/2/pi/r2;//N
```

```

17 //Net Force
18 F=F1-F2;//N
19 disp(F,"Resultant force developed(N)");

```

Scilab code Exa 2.21 Value of exciting current

```

1 //Ex_2_21
2 clc;
3 clear;
4 close;
5 format('v',4);
6 //given data :
7 N=500;//turns
8 A=0.01;//m^2(Area of cross section of poles)
9 l=0.5;//m(mean length)
10 mu0=4*pi*10^-7;//permeability of air
11 mu_r=1000;//relative permeability
12 g=9.8;//gravitational acceleration
13 W=200;//kg
14 F=W/2;//kg
15 F=F*g;//N
16 B=sqrt(F*2*mu0/A);//Wb/m^2
17 H=B/mu0/mu_r;//Wb/m^2
18 I=H*l/N;//A
19 disp(I,"Exciting current(A)");

```

Chapter 3

AC Fundamentals

Scilab code Exa 3.1 rms value of current

```
1 //Example 3_1
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 //v=100*sin(314*t)
8 R=20;//ohm
9 Vm=100;//V
10 omega=314;//
11 Vrms=Vm/2;//V
12 Irms=Vrms/R;//A
13 disp(Irms,"rms value of current (A)");
```

Scilab code Exa 3.2 Frequency of the supply

```
1 //Example 3_2
2 clc;
```

```

3 clear;
4 close;
5 format('v',5);
6 //given data :
7 //v=150*sin(100*%pi*t)
8 R=50; //ohm
9 Vm=150; //V
10 omega=100*%pi; //
11 f=omega/2/%pi; //Hz
12 Vrms=Vm/2; //V
13 Vav=Vm/%pi; //V
14 Irms=Vm/2/R; //A
15 disp(Irms,"rms value of current (A)");
16 Iav=Vm/%pi/R; //A
17 disp(Iav,"Average value of current (A)");
18 Kf=Irms/Iav; //Form Factor
19 disp(Kf,"Form Factor")

```

Scilab code Exa 3.3 Form factor

```

1 //Example 3_3
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 v=10; //V
8 T=0.2; //second
9 Vav=1/T*integrate('1*v','t',0,T/2); //V
10 Vrms=sqrt(1/T*integrate('v^2','t',0,T/2)); //V
11 disp(Vrms,"rms value of Voltage (V)");
12 disp(Vav,"Average value of Voltage (V)");
13 Kf=Vrms/Vav; //Form Factor
14 disp(Kf,"Form Factor")
15 //Answer is not accurate in the book.

```

Scilab code Exa 3.4 Rms and average value

```
1 //Example 3_4
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 //Let T=1 for calculation
8 T=1;
9 //i=5*t/T+5;//A
10 Iav=1/T*integrate('5*t/T+5','t',0,T);
11 disp(Iav,"Average value(A)");
12 Irms=sqrt(1/T*integrate('(5*t/T+5)^2','t',0,T));//V
13 disp(Irms,"rms value(A)");
14 //Answer is not accurate in the book.
```

Scilab code Exa 3.5 Rms and average value and form factor

```
1 //Example 3_5
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 //Let T=1 for calculation
8 T=1;
9 //y=m*x, m=10/T & x=t
10 //i=10*t/T
11 Im=10;//A
12 Irms=sqrt(1/T*integrate('(10*t/T)^2','t',0,T));//V
```



```

13 disp(Irms,"rms value(A)");
14 Iav=Im/2;//A
15 disp(Iav,"Average value(A)");
16 Kf=Irms/Iav;//Form Factor
17 disp(Kf,"Form Factor")

```

Scilab code Exa 3.6 Voltage and current

```

1 //Example 3_6
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 L=0.5;//H
8 V=230;//V
9 f=50;//Hz
10 Vm=sqrt(2)*V;//V
11 XL=2*pi*f*L;//ohm
12 I=V/XL;//A
13 Im=sqrt(2)*I;//A
14 disp("Equations are : ");
15 disp("V="+string(Vm)+"*sin"+string(2*pi*f)+"*t");
16 disp("i="+string(Im)+"*sin("+string(2*pi*f)+"*t-%pi
/2)");
17 //Answer is not accurate in the book.

```

Scilab code Exa 3.7 Instantaneous current

```

1 //Example 3_7
2 clc;
3 clear;
4 close;

```

```

5 format('v',6);
6 //given data :
7 L=0.5;//H
8 C=100;//micro F
9 V=230;//V
10 f=50;//Hz
11 R=25;//ohm
12 Vm=sqrt(2)*V;//V
13 omega=2*%pi*f;//rad/s
14 disp("Voltage equation")
15 disp("V="+string(Vm)+"*sin"+string(omega)+"*t");
16 XL=omega*L;//ohm
17 XC=1/omega/(C*10^-6);//ohm
18 disp("Current through the resistor will be ");
19 disp("i="+string(Vm/R)+"*sin("+string(2*%pi*f)+"*t)"
);
20 disp("Current through the inductor will be ");
21 disp("i="+string(Vm/XL)+"*sin("+string(2*%pi*f)+"*t
-90)");
22 disp("Current through the capacitor will be ");
23 disp("i="+string(Vm/XC)+"*sin("+string(2*%pi*f)+"*t
+90)");
24 //Answer is not accurate in the book.

```

Scilab code Exa 3.8 Calculate the current

```

1 //Example 3_8
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=100;//V
8 f=50;//Hz
9 R=10;//ohm

```

```

10 L=100; //mH
11 C=100; //micro F
12 XL=2*%pi*f*L*10^-3; //ohm
13 XC=1/2/%pi/f/(C*10^-6); //ohm
14 IR=V/R; //A
15 disp(IR," Current through R(A)");
16 IL=V/XL; //A
17 disp(IL," Current through L(A)");
18 IC=V/XC; //A
19 disp(IC," Current through C(A)");

```

Scilab code Exa 3.9 Branch and Line current Power factor

```

1 //Example 3_9
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=230; //V
8 f=50; //Hz
9 R1=14; //ohm
10 L1=16; //mH
11 R2=18; //ohm
12 L2=32; //mH
13 XL1=2*%pi*f*L1*10^-3; //ohm
14 XL2=2*%pi*f*L2*10^-3; //ohm
15 Z1mag=sqrt(R1^2+XL1^2); //ohm
16 Z2mag=sqrt(R2^2+XL2^2); //ohm
17 fi1=atand(XL1/R1); //radian
18 fi2=atand(XL2/R2); //radian
19 Z1=Z1mag*expm(%i*fi1*%pi/180); //ohm
20 Z2=Z2mag*expm(%i*fi2*%pi/180); //ohm
21 Y1=1/Z1; //mho
22 Y2=1/Z2; //mho

```

```

23 I1=V*Y1; //A
24 I1mag=abs(I1); //A
25 I1ang=atand(imag(I1),real(I1)); //degree
26 disp(I1ang,I1mag,"Branch Current I1 , magnitude(A) &
    angle(degree) are: ");
27 I2=V*Y2; //A
28 I2mag=abs(I2); //A
29 I2ang=atand(imag(I2),real(I2)); //degree
30 disp(I2ang,I2mag,"Branch Current I2 , magnitude(A) &
    angle(degree) are: ");
31 I_cosfi=I1mag*cosd(fi1)+I2mag*cosd(fi1);
32 I_sinfi=I1mag*sind(fi1)+I2mag*sind(fi1);
33 tanfi=I_sinfi/I_cosfi;
34 fi=atand(tanfi); //degree
35 pf=cosd(fi); //Power Factor lagging
36 disp(pf,"Total Power Factor(lagging)");
37 I=sqrt(I_sinfi^2+I_cosfi^2); //A
38 disp(fi,-I,"Line Current I , magnitude(A) & angle(
    degree) are: ");
39 //Answer is not accurate in the book.

```

Scilab code Exa 3.10 Apparent Real and active power

```

1 //Example 3_10
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=200; //V
8 f=50; //Hz
9 R=40; //ohm
10 L=0.0637; //H
11 XL=2*%pi*f*L; //ohm
12 IR=V/R; //A

```

```

13 IL=V/XL; //A
14 I=sqrt(IR^2+IL^2); //A
15 disp(I,"(a) Current drawn from supply(A)");
16 S=V*I/1000; //kVA
17 disp(S,"(b) Apparent Power(kVA)");
18 P=V*IR/1000; //kW
19 disp(P,"(c) Real Power(kW)");

```

Scilab code Exa 3.11 Current Power factor and power

```

1 //Example 3_11
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=100; //V
8 f=50; //Hz
9 R1=8; //ohm
10 X1=6; //ohm
11 R2=6; //ohm
12 X2=-8; //ohm
13 Z1=R1+%i*X1; //ohm
14 Z2=R2+%i*X2; //ohm
15 I1=V/Z1; //A
16 I1mag=abs(I1); //A
17 I1ang=atand(imag(I1),real(I1)); //degree
18 disp(I1ang,I1mag,"Branch Current I1 , magnitude(A) &
    angle(degree) are: ");
19 I2=V/Z2; //A
20 I2mag=abs(I2); //A
21 I2ang=atand(imag(I2),real(I2)); //degree
22 disp(I2ang,I2mag,"Branch Current I2 , magnitude(A) &
    angle(degree) are: ");
23 I=I1+I2; //A

```

```

24 Imag=abs(I); //A
25 Iang=atand(imag(I),real(I)); //degree
26 disp(Iang,Imag,"Total Current I, magnitude(A) &
    angle(degree) are: ");
27 fi=atand(imag(I),real(I)); //degree
28 pf=cosd(fi); //Power Factor lagging
29 disp(pf,"Total Power Factor(lagging)");
30 P=V*Imag*cosd(fi); //W
31 disp(P,"Active Power(W)");
32 S=V*Imag*sind(fi); //VAR
33 disp(S,"Reactive Power(VAR)");
34 //Answer is not accurate in the book.

```

Scilab code Exa 3.12 Current Power factor and power

```

1 //Example 3_12
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=230; //V
8 f=50; //Hz
9 R=5; //ohm
10 L=30; //mH
11 XL=2*%pi*f*L*10^-3; //ohm
12 Z=R+%i*XL; //ohm
13 I=V/Z; //A
14 Imag=abs(I); //A
15 disp(Imag,"Magnitude of current(A) : ");
16 fi=atand(imag(I),real(I)); //degree
17 format('v',5);
18 pf=cosd(fi); //Power Factor
19 disp(pf,"Power Factor(lagging)");
20 P=V*Imag*cosd(fi); //W

```

```
21 disp(P,"Power Consumed(W) : ");
22 //Answer is not accurate in the book.
```

Scilab code Exa 3.13 Current Power factor and power

```
1 //Example 3_13
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=230;//V
8 f=50;//Hz
9 R=15;//ohm
10 L=0.15;//H
11 C=100;//micro F
12 XL=2*pi*f*L;//ohm
13 XC=1/2/pi/f/(C*10^-6);//ohm
14 Z=R+i*(XL-XC);//ohm
15 I=V/Z;//A
16 Imag=abs(I);//A
17 fi=atand(imag(I),real(I));//degree
18 disp(Imag,"Magnitude of current(A) : ");
19 disp(fi,"Angle(lagging) of current(degree) : ");
20 format('v',7);
21 pf=cosd(fi);//Power Factor
22 disp(pf,"Power Factor(lagging)");
23 P=V*Imag*cosd(fi);//W
24 disp(P,"Power Consumed(W) : ");
25 //Answer is not accurate in the book.
```

Scilab code Exa 3.14 Value of Z2

```

1 //Example 3_14
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=230;//V
8 f=50;//Hz
9 V1=120*expm(%i*30*pi/180);//V
10 Z1=15*expm(%i*40*pi/180);//ohm
11 V2=V-V1;//V
12 I=V1/Z1;//A
13 Z2=V2/I;//ohm
14 R=real(Z2);//ohm
15 XC=imag(Z2);//ohm
16 C=-1/2/pi/f/XC*10^6;//micro F
17 disp(Z2," Value of Z2(ohm) : ");
18 disp(R," Resistance(ohm)");
19 format('v',7);
20 disp(C," Capacitance(micro F)");
21 //Answer is not accurate in the book.

```

Scilab code Exa 3.15 Impedence Power factor and Power

```

1 //Example 3_15
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 f=50;//Hz
8 V=160+%i*170;//V
9 I=12-%i*5;//A
10 Z=V/I;//ohm
11 disp(Z," Impedence Z(ohm)");

```



```

12 fi=atand(imag(Z)/real(Z)); //degree
13 pf=cosd(fi); //Power Factor
14 disp(pf,"Power Factor(lagging)");
15 P=abs(V)*abs(I)*pf; //W
16 disp(P,"Power Consumed(W)");
17 XL=imag(Z); //ohm
18 L=XL/2/%pi/f*1000; //mH
19 disp(L,"Inductance L(mH)");
20 //Answer is not accurate in the book.

```

Scilab code Exa 3.16 Value of L and R

```

1 //Example 3_16
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 //v=325*sin(314*t)
8 //i=14.14*sin(314*t-60)
9 Vm=325; //V
10 omega=314; //rad/s
11 V=Vm/sqrt(2); //V
12 f=omega/2/%pi; //Hz
13 Im=14.14; //A
14 I=Im/sqrt(2); //A
15 fi=60; //degree
16 pf=cosd(fi); //power factor
17 P=V*I*cosd(fi); //W
18 disp(P,"Power Consumed(W)");
19 Z=V/(I*expm(%i*-fi*%pi/180)); //ohm
20 R=real(Z); //ohm
21 disp(R,"Value of R(ohm)");
22 XL=imag(Z); //ohm
23 L=XL/2/%pi/f*1000; //mH

```

```
24 disp(L," Value of L(mH)");
25 //Answer is not accurate in the book.
```

Scilab code Exa 3.17 Value of R

```
1 //Example 3_17
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 L=100;//mH
8 f=50;//Hz
9 XL=2*%pi*f*L/1000;//ohm
10 //VL should be equal to 1/2*V
11 //equalting : VL=I*XL & 1/2*V=1/2*I*Z=1/2*I*sqrt(R
    ^2+XL^2)
12 R=sqrt(3*XL^2);//ohm
13 disp(R," Value of R(ohm)");
```

Scilab code Exa 3.18 Value of L and R

```
1 //Example 3_18
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 //v=100*sin(314*t)
8 //i=10*sin(314*t-%pi/6)
9 Vm=100;//V
10 omega=314;//rad/s
11 V=Vm/sqrt(2);//V
```

```

12 f=omega/2/%pi; //Hz
13 Im=10; //A
14 I=Im/sqrt(2); //A
15 fi=%pi/6; //radian
16 pf=cos(fi); //power factor
17 disp(pf,"Power Factor(Lagging)");
18 P=V*I*cos(fi); //W
19 disp(P,"Powe Consumed(W)");
20 Z=V/(I*expm(%i*-fi)); //ohm
21 R=real(Z); //ohm
22 disp(R,"Value of R(ohm)");
23 XL=imag(Z); //ohm
24 L=XL/2/%pi/f*1000; //mH
25 disp(L,"Value of L(mH)");

```

Scilab code Exa 3.19 Power Impedence R and L

```

1 //Example 3_19
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 //v=200*sin(314*t+%pi/3)
8 //i=20*sin(314*t+%pi/6)
9 Vm=200; //V
10 omega=314; //rad/s
11 V=Vm/sqrt(2); //V
12 f=omega/2/%pi; //Hz
13 Im=20; //A
14 I=Im/sqrt(2); //A
15 fi=%pi/3-%pi/6; //radian
16 pf=cos(fi); //power factor
17 disp(pf,"(i) Power Factor(Lagging)");
18 P=V*I*cos(fi); //W

```

```

19 disp(P,"(ii) Average Power(W)");
20 Z=V/(I*expm(%i*-fi)); //ohm
21 Zmag=abs(Z); //ohm
22 Zang=atand(imag(Z),real(Z)); //degree
23 disp(Zang,Zmag,"(iii) Impedence in polar form,
    Magnitude(ohm) & angle(degree) are");
24 disp(Z,"(iii) Impedence in rectangular form(ohm)");
25 R=real(Z); //ohm
26 disp(R,"(iv) Value of R(ohm)");
27 XL=imag(Z); //ohm
28 L=XL/2/%pi/f*1000; //mH
29 disp(L,"(iv) Value of L(mH)");

```

Scilab code Exa 3.20 Voltage and power factor

```

1 //Example 3_20
2 clc;
3 clear;
4 close;
5 format('v',4);
6 //given data :
7 VR=20; //V
8 VL=60; //V
9 VC=30; //V
10 V=sqrt(VR^2+(VL-VC)^2); //V
11 disp(V,"Magnitude of voltage(V)");
12 format('v',5);
13 fi=acosd(VR/V); //degree
14 disp(fi,"Power Factor angle(degree)");
15 pf=cosd(fi); //Power Factor
16 disp(pf,"Power Factor");
17 //Answer is not accurate in the book.

```

Scilab code Exa 3.21 Value of R and C

```
1 //Example 3_21
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 L=100; //mH
8 //i=14.148 sin(314*t+%pi/6)
9 //v=325*sin(314*t)
10 Vm=325; //V
11 Im=14.14; //A
12 omega=314; //rad/s
13 V=Vm/sqrt(2); //V
14 I=Im/sqrt(2); //A
15 Z=V/(I*expm(%i*%pi/6)); //ohm
16 R=real(Z); //ohm
17 disp(R,"Value of R(ohm)");
18 XCL=-imag(Z); //ohm//XCL=XC-XL
19 XC=XCL+omega*L/1000; //ohm
20 C=1/XC/omega; //F
21 C=C*10^6; //micro F
22 disp(C,"Value of C(micro F)");
23 //Answer is not accurate in the book.
```

Scilab code Exa 3.22 Current and power factor

```
1 //Example 3_22
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 L=100; //mH
```

```

8 R=15; //ohm
9 V=230; //V
10 f=50; //Hz
11 XL=2*%pi*f*L/1000; //ohm
12 IR=V/R; //A
13 disp(IR,"Branch Current IR(A)");
14 IL=V/XL; //A
15 format('v',5);
16 disp(IL,"Branch Current IL(A)");
17 I=sqrt(IR^2+IL^2); //A
18 disp(I,"Line Current I(A)");
19 pf=IR/I; //Power factor(lagging)
20 disp(pf,"Power Factor(lagging)");
21 fi=acosd(pf); //degree
22 P=V*I*cosd(fi); //W
23 disp(P,"Power Consumed(W)");
24 //Answer is not accurate in the book.

```

Scilab code Exa 3.23 Current and power factor

```

1 //Example 3_23
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 R1=5; //ohm
8 L1=150; //mH
9 R2=50; //ohm
10 L2=15; //mH
11 V=230; //V
12 f=50; //Hz
13 Z1=R1+%i*2*%pi*f*L1/1000; //ohm
14 Z2=R2+%i*2*%pi*f*L2/1000; //ohm
15 I1=V/Z1; //A

```

```

16 I2=V/Z2; //A
17 I=I1+I2; //A
18 Imag=abs(I); //A
19 Iang=atand(imag(I)/real(I)); //degree
20 disp(Iang,Imag,"Total current drawn, magnitude(A) &
    Angle(degree) are");
21 pf=cosd(Iang); //Power Factor(lagging)
22 format('v',4);
23 disp(pf,"Power Factor(lagging)");
24 P=V*Imag*pf; //W
25 format('v',5);
26 disp(P,"Power Consumed(W)");
27 //Answer is not accurate in the book.

```

Scilab code Exa 3.24 Current and Power

```

1 //Example 3_24
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Z1=10+%i*12; //ohm
8 Z2=12-%i*10; //ohm
9 V=230; //V
10 f=50; //Hz
11 Z=Z1*Z2/(Z1+Z2); //ohm
12 I=V/Z; //A
13 Imag=abs(I); //A
14 Iang=atand(imag(I)/real(I)); //degree
15 disp(Iang,Imag,"Total current drawn, magnitude(A) &
    Angle(degree) are");
16 pf=cosd(Iang); //Power Factor(lagging)
17 format('v',6);
18 disp(pf,"Power Factor(lagging)");

```

```

19 P=V*Imag*pf; //W
20 P=P/1000; //kW
21 disp(P,"Power Consumed(kW)");
22 //Answer is not accurate in the book.

```

Scilab code Exa 3.25 Apparent and reactive power

```

1 //Example 3_25
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 R1=12; //ohm
8 L=50; //mH
9 R2=50; //ohm
10 C=50; //micro F
11 V=200*expm(%i*30*%pi/180); //V
12 f=50; //Hz
13 XL=2*%pi*f*L/1000; //ohm
14 XC=1/2/%pi/f/(C*10^-6); //ohm
15 Z1=R1+%i*XL; //ohm
16 Z2=R2+%i*XC; //ohm
17 I1=V/Z1; //A
18 I2=V/Z2; //A
19 I=I1+I2; //A
20 Imag=abs(I); //A
21 Iang=atand(imag(I)/real(I)); //degree
22 disp(Iang,Imag,"Total current drawn, magnitude(A) &
    Angle(degree) are");
23 pf=cosd(Iang); //Power Factor(lagging)
24 fi=acosd(pf); //degree
25 disp(pf,"Power Factor(lagging)");
26 P=abs(V)*Imag*pf; //W
27 P=P/1000; //kW

```



```

28 disp(P,"Power Consumed(kW)");
29 S=abs(V)*Imag*sind(fi); //VARs
30 S=S/1000; //kVARs
31 disp(S,"Reactive Power (kVARs)");
32 Pa=abs(V)*Imag/1000; //kVA
33 disp(Pa,"Apparent Power(kVA)");
34 //Answer is not accurate in the book.

```

Scilab code Exa 3.26 Admittance and power factor

```

1 //Example 3_26
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=230; //V
8 f=50; //Hz
9 Z1=12*expm(%i*30*%pi/180); //ohm
10 Z2=8*expm(%i*-30*%pi/180); //ohm
11 Z3=10*expm(%i*60*%pi/180); //ohm
12 Y1=1/Z1; //mho
13 Y2=1/Z2; //mhob
14 Y3=1/Z3; //mho
15 Y=Y1+Y2+Y3; //mho
16 Ymag=abs(Y); //mho
17 Yang=atand(imag(Y)/real(Y)); //degree
18 disp(Yang,Ymag,"Total admittance , magnitude(mho) &
    Angle(degree) are");
19 Z=1/Y; //ohm
20 Zmag=abs(Z); //ohm
21 Zang=atand(imag(Z)/real(Z)); //degree
22 disp(Zang,Zmag,"Equivalent Impedance , magnitude(ohm
    ) & Angle(degree) are");
23 I=V/Z; //A

```

```

24 Imag=abs(I); //A
25 Iang=atand(imag(I)/real(I)); //degree
26 disp(Iang,Imag," Total current , magnitude(A) & Angle(
    degree) are");
27 pf=cosd(Iang); //Power Factor(lagging)
28 fi=acosd(pf); //degree
29 disp(pf," Power Factor(lagging)");
30 format('v',7);
31 P=abs(V)*Imag*pf; //W
32 P=P/1000; //kW
33 disp(P," Power Consumed(kW)");
34 //Answer is not accurate in the book.

```

Scilab code Exa 3.27 Calculate power and power factor

```

1 //Example 3_27
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=230; //V
8 f=50; //Hz
9 R1=12; //ohm
10 XL1=12; //ohm
11 R2=8; //ohm
12 XL2=16; //ohm
13 Z1=R1+%i*XL1; //ohm
14 Z2=R2+%i*XL2; //ohm
15 Y1=1/Z1; //mho
16 Y2=1/Z2; //mhob
17 I1=V*Y1; //A
18 I1mag=abs(I1); //A
19 I1ang=atand(imag(I1)/real(I1)); //degree
20 disp(I1ang,I1mag," current I1 , magnitude(A) & Angle(

```

```

        degree) are");
21 I2=V*Y2; //A
22 I2mag=abs(I2); //A
23 I2ang=atand(imag(I2)/real(I2)); //degree
24 disp(I2ang,I2mag," Current I2 , magnitude(A) & Angle(
        degree) are");
25 I=I1+I2; //A
26 Imag=abs(I); //A
27 Iang=atand(imag(I)/real(I)); //degree
28 disp(Iang,Imag," Total current , magnitude(A) & Angle(
        degree) are");
29 pf=cosd(Iang); //Power Factor(lagging)
30 fi=acosd(pf); //degree
31 disp(pf," Power Factor(lagging)");
32 P=abs(V)*Imag*pf; //W
33 P=P/1000; //kW
34 disp(P," Power Consumed(kW)");
35 //Answer is not accurate in the book.

```

Scilab code Exa 3.28 Total Current drawn

```

1 //Example 3_28
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=230; //V
8 f=50; //Hz
9 R1=10; //ohm
10 L1=0.0636; //H
11 R2=8; //ohm
12 C=398; //micro F
13 R3=6; //ohm
14 L2=0.0319; //H

```

```

15 Z1=R1+%i*2*%pi*f*L1; //ohm
16 Z2=R2-%i/2/%pi/f/(C*10^-6); //ohm
17 Z3=R3+%i*2*%pi*f*L2; //ohm
18 Z=Z1*Z2/(Z1+Z2)+Z3; //ohm
19 I=V/Z; //A
20 Imag=abs(I); //A
21 Iang=atand(imag(I)/real(I)); //degree
22 disp(Iang,Imag,"Current , magnitude(A) & Angle(degree
    ) are");
23 disp(Imag,"Total Current(A)");
24 pf=cosd(Iang); //Power Factor(lagging)
25 fi=acosd(pf); //degree
26 disp(pf,"Power Factor(lagging)");
27 //Answer is not accurate in the book.

```

Scilab code Exa 3.29 Value of R

```

1 //Example 3_29
2 clc;
3 clear;
4 close;
5 format('v',4);
6 //given data :
7 V=230; //V
8 I=25; //A
9 f=50; //Hz
10 R1=5; //ohm
11 R2=10; //ohm
12 L2=50; //mH
13 Z1=R1; //ohm
14 Z2=R2+%i*2*%pi*f*L2/1000; //ohm
15 R=poly(0,'R');
16 Z3=R; //ohm
17 Z12=Z1*Z2/(Z1+Z2); //ohm
18 Z=V/I; //ohm//Zdash is Z durectly

```

```

19 R3=Z-Z12; //ohm
20 R3=real(R3); //ohm
21 disp(R3," Value of R(ohm)");

```

Scilab code Exa 3.30 Current and power factor

```

1 //Example 3_30
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=200; //V
8 f=50; //Hz
9 ZA=4+%i*3; //ohm
10 ZB=10-%i*7; //ohm
11 ZC=6+%i*5; //ohm
12 Z=ZC+ZA*ZB/(ZA*ZB); //ohm
13 IC=V/Z; //A
14 ICmag=abs(IC); //A
15 ICang=atand(imag(IC)/real(IC)); //degree
16 disp(ICang,ICmag," Current IC, magnitude(A) & Angle(
    degree) are");
17 IA=IC*ZB/(ZA+ZB); //A
18 IAmag=abs(IA); //A
19 IAang=atand(imag(IA)/real(IA)); //degree
20 disp(IAang,IAmag," Current IA, magnitude(A) & Angle(
    degree) are");
21 IB=IC*ZA/(ZA+ZB); //A
22 IBmag=abs(IB); //A
23 IBang=atand(imag(IB)/real(IB)); //degree
24 disp(IBang,IBmag," Current IB, magnitude(A) & Angle(
    degree) are");
25 fi=ICang; //degree //angle of pf
26 pf=cosd(fi); //Power Factor(lagging)

```

```

27 disp(pf,"Power Factor(lagging)");
28 VC=IC*ZC;//V
29 Vcmag=abs(VC);//A
30 VCang=atand(imag(VC)/real(VC));//degree
31 disp(VCang,Vcmag,"Voltage VC, magnitude(V) & Angle(
    degree) are");
32 VA=IC*ZA*ZB/(ZA+ZB);//V
33 VAmag=abs(VA);//A
34 VAang=atand(imag(VA)/real(VA));//degree
35 disp(VAang,VAmag,"Voltage VA, magnitude(V) & Angle(
    degree) are");
36 VB=IC*ZA*ZB/(ZA+ZB);//V
37 VBmag=abs(VB);//A
38 VBang=atand(imag(VB)/real(VB));//degree
39 disp(VBang,VBmag,"Voltage VB, magnitude(V) & Angle(
    degree) are");
40 //Answer is not accurate in the book.

```

Scilab code Exa 3.31 Determine the voltage

```

1 //Example 3_31
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 I2=10;//A
8 f=50;//Hz
9 R1=5;//ohm
10 L1=0.0191;//H
11 R2=7;//ohm
12 C2=398;//micro F
13 R3=8;//ohm
14 L3=0.0318;//H
15 Z1=R1+%i*2*%pi*f*L1;//ohm

```

```

16 Z2=R2-%i/2/%pi/f/(C2*10^-6); //ohm
17 Z3=R3+%i*2*%pi*f*L3; //ohm
18 VAC=I2*Z2; //V
19 I1=VAC/Z1; //A
20 I=I1+I2; //A
21 VCB=I*Z3; //V
22 VAB=VAC+VCB; //V
23 VABmag=abs(VAB); //A
24 VABang=atand( imag(VAB)/real(VAB)); //degree
25 disp(VABang,VABmag," Voltage AB, magnitude(V) & Angle
    (degree) are");
26 //Answer is not accurate in the book.

```

Scilab code Exa 3.32 Impedence Current and power

```

1 //Example 3_32
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=110; //V
8 f=50; //Hz
9 ZA=2; //ohm
10 ZB=3+%i*4; //ohm
11 ZC=2-%i*2; //ohm
12 ZAB=ZA*ZB/(ZA+ZB); //ohm
13 ZP=ZAB*ZC/(ZAB+ZC); //ohm
14 ZD=1+%i*1; //ohm
15 z=ZP+ZD; //ohm
16 zmag=abs(z); //A
17 zang=atand( imag(z)/real(z)); //degree
18 disp(zang,zmag,"(a) Total impedance , magnitude(ohm)
    & Angle(degree) are");
19 I=V/abs(z); //A

```

```

20 format('v',5);
21 disp(I,"(b) Current taken by circuit(A)");
22 format('v',7);
23 ID=I;//A
24 RD=real(ZD);//ohm
25 PD=ID^2*RD;//W
26 disp(PD,"Power Consumed by branch D(W)");
27 //VPQ=I*ZP;
28 IA=I*abs(ZP)/abs(ZA);//A
29 RA=2;//ohm
30 PA=IA^2*RA;//W
31 disp(PA,"Power Consumed by branch A(W)");
32 IB=I*abs(ZP)/abs(ZB);//A
33 RB=3;//ohm
34 PB=IB^2*RB;//W
35 disp(PB,"Power Consumed by branch B(W)");
36 IC=I*abs(ZP)/abs(ZC);//A
37 RC=2;//ohm
38 PC=IC^2*RC;//W
39 disp(PC,"Power Consumed by branch C(W)");
40 P=PA+PB+PC+PD;//W
41 disp(P,"Total Power Consumed(W)");
42 //Answer is not accurate in the book.

```

Scilab code Exa 3.33 Frequency and Q factor

```

1 //Example 3_33
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 R=10;//ohm
8 L=0.1;//H
9 C=8;//micro F

```



```

10 f0=1/2/%pi/sqrt(L*C*10^-6); //Hz
11 disp(f0,"(a) Resonant Frequency(Hz)");
12 Q=2*%pi*f0*L/R; //Q-factor
13 disp(Q,"(b) Q-factor");
14 f1=f0-R/4/%pi/L; //Hz
15 f2=f0+R/4/%pi/L; //Hz
16 disp(f2,f1,"(c) Half power frequencies , f1 & f2 in
    Hz are");
17 BW=f2-f1; //Hz
18 disp(BW,"Bandwidth(Hz)");
19 //Answer is not accurate in the book.

```

Scilab code Exa 3.34 Capacitance and Q factor

```

1 //Example 3_34
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 R=4; //ohm
8 L=0.5; //H
9 V=100; //V
10 f=50; //Hz
11 C=(1/2/%pi/f)^2/L*10^6; //micro F
12 disp(C,"(a) Capacitance at resonant Frequency(micro
    F)");
13 IO=V/R; //A
14 VC=IO/2/%pi/f/(C*10^-6); //V
15 disp(VC,"(b) Voltage across the capacitor at
    resonant (V)");
16 Q=VC/V; //Q-factor
17 disp(Q,"(b) Q-factor");
18 //Answer is not accurate in the book.

```

Scilab code Exa 3.35 Circuit parameters

```
1 //Example 3_35
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V=230; //V
8 f=50; //Hz
9 Im=1.5; //A//Maximum current
10 VC=600; //V
11 VL=600; //V
12 R=V/Im; //ohm
13 XL=VL/Im; //ohm
14 L=XL/2/%pi/f; //H
15 XC=XL; //ohm
16 C=1/2/%pi/f/XC; //F
17 disp(R," Resistance (ohm)");
18 format('v',5);
19 disp(L," Inductance (H)");
20 format('v',11);
21 disp(C," Capacitance (F)");
22 //Answer is not accurate in the book.
```

Scilab code Exa 3.36 Circuit parameters and Q factors

```
1 //Example 3_36
2 clc;
3 clear;
4 close;
5 format('v',6);
```

```

6 //given data :
7 f=100; //Hz
8 C=100; //micro F
9 Cdash=200; //micro F//When current is half of maximum
10 L=1/(2*%pi*f)^2/(C*10^-6); //H
11 disp(L," Inductance (H)");
12 XL=2*%pi*f*L; //ohm
13 XC=1/2/%pi/f/(Cdash*10^-6); //ohm
14 //at I=Im/2 Z will be 2*R
15 //Im=V/R and I=V/Z=V/sqrt(R^2+(XL-XC)^2)
16 R=(XL-XC)/sqrt(3); //ohm
17 format('v',5);
18 disp(R," Resistance (ohm)");
19 //Answer is not accurate in the book.

```

Scilab code Exa 3.37 Voltage and Q factor

```

1 //Example 3_37
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 R=10; //ohm
8 L=20; //mH
9 C=10; //micro F
10 V=50; //V
11 f0=1/2/%pi/sqrt(L/1000*C/10^6); //Hz
12 disp(f0," Resonance frequency (Hz)");
13 I0=V/R; //A
14 XL=2*%pi*f0*L/1000; //ohm
15 VL=I0*XL; //V
16 disp(VL," Voltage across inductance (V)");
17 VR=I0*R; //V
18 disp(VR," Voltage across Resistance (V)");

```

```

19 XC=1/2/%pi/f0/(C*10^-6); //ohm
20 VC=I0*XC; //V
21 disp(VC,"Voltage across Capacitance(V)");
22 Q=VL/V; //Q-factor
23 disp(Q,"Q-factor");
24 //Answer is not accurate in the book.

```

Scilab code Exa 3.38 Value of C and voltage

```

1 //Example 3_38
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 R=50; //ohm
8 L=1; //mH
9 Im=5; //A//Maximum current
10 f0=50; //Hz
11 C=1/(2*%pi*f0)^2/(L/1000); //F
12 disp(C,"Value of C(F)");
13 V=Im*R; //V
14 disp(V,"Applied Voltage(V)");
15 //Answer is not accurate in the book.

```

Scilab code Exa 3.39 Power factor Impedence and current

```

1 //Example 3_39
2 clc;
3 clear;
4 close;
5 format('v',10);
6 //given data :

```

```

7 R=2.5; //ohm
8 XL=25; //ohm
9 V=200; //V
10 f0=50; //Hz
11 XC=XL; //ohm
12 C=1/(2*%pi*f0*XC); //F
13 disp(C,"For maximum current , Value of C(F)");
14 //At resonance Z=R
15 pf=1; //power factor
16 disp(pf,"Power Factor ");
17 Z=R; //ohm
18 disp(Z,"Impedence(ohm)");
19 Im=V/R; //A
20 disp(Im,"Current(A)");
21 //Answer is not accurate in the book.

```

Scilab code Exa 3.40 Frequency Q factor and current

```

1 //Example 3_40
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 R=10; //ohm
8 L=100; //mH
9 C=20; //micro F
10 V=100; //V
11 f0=1/2/%pi*sqrt(1/(L/1000*C*10^-6)-R^2/(L/1000)^2);
    //Hz
12 disp(f0,"Resonant frequency(Hz)");
13 Q=2*%pi*f0*L/1000/R; //Q-factor
14 disp(Q,"Q-factor");
15 Z0=L/1000/(C*10^-6)/R; //ohm
16 disp(Z0,"Dynamic Impedence(ohm)");

```

```

17 I0=V/Z0; //A
18 disp(I0,"Current at resonance(A)");
19 //Answer is not accurate in the book.

```

Scilab code Exa 3.41 Value of capacitor

```

1 //Example 3_41
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 R=5; //ohm
8 XL=10; //ohm
9 V=230; //V
10 f=50; //Hz
11 Z=R+%i*XL; //ohm
12 IL=V/Z; //A
13 fi_L=atand(imag(IL)/real(IL)); //degree
14 IC=abs(IL)*sind(fi_L); //A
15 XC=-V/IC; //ohm
16 C=1/2/%pi/f/XC*10^6; //micro F
17 disp(C,"Value of capacitor(micro F)");
18 I=abs(IL)*cosd(fi_L); //A
19 format('v',3);
20 disp(I,"Magnitude of in-phase current(A)");
21 //Answer is not accurate in the book.

```

Scilab code Exa 3.42 Resonant current

```

1 //Example 3_42
2 clc;
3 clear;

```

```

4 close;
5 format('v',7);
6 //given data :
7 R=4;//ohm
8 L=20;//mH
9 V=230;//V
10 f=50;//Hz
11 omega=2*%pi*f;//rad/s
12 ZL=R+%i*omega*L/1000;//ohm
13 IL=V/ZL;//A
14 fi_L=atand(imag(IL)/real(IL));//degree
15 IC=abs(IL)*sind(fi_L);//A
16 XC=-V/IC;//ohm
17 C=1/2/%pi/f/XC*10^6;//micro F
18 disp(C,"Value of capacitor(micro F)");
19 IO=abs(IL)*cosd(fi_L);//A
20 format('v',5);
21 disp(IO,"Magnitude of in-phase current(A)");
22 //Answer is not accurate in the book.

```

Scilab code Exa 3.43 Value of Ri

```

1 //Example 3_43
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 XL1=6;//ohm
8 R2=10;//ohm
9 XC2=4;//ohm
10 R1=poly(0,'R1');
11 Z1=R1+%i*XL1;//ohm
12 Z2=R2-%i*XC2;//ohm
13 Z=Z1*Z2/(Z1+Z2);//ohm

```

```
14 //Imaginary part of Z will be zero
15 //For Calculation
16 eq=imag( numer(Z)*denom(Z'));//equation of imaginary
    part
17 R1=roots(eq); //ohm
18 R1=R1(1); //ohm//leaving -ve value
19 disp(R1," Value of R1(ohm)");
```

Chapter 4

Semiconductor Fundamentals

Scilab code Exa 4.1 Value of wave vector

```
1 //Example 4_1
2 clc;
3 clear;
4 close;
5 format('v',9)
6 //given data :
7 E=2;//eV
8 c=3*10^8;//m/s//Speed of light
9 h=6.64*10^-34;//Js//Planks Constant
10 E=E*1.6*10^-19;//J
11 lambda=c*h/E;//m
12 lambda=lambda/10^-10;//Angstrum
13 disp(lambda,"Wavelength (Angstrum)");
14 k=2*%pi/(lambda*10^-10);//m^-1
15 disp(k,"k-vector (m^-1)");
```

Scilab code Exa 4.2 Identify the semiconductor

```

1 //Example 4_2
2 clc;
3 clear;
4 close;
5 format('v',7)
6 //given data :
7 c=3*10^8; //m/s//Speed of light
8 h=1.05*10^-34; //Js//Planks Constant
9 lambda=0.5; //micro m//or less
10 lambda=lambda/10^6; //m
11 Eg=2*pi*h*c/lambda; //J
12 Eg=Eg/(1.6*10^-19); //eV
13 disp(Eg,"Bandgap Eg(eV)");
14 disp("Semiconductors Guess: C, BN, GaN & SiC");

```

Scilab code Exa 4.3 Calculate the energy of electron

```

1 //Example 4_3
2 clc;
3 clear;
4 close;
5 format('v',4)
6 //given data :
7 c=3*10^8; //m/s//Speed of light
8 h=1.05*10^-34; //Js//Planks Constant
9 mc=0.1; //mo
10 mc=mc*0.91*10^-30; //kg
11 k=0.3; ///per Angstrum
12 E=h^2*(k/10^-10)^2/2/mc; //J
13 E=E/(1.6*10^-19); //eV
14 disp(E,"Energy of the electron (eV)");

```

Scilab code Exa 4.4 Calculate the energy of electron

```

1 //Example 4_4
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 c=3*10^8; //m/s//Speed of light
8 h=1.05*10^-34; //Js//Planks Constant
9 mc_GaAs=0.067; //mo
10 mc_InAs=0.01; //mo
11 k=0.01; ///per Angstrum
12 mc_GaAs=mc_GaAs*0.91*10^-30; //kg
13 mc_InAs=mc_InAs*0.91*10^-30; //kg
14 E_GaAs=h^2*(3*k*10^10)^2/2/mc_GaAs; //J
15 E_GaAs=E_GaAs/(1.6*10^-19)*1000; //meV
16 disp(E_GaAs,"Energy of the electron in GaAs(meV)");
17 E_InAs=h^2*(3*k*10^10)^2/2/mc_InAs; //J
18 E_InAs=E_InAs/(1.6*10^-19)*1000; //meV
19 disp(E_InAs,"Energy of the electron in InAs(meV)");
20 //Answer given in the textbook is wrong.

```

Scilab code Exa 4.5 Calculate the energy of electron

```

1 //Example 4_5
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 c=3*10^8; //m/s//Speed of light
8 h=1.05*10^-34; //Js//Planks Constant
9 mc=0.067; //mo
10 k=[0.1 0.1 0 0]; ///per Angstrum
11 mc=mc*0.91*10^-30; //kg
12 E=h^2*((k(1)*10^10)^2+(k(2)*10^10)^2)/2/mc; //J

```

```

13 E=E/(1.6*10^-19); //eV
14 disp(E,"Energy of the electron in GaAs(eV)");
15 //Answer given in the textbook is wrong.

```

Scilab code Exa 4.6 Estimate smallest k vector

```

1 //Example 4_6
2 clc;
3 clear;
4 close;
5 format('v',8)
6 //given data :
7 c=3*10^8; //m/s //Speed of light
8 h=1.05*10^-34; //Js //Planks Constant
9 mc=0.067; //mo
10 mc=mc*0.91*10^-30; //kg
11 E=0.3; //eV
12 E=E*1.6*10^-19; //J
13 //Formula //E=3*h^2*kx^2/2/mc
14 kx=sqrt(2*mc*E/3/h^2); //m^-1
15 disp(kx,"Smallest k-vector along x-direction (m^-1)")
    ;

```

Scilab code Exa 4.7 Calculate the energy of electron

```

1 //Example 4_7
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 c=3*10^8; //m/s //Speed of light
8 h=1.05*10^-34; //Js //Planks Constant

```

```

9 mc_GaAs=0.067; //mo
10 mc_InAs=0.01; //mo
11 k=[0.01 0.01 0.01]; ///per Angstrum
12 mc_GaAs=mc_GaAs*0.91*10^-30; //kg
13 mc_InAs=mc_InAs*0.91*10^-30; //kg
14 E_GaAs=h^2*(3*k(1)*10^10)^2/2/mc_GaAs; //J
15 E_GaAs=E_GaAs/(1.6*10^-19)*1000; //meV
16 disp(E_GaAs,"Energy of the electron in GaAs(meV)");
17 E_InAs=h^2*(3*k(1)*10^10)^2/2/mc_InAs; //J
18 E_InAs=E_InAs/(1.6*10^-19)*1000; //meV
19 disp(E_InAs,"Energy of the electron in InAs(meV)");
20 //Answer given in the textbook is wrong.

```

Scilab code Exa 4.8 Position of fermi level

```

1 //Example 4_8
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 n0=6*10^17; //cm^-3
8 Nc=4.45*10^17; //cm^-3
9 kBT=0.026; //eV//at room temperature/T=300 K
10 EF=kBT*log(n0/Nc)*1000; //meV
11 disp(EF,"Position of fermi level(meV)");

```

Scilab code Exa 4.9 Position of fermi level

```

1 //Example 4_9
2 clc;
3 clear;
4 close;

```

```

5 format('v',6)
6 //given data :
7 //me=2*mh
8 meBYmh=2; //ratio
9 T=300; //K
10 kT=0.026; //eV//at room temperature/T=300 K
11 //EF=3/4*kT*log(1/meBYmh)-EG/2
12 //position of fermi level below centre of forbidden
    gap
13 EF=-3/4*kT*log(1/meBYmh); //eV
14 disp(EF,"Position of fermi level below centre of
    forbidden gap by (eV) : ");

```

Scilab code Exa 4.10 Position of fermi level

```

1 //Example 4_10
2 clc;
3 clear;
4 close;
5 format('v',7)
6 //given data :
7 h=1.05*10^-34; //Js//Planks Constant
8 mc=0.067; //mo
9 mc=mc*0.91*10^-30; //kg
10 n0=10^18; //cm^-3
11 n0=n0*10^6; //m^-3
12 EF=(h^2/2/mc)*(3*pi^2*n0)^(2/3); //J
13 EF=EF/(1.6*10^-19); //eV
14 disp(EF,"Position of fermi level(eV)");
15 //Answer given in the textbook is wrong

```

Scilab code Exa 4.11 Calculate the time

```

1 //Example 4_11
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 h=1.05*10^-34; //Js//Planks Constant
8 e=1.6*10^-19; //C///Charge on electron
9 E0=10^4; //V/cm
10 a=5.62*10^-8; //cm//lattice constant for n-GaAs
11 kB=2*%pi/a; //cm^-1///Brillouin Edge
12 tau=h*kB/e/E0*10^12; //ps
13 disp(tau,"Time taken by electron to reach Brillouin
    Zone(ps)");
14 //Answer given in the textbook is wrong

```

Scilab code Exa 4.12 Calculate the drift velocity

```

1 //Example 4_12
2 clc;
3 clear;
4 close;
5 format('e',9)
6 //given data :
7 h=1.05*10^-34; //Js//Planks Constant
8 e=1.6*10^-19; //C///Charge on electron
9 mc=0.067; //mo
10 mc=mc*0.91*10^-30; //kg
11 E0=1; //kV/cm
12 E0=E0*10^3/10^-2; //V/m
13 //Part (a)
14 tau_sc=10^-13; //s
15 v0=e*tau_sc*E0/mc; //m/s
16 v0=v0*100; //cm/s
17 disp(v0,"(a) Drift velocity(cm/s)");

```

```

18 //Part (b)
19 tau_sc=10^-12; //s
20 v0=e*tau_sc*E0/mc; //m/s
21 v0=v0*100; //cm/s
22 disp(v0,"(b) Drift velocity(cm/s)");
23 //Part (c)
24 tau_sc=10^-11; //s
25 v0=e*tau_sc*E0/mc; //m/s
26 v0=v0*100; //cm/s
27 disp(v0,"(c) Drift velocity(cm/s)");

```

Scilab code Exa 4.13 Conductivity and drift velocity

```

1 //Example 4_13
2 clc;
3 clear;
4 close;
5 format('v',9)
6 //given data :
7 n0=7.87*10^28; //m^-3
8 mu=35.2; //cm^2/vs
9 E0=30*10^2; //V/m
10 h=1.05*10^-34; //Js //Planks Constant
11 e=1.6*10^-19; //C //Charge on electron
12 //Part (a)
13 sigma=n0*e*mu*10^-4; //s/m
14 disp(sigma,"(a) Conductivity(s/m)");
15 //Part (b)
16 V0=E0*mu*10^-4; //m/s
17 disp(V0,"(b) Drift velocity of electron(m/s)");
18 J=sigma*E0; //A/m^3
19 disp(J,"(b) Current density(A/m^3)")
20 //Answer given in the textbook is not accurate.

```

Scilab code Exa 4.14 Calculate the drift velocity

```
1 //Example 4_14
2 clc;
3 clear;
4 close;
5 format('e',9)
6 //given data :
7 A=10^-5; //m^2
8 I=100; //A
9 n0=8.5*10^28; //m^-3
10 e=1.6*10^-19; //C///Charge on electron
11 //Formula : I=no*A*vd*e
12 vd=I/n0/A/e; //ms^-1
13 disp(vd," Drift Velocity (ms^-1)")
```

Scilab code Exa 4.15 Calculate the drift velocity

```
1 //Example 4_15
2 clc;
3 clear;
4 close;
5 format('e',9)
6 //given data :
7 A=10^-5; //m^2
8 I=100; //A
9 n0=8.5*10^28; //m^-3
10 e=1.6*10^-19; //C///Charge on electron
11 //Formula : I=no*A*vd*e
12 vd=I/n0/A/e; //ms^-1
13 disp(vd," Drift Velocity (ms^-1)")
```

Scilab code Exa 4.16 Calculate the drift velocity

```
1 //Example 4_16
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 V=1; //V
8 L=10; //m
9 tau=10^-14; //s
10 e=1.6*10^-19; //C///Charge on electron
11 m=0.02*9.1*10^-31; //kg//effective mass of electron
12 E0=V/L; //V/m
13 v0=e*E0*tau/m; //m/s
14 disp(v0," Drift Velocity (ms^-1)")
```

Scilab code Exa 4.17 Equilibrium hole concentration

```
1 //Example 4_17
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 Nd=10^17; //atoms/cm^3
8 ni=1.5*10^10; //atoms/cm^3
9 n0=Nd; //atoms/cm^3 (For Nd>>ni)
10 p0=ni^2/n0; //atoms/cm^3
11 disp(p0," Equilibrium hole concentration (cm^-3)")
```

Scilab code Exa 4.18 Calculate the time

```
1 //Example 4_18
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 h=1.05*10^-34; //Js //Planks Constant
8 e=1.6*10^-19; //C //Charge on electron
9 E0=10^4; //V/cm
10 a=5.62*10^-8; //cm //lattice constant for n-GaAs
11 kB=2*pi/a; //cm^-1 //Brillouin Edge
12 tau=h*kB/e/E0*10^12; //ps
13 disp(tau,"Time taken by electron to reach Brillouin
    Zone(ps)");
14 //Answer given in the textbook is wrong
```

Scilab code Exa 4.19 Estimate smallest k vector

```
1 //Example 4_19
2 clc;
3 clear;
4 close;
5 format('v',8);
6 //given data :
7 c=3*10^8; //m/s //Speed of light
8 h=1.05*10^-34; //Js //Planks Constant
9 mc=0.067; //mo
10 mc=mc*0.91*10^-30; //kg
11 E=0.3; //eV
12 E=E*1.6*10^-19; //J
```

```

13 //Formula //E=3*h^2*kx^2/2/mc
14 kx=sqrt(2*mc*E/3/h^2); //m^-1
15 disp(kx,"Smallest k-vector along x-direction (m^-1)")
    ;

```

Scilab code Exa 4.20 Electron and hole concentration

```

1 //Example 4_20
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 ni=1.5*10^10; //cm^-3
8 mu_n=1350; //cm^2/V-s
9 mu_p=450; //cm^2/V-s
10 n0=ni*sqrt(mu_p/mu_n); //cm^-3
11 p0=ni*sqrt(mu_n/mu_p); //cm^-3
12 disp(n0,"Electron concentration (cm^-3)")
13 disp(p0,"Hole concentration (cm^-3)")

```

Scilab code Exa 4.21 Position of fermi level

```

1 //Example 4_21
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 h=1.05*10^-34; //Js //Planks Constant
8 n0=6.02*10^23; //atom/mole
9 n0=n0/72.6; //atom/gram
10 n0=n0*5.32; //atom/cm^3

```

```

11 ND=1/10^7*n0; //cm^-3
12 T=300; //K
13 //mc=1/2*mo
14 mcBYmo=1/2;
15 kBT=0.026; //eV//For T=300K
16 Nc=ND*(mcBYmo*T)^(3/2); //cm^-3
17 n0=ND; //cm^-3//Considering full ionization
18 EF=kBT*log(n0/Nc); //eV
19 disp(EF,"Position of fermi level(eV)")

```

Scilab code Exa 4.22 Mobility of free electron

```

1 //Example 4_22
2 clc;
3 clear;
4 close;
5 format('e',8);
6 //given data :
7 e=1.6*10^-19; //C/electron
8 d=270; //g/cm^3
9 rho=3.44*10^-6; //ohm-cm
10 ne=3; //electrons/atom
11 me=26.97*1.66*10^-27
12 n0=d/100*ne*10^-3/me*10^6; //m^-3
13 mu=1/n0/e/rho*10^2; //V-sec
14 disp(mu,"Mobility of free electron (m^2/V-s)")

```

Scilab code Exa 4.23 Mobility of free electron

```

1 //Example 4_23
2 clc;
3 clear;
4 close;

```

```

5 format('v',4);
6 //given data :
7 e=1.6*10^-19; //C/electron
8 Eg=1.21; //eV
9 ne=3; //electrons/atom
10 dniBYni=(1.5+Eg/0.052)*(1/ne/100)*100; // % per degree
11 disp(dniBYni,"100*dni/ni is (% per degree)");

```

Scilab code Exa 4.24 Drift velocity mobility and conductivity

```

1 //Example 4_24
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 d=1.03; //mm
8 R=6.51; //ohm per 1000 ft.
9 n0=8.4*10^27; //electrons/m^3
10 I=2; //A
11 A=%pi/4*d^2*10^-6; //m^2
12 J=I/A; //A/m^2
13 e=1.6*10^-19; //C/electron
14 v0=J/n0/e; //m/s
15 disp(v0,"(a) Drift Velocity(m/s)");
16 R=R/1000/0.304; //ohm/m
17 E0=I*R; //V/m
18 mu=v0/E0; //m^2/V-s
19 disp(mu,"(b) Mobility(m^2/V-s)");
20 sigma=n0*e*mu; //(ohm-m)^-1
21 disp(sigma,"(c) Conductivity((ohm-m)^-1)");
22 //Answer wrong in the book. calculation mistake.

```

Scilab code Exa 4.25 Concentration of free electron

```
1 //Example 4_25
2 clc;
3 clear;
4 close;
5 format('v',9);
6 //given data :
7 T=300;//K
8 //Part (a)
9 ND=2*10^14;//cm^-3//Donor
10 NA=3*10^14;//cm^-3//Acceptor
11 ni=2.5*10^19;//m^-3//Intrinsic
12 ni=ni/10^6;//m^-3
13 n0=-(NA-ND)/2+sqrt([(NA-ND)/2]^2+ni^2);//cm^-3
14 p0=-(ND-NA)/2+sqrt([(ND-NA)/2]^2+ni^2);//cm^-3
15 disp(n0,"n0 is (cm^-3)");
16 disp(p0,"p0 is (cm^-3)");
17 if p0>n0 then
18     disp("(a) Since p0>n0, Sample is of p-type.");
19 end;
20 //Part (b)
21 format('v',4);
22 ND=10^15;//cm^-3
23 NA=10^15;//cm^-3
24 p0=poly(0,'p0');
25 n0=p0+ND-NA;//cm^-3
26 disp(n0,"(b) n0 is equal to ");
27 disp("It is Intrinsic Semiconductor")
28 //Part (c)
29 disp("Part(c) : ");
30 format('v',7);
31 ND=10^16;//cm^-3
32 NA=10^14;//cm^-3
33 n0=ND;//cm^-3(For NA<<ND)
34 p0=ni^2/ND;//cm^-3
35 disp(n0,"n0 is (cm^-3)");
36 format('v',9);
```

```

37 disp(p0,"p0 is (cm-3)");
38 if p0<n0 then
39     disp("(c) Since p0<n0, Sample is of n-type.");
40 end;

```

Scilab code Exa 4.26 Concentration of holes and electron

```

1 //Example 4_26
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 T=300;//K
8 e=1.6*10-19;//C/electron
9 disp("Part(a) :");
10 sigma=100;//(ohm-cm)-1
11 ni=2.5*1013;//cm-3//For Ge
12 mu_p=1800;//cm2/V-s//For Ge
13 //sigma=p0*e*mu_p, since p0>>n0
14 p0=sigma/e/mu_p;//cm-3
15 n0=ni2/p0*106;//m-3
16 disp(p0,"Concentration of holes (cm-3)");
17 disp(n0,"Concentration of electrones (m-3)");
18 disp("Part(b) :");
19 sigma=0.1;//(ohm-cm)-1
20 ni=1.5*1010;//cm-3//For Si
21 mu_n=1300;//cm2/V-s//For Si
22 //sigma=n0*e*mu_p, since n0>>p0
23 n0=sigma/e/mu_n;//cm-3
24 p0=ni2/n0*106;//m-3
25 disp(n0,"Concentration of electrones (cm-3)");
26 disp(p0,"Concentration of holes (m-3)");

```

Scilab code Exa 4.27 Resistivity of intrinsic Ge

```
1 //Example 4_27
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //data for intrinsic Ge
7 //n0=p0=ni;///for intrinsic
8 ni=2.5*10^13; //cm^-3
9 mu_n=3800; //cm^2/V-s
10 mu_p=1800; //cm^2/V-s
11 mu=mu_n+mu_p; //cm^2/V-s
12 e=1.6*10^-19; //C/electron
13 sigma=e*ni*(mu); //(s/cm)
14 rho=1/sigma; //ohm-cm
15 disp(rho," Resistivity of intrinsic Ge(ohm-cm) : ");
```

Scilab code Exa 4.28 Conductivity of intrinsic Ge

```
1 //Example 4_28
2 clc;
3 clear;
4 close;
5 format('v',8);
6 //data for intrinsic Ge
7 //n0=p0=ni;///for intrinsic
8 ni=2.5*10^13; //cm^-3
9 mu_n=3800; //cm^2/V-s
10 mu_p=1800; //cm^2/V-s
11 mu=mu_n+mu_p; //cm^2/V-s
12 e=1.6*10^-19; //C/electron
```

```

13 sigma=e*ni*(mu);//(s/cm)
14 disp(sigma,"(a) Conductivity of intrinsic Ge(s/cm) :
    ");
15 format('v',5);
16 n=4.41*10^22;//cm^-3//Concentration of Ge atom
17 ND=n/10^7;//cm^-3
18 n0=ND;//cm^-3
19 p0=ni^2/ND;//cm^-3
20 sigma=n0*e*mu_n;//s/cm(n0<<p0, n0 neglected)
21 disp(sigma,"(b) Conductivity(s/cm)");
22 NA=n/10^7;//cm^-3
23 p0=NA;//cm^-3
24 n0=ni^2/NA;//cm^-3
25 sigma=p0*e*mu_p;//s/cm(p0<<n0, p0 neglected)
26 disp(sigma,"(c) Conductivity(s/cm)");

```

Chapter 5

Diode Fundamentals

Scilab code Exa 5.1 Height of potential barrier

```
1 //Example 5_1
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 rho_p=1.5;//ohm-cm
8 rho_n=1;//ohm-cm
9 e=1.6*10^-19;//C/electron
10 //For Ge diode
11 mu_p=1800;//cm^2/V-s//For Ge
12 mu_n=3800;//cm^2/V-s//For Si
13 VT=0.026;//eV//at room temperature
14 ni=2.5*10^13;//cm^-3s
15 //rho=1/(NA*e*mu)
16 NA=1/(rho_p*e*mu_p);//cm^-3
17 ND=1/(rho_n*e*mu_n);//cm^-3
18 V0=VT*log(NA*ND/ni^2);//eV
19 disp(V0,"(a) Height of potential barrier(eV)");
20 //For Si diode
21 mu_p=500;//cm^2/V-s//For Ge
```

```

22 mu_n=1300; //cm^2/V-s//For Si
23 VT=0.026; //eV//at room temperature
24 ni=1.5*10^10; //cm^-3s
25 //rho=1/(NA*e*mu)
26 NA=1/(rho_p*e*mu_p); //cm^-3
27 ND=1/(rho_n*e*mu_n); //cm^-3
28 V0=VT*log(NA*ND/ni^2); //eV
29 disp(V0,"(b) Height of potential barrier(eV)");
30 //Answer in the texbook is not accurate.

```

Scilab code Exa 5.2 Width of depletion zone

```

1 //Example 5_2
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 ND=10^16; //cm^-3
8 A=4*10^-4; //cm^2
9 NA=5*10^18; //cm^-3
10 T=300; //K
11 epsilon0=8.85*10^-14; //vaccum permittivity
12 epsilon_r=11.8; //relative permittivity
13 e=1.6*10^-19; //C/electron
14 ni=1.5*10^10; //cm^-3
15 kBT=0.0259; //eV//at room temperture
16 V0=kBT*log(NA*ND/ni^2); //V
17 W=sqrt(2*epsilon_r*epsilon0*V0/e*(1/NA+1/ND)); //cm
18 disp(W,"Width of depletion zone(cm)");
19 //Answer in the texbook is not accurate. Calculation
    mistake in W.

```

Scilab code Exa 5.3 Thermal and barrier voltage

```
1 //Example 5_3
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 ND=1.2*10^21; //cm^-3
8 NA=10^22; //cm^-3
9 T=(273+30); //K
10 kB=1.38*10^-23; //Boltzman constant
11 e=1.6*10^-19; //C/electron
12 VT=kB*T/e*1000; //mV//Thermal Voltage
13 disp(VT,"Thermal Voltage(mV)")
14 format('v',6);
15 ni=1.5*10^16; //cm^-3
16 V0=VT/1000*log(NA*ND/ni^2); //V
17 disp(V0,"Barrier Voltage(V)");
18 ///Answer in the texbook is not accurate.
```

Scilab code Exa 5.4 Calculate the barrier potential

```
1 //Example 5_4
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 t1=25; //degree C
8 t2=70; //degree C
9 VB1=0.7; //V
10 delV=-0.002*(t2-t1); //V
11 VB2=VB1+delV; //V//barrier potential
12 disp(VB2,"(a) Barrier potential at 70 degree C is (V)
```

```

    )");
13 //Part (b)
14 t1=25; //degree C
15 t2=0; //degree C
16 VB1=0.7; //V
17 delV=-0.002*(t2-t1); //V
18 VB2=VB1+delV; //V// barrier potential
19 disp(VB2,"(b) Barrier potential at 0 degree C is (V)
    ");

```

Scilab code Exa 5.5 Find CT

```

1 //Example 5_5
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //Part(a) Derivation
7 //Part(b)
8 //given data :
9 mu_p=500; //cm2/V-s
10 q=1.6*10-19; //C/electron
11 rho=3; //ohm-cm
12 V0=0.4; //V// Barrier Height
13 Vd=4.5; //V// Reverse Voltage
14 D=40; //mils
15 D=D*10-3; //inch
16 D=D*2.54; //cm/in
17 A=%pi/4*D2; //cm2
18 NA=1/rho/mu_p/q; //cm-3
19 W=sqrt((V0+Vd)/(14.13*1010)); //m2
20 Vj=V0+Vd; //V
21 CT=2.9*10-4*sqrt(NA/Vj)*A; ///pF
22 disp(CT,"CT(pF) : ");
23 //Answer given in the textbook is not accurate.

```

Scilab code Exa 5.6 Compute the decrease in capacitance

```
1 //Example 5_6
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=5;//V
8 CT=20;//pF
9 lambda=CT*sqrt(V);//pm
10 //increased V=V+1.5;//V
11 V=V+1.5;//V
12 CTnew=lambda/sqrt(V);//pF
13 dCT=CT-CTnew;//pF
14 disp(dCT,"Decrease in capacitance(pF)");
15 //Answer given in the textbook is not accurate.
```

Scilab code Exa 5.7 Calculate the barrier capacitance

```
1 //Example 5_7
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 A=1.5*1.5;//mm^2
8 A=A/100;//cm^2
9 W=2*10^-4;//cm(Space charge thickness)
10 epsilon=16/(36*%pi*10^11);//F/cm(For Ge)
11 CT=epsilon*A/W*10^12;//pF
12 disp(CT,"Barrier capacitance(pF)");
```

Scilab code Exa 5.8 Width of depletion layer

```
1 //Example 5_8
2 clc;
3 clear;
4 close;
5 format('v',4);
6 //given data :
7 e=1.6*10^-19; //C/electron
8 NA=2.5*10^20; //atoms/m^3
9 epsilon=16/(36*%pi*10^9); //F/m(For Ge)
10 Vd=0.2; //V//Barrier height
11 //Part(a)
12 V0=10; //V(reverse bias)
13 W=sqrt((V0+Vd)*2*epsilon/e/NA)*10^6; //micro m
14 disp(W,"(a) Width of depletion layer(micro m)");
15 format('v',5);
16 //Part(b)
17 V0=0.1; //V(reverse bias)
18 W=sqrt((V0+Vd)*2*epsilon/e/NA)*10^6; //micro m
19 disp(W,"(b) Width of depletion layer(micro m)");
20 //Part(c)
21 V0=0.1; //V(forward bias)
22 W=sqrt((Vd-V0)*2*epsilon/e/NA)*10^6; //micro m
23 disp(W,"(c) Width of depletion layer(micro m)");
24 //Part(d)
25 A=1; //mm^2//Cross section area
26 A=A/10^6; //m^2
27 format('v',6);
28 //For (a)
29 V0=10; //V(reverse bias)
30 W=sqrt((V0+Vd)*2*epsilon/e/NA)*10^6; //micro m
31 CT=epsilon*A/(W*10^-6)*10^12; //pF
32 disp(CT,"(d)(a) Space Charge capacitance(pF) ");
```



```

33 //For (b)
34 V0=0.1; //V(reverse bias)
35 W=sqrt((V0+Vd)*2*epsilon/e/NA)*10^6; //micro m
36 CT=epsilon*A/(W*10^-6)*10^12; //pF
37 disp(CT,"(d)(b) Space Charge capacitance(pF) ");
38 //Answer given in the textbook is not accurate.

```

Scilab code Exa 5.10 Reverse saturation point

```

1 //Example 5_10
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 sigma_p=3; //(ohm-cm)^-1
8 sigma_n=0.1; //(ohm-cm)^-1
9 Ln=0.15; //cm
10 Lp=0.15; //cm
11 e=1.6*10^-19; //C/electron
12 mu_p=1800; //cm^2/V-s//For Ge
13 mu_n=3800; //cm^2/V-s//For Si
14 VT=0.026; //eV//at T=27 degree C
15 A=1.5; //mm^2
16 A=A*10^-6; //m^2
17 b=mu_n/mu_p; //unitless
18 ni=2.5*10^15; //m^-3
19 sigma_i=(mu_n+mu_p)*ni*e; //(ohm-m)^-1
20 I0=A*VT*b*sigma_i^2/(1+b)^2*(1/Lp/sigma_p+1/Ln/
    sigma_n)*10^6; //micro A
21 disp(I0,"Reverse saturation point of current(micro A
    )");

```

Scilab code Exa 5.12 Reverse saturation current

```
1 //Example 5_12
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 A=5; //mm2
8 A=A*10-2; //cm2
9 Ln=0.01; //cm
10 Lp=0.01; //cm
11 sigma_p=0.01; //(ohm-cm)-1
12 sigma_n=0.01; //(ohm-cm)-1
13 mu_p=500; //cm2/V-s //For Ge
14 mu_n=1300; //cm2/V-s //For Si
15 e=1.6*10-19; //C/electron
16 VT=0.026; //eV//at T=27 degree C
17 b=mu_n/mu_p; // unitless
18 ni=1.5*1010; //m-3
19 sigma_i=(mu_n+mu_p)*ni*e; //(ohm-m)-1
20 IO=A*VT*b*sigma_i2/(1+b)2*(1/Lp/sigma_p+1/Ln/
    sigma_n)*1012; //pA
21 disp(IO,"Reverse saturation current (pA)");
```

Scilab code Exa 5.13 Ratio of reverse saturation current

```
1 //Example 5_13
2 clc;
3 clear;
4 close;
5 format('e',9);
6 //given data :
7 Ln=0.1; //cm
8 Lp=0.1; //cm
```

```

9 e=1.6*10^-19; //C/electron
10 //For Si
11 ni=1.5*10^10; //m^-3
12 sigma_p=0.01; //(ohm-cm)^-1
13 sigma_n=0.01; //(ohm-cm)^-1
14 mu_n=1300; //cm^2/V-s //For Si
15 mu_p=500; //cm^2/V-s //For Ge
16 b=mu_n/mu_p; // unitless
17 sigma_i=(mu_n+mu_p)*ni*e; //(ohm-m)^-1
18 YSi=b*sigma_i^2/(1+b)^2*(1/Lp/sigma_p+1/Ln/sigma_n);
    //(ohm-cm^2)^-1
19 //For Ge
20 ni=2.5*10^13; //m^-3
21 sigma_p=1; //(ohm-cm)^-1
22 sigma_n=1; //(ohm-cm)^-1
23 mu_n=3800; //cm^2/V-s //For Si
24 mu_p=1800; //cm^2/V-s //For Ge
25 b=mu_n/mu_p; // unitless
26 sigma_i=(mu_n+mu_p)*ni*e; //(ohm-m)^-1
27 YGe=b*sigma_i^2/(1+b)^2*(1/Lp/sigma_p+1/Ln/sigma_n);
    //(ohm-cm^2)^-1
28 ratio=YGe/YSi;
29 disp(ratio,"Ratio of reverse saturation current in
    Ge to that in Si");
30 //Answer given in the book is not accurate.

```

Scilab code Exa 5.14 Calculate the current

```

1 //Example 5_14
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 I0=9*10^-7; //A

```

```

8 VF=0.1; //V
9 I=I0*(exp(40*VF)-1)*10^6; //micro A
10 disp(I,"Current flowing(micro A)");
11 //Answer given in the book is not accurate.

```

Scilab code Exa 5.15 Find the voltage

```

1 //Example 5_15
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 e=1.6*10^-19; //C/electron
8 J0=500; //mA/m^2
9 J0=J0/1000; //A/m^2
10 T=350; //K
11 Eta=1; //For Ge
12 k=1.38*10^-23; //Boltzman constant
13 J=10^5; //Am^-2
14 //J=J0*(exp(e*V/Eta/kT-1)
15 V=(1+log(J/J0))/e*Eta*k*T; //V
16 disp(V,"Voltage to be applied at junction(V)");
17 //Answer given in the book is not accurate.

```

Scilab code Exa 5.16 Find the current

```

1 //Example 5_16
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :

```

```

7 e=1.6*10^-19; //C/electron
8 kB=1.38*10^-23; //Boltzman constant
9 Is=0.15; //pA
10 Is=Is*10^-12; //A
11 V=0.55; //V(Forward Biased)
12 Eta=1; //Assumed
13 //At t=20 degee C
14 t=20; //degree C
15 T=t+273; //K
16 VT=kB*T/e; //V
17 I=Is*(exp(V/Eta/VT)-1)*1000; //mA
18 //At t=100 degee C
19 t=100; //degree C
20 T=t+273; //K
21 VT=kB*T/e; //V
22 //Is increased by factor 2^8
23 Is=Is*2^8; //A
24 I=Is*(exp(V/Eta/VT)-1); //A
25 disp(I,"Current in the diode(A)");

```

Scilab code Exa 5.17 Calculate the current and voltage

```

1 //Example 5_17
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 e=1.6*10^-19; //C/electron
8 kB=1.38*10^-23; //Boltzman constant
9 Eta=2; //For Si diode
10 I01=2; //micro A
11 I02=4; //micro A
12 Vz1=100; //V
13 Vz2=100; //V

```

```

14 VT=0.026; //V//Thermal temperature
15 disp("When V=90V : ");
16 V=90; //V
17 //V<Vz1 & Vz2; Breakdown will not occur
18 I1=I01/2; //micro A(For D1)
19 disp(I1,"For D1, Current is (micro A)");
20 I2=-I01/2; //micro A
21 disp(I2,"For D2, Current is (micro A)");
22 V2=Eta*VT*log(1-I01/I02); //V
23 V1=V+V2; //V
24 disp(V1,"Voltage V1(V) : ");
25 format('v',5);
26 V2=V2*1000; //mV
27 disp(V2,"Voltage V2(mV) : ");
28 disp("When V=110V : ");
29 V=110; //V
30 //V>Vz1 //D1 breakdown & D2 reverse biased
31 I=I01; //micro A
32 disp(I,"Current in the circuit is (micro A)");
33 V1=-Vz1; //V
34 V2=-(V-Vz2); //V
35 disp(V1,"Voltage V1(V) : ");
36 disp(V2,"Voltage V1(V) : ");

```

Scilab code Exa 5.18 Ratio of current

```

1 //Example 5_18
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 e=1.6*10^-19; //C/electron
8 VT=0.026; //V//Thermal Voltage
9 IBYIO=-90/100; //ratio

```

```

10 //Part (a)
11 //I=I0*(exp(V/VT)-1)
12 V=log(IBYI0+1)*VT;//V
13 disp(V,"(a) Required Voltage is (V)");
14 //Part (b)
15 format('v',5);
16 V=0.05;//V(Forward bias)
17 ratio=(exp(V/VT)-1)/(exp(-V/VT)-1);//ratio
18 disp(ratio,"(b) Current ratio");
19 //Part (c)
20 format('v',6);
21 I0=15;//micro A
22 V=[0.1 0.2 0.3]*1000;//mV
23 VT=VT*1000;//mV
24 I1=I0*(exp(V(1)/VT)-1)/1000;//mA
25 I2=I0*(exp(V(2)/VT)-1)/1000;//mA
26 I3=I0*(exp(V(3)/VT)-1)/10^6;//A
27 disp("(c) Current for 0.1 V is "+string(I1)+" mA,
      for 0.2 V is "+string(I2)+" mA & for 0.3 V is "+
      string(I3)+" A.");
28 //Answer given in the book is not accurate.

```

Scilab code Exa 5.19 Calculate the anticipated factor

```

1 //Example 5_19
2 clc;
3 clear;
4 close;
5 format('v',4);
6 //given data :
7 //Part (a)
8 t1=25;//degree C
9 t2=70;//degree C
10 I0t2BYI0t1=2^((t2-t1)/10+1);//anticipated factor
11 disp(I0t2BYI0t1,"(a) Anticipated factor");

```

```

12 disp(" I0 (70 degree C) = "+string(I0t2BYI0t1)+"*I0 (25
    degree C)");
13 //Part (b)
14 format('v',6)
15 t1=25;//degree C
16 t2=150;//degree C
17 I0t2BYI0t1=2^((t2-t1)/10);//anticipated factor
18 disp(I0t2BYI0t1,"(b) Anticipated factor");
19 disp(" I0 (150 degree C) = "+string(I0t2BYI0t1)+"*I0
    (25 degree C)");
20 //Answer in the textbook is not accurate.

```

Scilab code Exa 5.20 Leakage resistance

```

1 //Example 5_20
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 I=5;//micro A
8 V=10;//V
9 //1/I0*dI0/dT=0.15 & 1/I*dI0/dT=0.07
10 I0=I/(0.15/0.07);//micro A
11 //I=I0+IR
12 IR=I-I0;//micro A
13 R=V/IR;//Mohm
14 disp(R,"Leakage Resistance (Mohm)");

```

Scilab code Exa 5.21 Maximum reverse bias voltage

```

1 //Example 5_21
2 clc;

```



```

3 clear;
4 close;
5 format('v',5);
6 //given data :
7 Rt=0.15; //mW/degree C(Thermal resistance)
8 t1=25; //degree C
9 IO_t1=5; //micro A(at 25 degree C)
10 deltt=10; //degree C
11 t2=t1+deltt; //degree C
12 Pout=Rt*(t2-t1); //mW
13 //reverse current doubles at evry 10 degree C
14 IO_t2=2*IO_t1; //micro A
15 V=Pout/(IO_t2/1000); //V
16 disp(V,"Maximum reverse bias voltage(V)");

```

Scilab code Exa 5.22 Current multiplying factor

```

1 //Example 5_22
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=0.4; //V(Forward voltage)
8 t1=25; //degree C
9 t=150; //degree C
10 T=t+273; //K
11 T1=t1+273; //K
12 VT=T/11600; //V
13 //IOT=I01*2^((T-T1)/10)
14 IOTBYIOT1=2^((T-T1)/10); //ratio of current
15 Eta=2; //for Si
16 I2ByIOT=(exp(V/Eta/VT)-1); //ratio of current
17 //At 25 degree C
18 VT1=T1/11600; //V

```

```

19 I1ByIOT1=(exp(V/Eta/VT1)-1);//A///at 25 degree C
20 I2ByI1=I2ByIOT/I1ByIOT1*IOTBYIOT1;///ratio of I2 &
    I1
21 disp(I2ByI1,"Current multiplying factor is ");
22 //Note : Solution is complete in this code.
23 //In the textbook, extra lines are given for which
    data is not given.

```

Scilab code Exa 5.24 Diffusion Length

```

1 //Example 5_24
2 clc;
3 clear;
4 close;
5 format('e',10);
6 //given data :
7 I=1;///mA
8 CD=1.5;///micro F
9 Eta=2;///for Si
10 Dp=13;///for Si
11 VT=0.026;///V(Thermal voltage)
12 Lp=sqrt(CD/10^6*Dp*Eta*VT/(I*10^-3));///m
13 disp(Lp,"Diffusion Length(m)");

```

Scilab code Exa 5.25 Find the static resistance

```

1 //Example 5_25
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 I0=20;///micro A

```

```

8 VF=0.2; //V
9 t=27; //degree C
10 T=t+273; //K
11 VT=T/11600; //V(Thermal voltage)
12 Eta=1; //for Ge
13 I=I0*10^-6*[exp(VF/Eta/VT) -1]*1000; //mA
14 rdc=VT/(I0*10^-6)*exp(VF/Eta/VT)/10^6; //Mohm
15 disp(rdc," Static Resistance(Mohm) : ");
16 //Note : Answer & Solution in the textbook is wrong
    as they calculated rdc for the values given in
    next example.
17 //I0 taken 80micro A instead 20 micro A & VT taken
    for 125 degree C instead 25 degree C.

```

Scilab code Exa 5.26 Find the dynamic resistance

```

1 //Example 5_26
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 I0=80; //micro A
8 t=125; //degree C
9 T=t+273; //K
10 Eta=1; //for Ge
11 VF=0.2; //V
12 VT=T/11600; //V(Volt equivalent of temperature)
13 ///Part(a) In forward direction
14 Rac=VT/(I0*10^-6)*exp(-VF/Eta/VT); //ohm
15 disp(Rac,"(a) Dynamic Resistance in forward diection
    (ohm) : ");
16 ///Part(b) In reverse direction
17 format('v',8);
18 Rac=VT/(I0*10^-6)*exp(VF/Eta/VT)/10^6; //Mohm

```

```
19 disp(Rac,"(b) Dynamic Resistance in reverse diection
    (Mohm) : ");
20 //Answer in the textbook is not accurate.
```

Scilab code Exa 5.27 Determine ac resistance

```
1 //Example 5_27
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 I0=1.5;///micro A
8 T=300;///K
9 VF=150;///mV
10 kB=8.62*10^-5;///Boltzman Constant
11 VT=T/11600;///V(Volt equivalent of temperature)
12 rac=1/(I0*10^-6/kB/T*exp(VF/1000/VT));
13 disp(rac,"Ac resistance(ohm)")
14 //Answer and unit in the textbok is wrong.
```

Scilab code Exa 5.28 Maximum allowable current

```
1 //Example 5_28
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 Pmax=2.5;///W
8 Vf=900;///mV
9 If_max=Pmax/(Vf/1000);///A
```

```

10 disp(If_max,"(a) Maximum allowable forward current(A
    ) : ");
11 Rf=Pmax/If_max^2;//ohm
12 format('v',7);
13 disp(Rf,"(b) Forward Diode Resistance(ohm)")
14 //Answer in the textbok is wrong.

```

Scilab code Exa 5.29 Height of potential barrier

```

1 //Example 5_29
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 //for Ge diode
8 rho_p=2;//ohm-cm(p-side resistivity)
9 rho_n=1;//ohm-cm(n-side resistivity)
10 e=1.6*10^-19;//C/electron
11 mu_p=1800;//m^2/V-s
12 mu_n=3800;//m^2/V-s
13 VT=0.026;//V(Thermal Voltage)
14 ni=2.5*10^13;//per cm^3(intrinsic concentration)
15 NA=1/(rho_p*e*mu_p);//per cm^3
16 ND=1/(rho_n*e*mu_n);//per cm^3
17 V0=VT*log(ND*NA/ni^2);//eV
18 disp(V0,"(a) Height of potential barrier(eV) : ");
19 //for Si diode
20 format('v',6);
21 mu_p=500;//m^2/V-s
22 mu_n=1300;//m^2/V-s
23 ni=1.5*10^10;//per cm^3(intrinsic concentration)
24 NA=1/(rho_p*e*mu_p);//per cm^3
25 ND=1/(rho_n*e*mu_n);//per cm^3
26 V0=VT*log(ND*NA/ni^2);//eV

```

```
27 disp(v0,"(b) Height of potential barrier(eV) : ");
```

Scilab code Exa 5.30 Find the dynamic resistance

```
1 //Example 5_30
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 t=125;//degree C
8 T=t+273;//K
9 Eta=1;//for Ge
10 VF=0.2;//V
11 VT=T/11600;//V(Volt equivalent of temperature)
12 I0=35;//micro A
13 //Part(a) Forward Direction
14 r=VT/(I0*10^-6)/exp(VF/VT);//ohm
15 disp(r,"(a) Dynamic Resistance in forward direcion(
    ohm) : ");
16 //Part(b) Reverse Direction
17 r=VT/(I0*10^-6)/exp(-VF/VT);//ohm
18 r=r/10^6;//Mohm
19 disp(r,"(b) Dynamic Resistance in reverse direcion(
    Mohm) : ");
20 ///Answer in the textbook is not accurate.
```

Scilab code Exa 5.31 Maximum and minimum zener current

```
1 //Example 5_31
2 clc;
3 clear;
4 close;
```

```

5 format('v',6);
6 //given data :
7 Vz=10;//V
8 Rs=1;//kohm
9 RL=10;//kohm
10 IL=5;//mA(Assumed)
11 Vi=25:40;//V
12 RLmin=Rs;//kohm
13 Iz=(max(Vi)-Vz)/RLmin-IL;//mA
14 disp(Iz,"(a) Maximum value of zener current(mA) : ")
    ;
15 Iz_min=(min(Vi)-Vz)/Rs-IL;//mA
16 disp(Iz_min,"(b) Minimum value of zener current(mA)
    : ");

```

Scilab code Exa 5.32 Find the range of R

```

1 //Example 5_32
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Vz=5;//V
8 Pmax=250;//mW
9 Vs=15;//V(Supply voltage)
10 PL=50;//W(Load)
11 Imax=Pmax/Vz;//mA(Maximum permissible current)
12 //Minimum current to maintain constant voltage
13 Imin=Imax-Imax*10/100;//mA
14 Rmin=Vs/Imax;//kohm
15 Rmax=Vs/Imin;//kohm
16 disp("For maintainng constant voltage , Range of R is
    "+string(Rmin)+" kohm to "+string(Rmax)+" kohm."
    );

```

```

17 //Diode loaded with 50W load
18 Imax=PL/Vz; //mA(Maximum permissible current)
19 //Minimum current to maintain constant voltage
20 Imin=Imax-Imax*10/100; //mA
21 Rmin=Vs/Imax; //kohm
22 Rmax=Vs/Imin; //kohm
23 disp("New range of R is "+string(Rmin)+" kohm to "+
      string(Rmax)+" kohm.");
24 //Solution is not complete in the textbook.

```

Scilab code Exa 5.33 Find out breakdown voltage

```

1 //Example 5_33
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 ND=2*1015; //cm-3
8 Ep=1.5*105; //V/cm
9 epsilon=8.854*10-14; //Permittivity
10 e=1.6*10-19; //C/electron
11 //Width of depletion region
12 W=Ep*11.9*epsilon/e/ND;
13 VBR=W*Ep/2; //V
14 disp(VBR," Breakdown Voltage (V) : ");

```

Scilab code Exa 5.35 Breakdown Voltage

```

1 //Example 5_35
2 clc;
3 clear;
4 close;

```



```

5 format('v',4);
6 //given data :
7 Ez=2*10^7; ///V/m
8 //Vz=epsilon*Ez^2/(2*e*NA)
9 //e*NA=sigp/mu_p; as sigp=NA*e*mu_p
10 epsilon=16/(36*%pi*10^9); //F/m
11 mu_p=1800; //cm^2/V-s
12 sigp=poly(0,'sigp'); //Notation : sigp=sigma_p
13 Vz=epsilon*Ez^2/2*mu_p*10^-6/sigp; //V
14 disp(Vz,"(a) Breakdown Voltage calculated and proved
      as ");
15 format('v',6);
16 sigma_i=1/45; //(ohm-cm)^-1
17 sigma_p=sigma_i; //(ohm-cm)^-1//as p-material is
      intrinsic
18 Vz=51/sigma_p; //V
19 disp(Vz,"(b) Vz(V) : ");
20 sigma_p=1/3.9; //(ohm-cm)^-1
21 Vz=51/sigma_p; //V
22 disp(Vz,"(c) Vz(V) : ");
23 //Part (d)
24 Vz=1.5; ///V
25 sigma_p=51/Vz; //V
26 disp(sigma_p,"(d) Resistivity(ohm-cm)^-1 : ");
27 //Note : Part(b) answer wrong in the book & part(d)
      not complete.
28 //Note : sigp is used instead sigma_p as poly
      support only less than 5 character.

```

Scilab code Exa 5.36 Voltage across junction

```

1 //Example 5_36
2 clc;
3 clear;
4 close;

```

```

5 format('v',5);
6 //given data :
7 Eta=1;//for Ge
8 T=300;//K
9 VT=0.026;//V(Thermal Voltage)
10 VF=5;//V
11 //I=I0;/// given
12 IByI0=1;//ratio
13 //Using I=I0*(exp(V/VT)-1)
14 V=log(IByI0+1)*VT;//V
15 V2=VF-V;//V(Voltage across 2nd diode)
16 disp(V2,"(a) Voltage across each junction(V) : ");
17 //Part (b)
18 format('v',6);
19 Vz=4.9;//V
20 Vrb=Vz;//V(Across reverse biased diode)
21 V2=VF-Vrb;//V
22 I0=6;//micro A
23 I=I0*(exp(V2/VT)-1);//micro A
24 disp(I,"(b) Current in the circuit(micro A) : ");
25 //Note : Answer in the textbook is not accurate.

```

Scilab code Exa 5.37 Find out ideality factor

```

1 //Example 5_37
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 I1=0.5;//mA
8 V1=340;//mV
9 I2=15;//mA
10 V2=465;//mV
11 kBTBye=25;//mV(It is kB*T/e)

```

```

12 //I=Is*(exp(V/Eta/kBTBye)-1)
13 Eta=(V2/kBTBye-V1/kBTBye)/log(I2/I1); //neglecting 1
    as exp(V/Eta/kBTBye)>>1
14 disp(Eta,"Ideality Factor(Eta) : ");

```

Scilab code Exa 5.38 Temperature coefficient

```

1 //Example 5_38
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 Vd=12; //V
8 TC1=-1.7; //mV/degree C(Temperatre Coefficient of Si
    diode)
9 //For series combination to have TC=0
10 TC2=-TC1; //mV/degree C(Temperatre Coefficient of
    Avalanche diode)
11 //In percentage
12 TC2=TC2*10^-3/Vd*100; //%/degree C
13 disp(TC2,"Required temperature coefficient(%/degree
    C) : ");

```

Scilab code Exa 5.39 Calculate R

```

1 //Example 5_39
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 //For IL=0; //A

```

```

8 V0=60; //V
9 V=200; //V(Supply Voltage)
10 ID=5:40; //mA
11 R=(V-V0)/max(ID); //kohm(R is >= this value)
12 //For IL=ILmax; //A
13 IT=max(ID); //mA
14 ID=min(ID) //mA(ID<=this value)
15 Imax=IT-ID; //mA
16 disp(Imax, "(a) Imax(mA) : ");
17 //Part (b)
18 IL=25; //mA
19 ID=5:40; //mA
20 //Taking minimum current for good regulation
21 IT=min(ID)+IL; //mA
22 Vmax1=IT*R+V0; //V
23 //Taking maximum current for good regulation
24 IT=max(ID)+IL; //mA
25 Vmax2=IT*R+V0; //V
26 disp("(b) Without loss of regulation , V may vary
      from "+string(Vmax1)+" V to "+string(Vmax2)+" V."
      );

```

Chapter 6

Diode Circuits

Scilab code Exa 6.1 Find the current

```
1 //Example 6_1
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 I0=10;//micro A
8 Vz=100;//V
9 R=1.5;//kohm
10 V=45;//V
11 ///Part(a)
12 I=V/R;//mA(neglecting diode threshold voltage)
13 //I=I0*(exp(38.4*V)-1)//Diode Current Equation
14 Vd=(log(I*10^-3/(I0*10^-6)+1))/38.4;//V(Diode
    Voltage)
15 //Now calculating I again
16 I=(V-Vd)/R;//mA
17 disp(I,"(a) If diode is forward biased , Current(mA)"
    );
18 //Part(b)
19 Vd=-V;//V(for reverse polarity of battery)
```

```

20 I=-I0;//micro A
21 //Voltage drop across resistor neglected
22 disp(I,"(b) If battery inserted with reverse
    polarity , Current(micro A)");
23 //Part(c)
24 Vz=10;//V
25 //in forward direction behaviour will remain same
26 I=V/R;//mA(neglecting diode threshold voltage)
27 //I=I0*(exp(38.4*V)-1)//Diode Current Equation
28 Vd=(log(I*10^-3/(I0*10^-6)+1))/38.4;//V(Diode
    Voltage)
29 //Now calculating I again
30 I=(V-Vd)/R;//mA
31 disp(I,"(c) If diode is forward biased , Current(mA)"
    );
32 //reverse direction
33 //load line dataV=30;//
34 V=30;//V
35 I=-30;//mA
36 V1=20;//V//from Load Line
37 Idash=I*V1/V;//A
38 disp(Idash,"(c) If battery inserted with reverse
    polarity , Current(mA)");
39 //Answer in the book is not accurate ,

```

Scilab code Exa 6.2 Find the current

```

1 //Example 6_2
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V=100;//V
8 //For diode D1

```

```

 9 V1gamma=0.2; //V
10 r1=20; //ohm
11 //For diode D2
12 V2gamma=0.6; //V
13 r2=15; //ohm
14 //Part(a)
15 //Assume D1 & D2 are ON
16 R=10; //kohm
17 //Writing loop equations
18 //V=(R+r1/1000)*I1+R*I2+V1gamma;(eqn(1))
19 A1=[(R+r1/1000) R]; //Coefficient matrix
20 B1=[V-V1gamma]; //Coefficient matrix
21 //V=(R+r2/1000)*I2+R*I1+V2gamma;(eqn(2))
22 A2=[R (R+r2/1000)]; //Coefficient matrix
23 B2=[V-V2gamma]; //Coefficient matrix
24 A=[A1;A2]; //Coefficient matrix
25 B=[B1;B2]; //Coefficient matrix
26 X=A^-1*B; //solution matrix
27 I1=X(1); //mA
28 I2=X(2); //mA
29 if I2<0 then
30     disp("I2<0, Assumption D2 is ON, not valid.")
31 //Assume D1 is ON & D2 is OFF
32 I2=0; //A
33 I1=(V-V1gamma)/(R+r1/1000); //mA
34 disp(I2,I1,"(a) Diode current I1 & I2 in mA are : ")
    ;
35 end;
36 //Part(b)
37 format('v',7);
38 //Assume D1 & D2 are ON
39 R=1.5; //kohm
40 //Writing loop equations
41 //V=(R+r1/1000)*I1+R*I2+V1gamma;(eqn(1))
42 A1=[(R+r1/1000) R]; //Coefficient matrix
43 B1=[V-V1gamma]; //Coefficient matrix
44 //V=(R+r2/1000)*I2+R*I1+V2gamma;(eqn(2))
45 A2=[R (R+r2/1000)]; //Coefficient matrix

```

```

46 B2=[V-V2gamma]; // Coefficient matrix
47 A=[A1;A2]; // Coefficient matrix
48 B=[B1;B2]; // Coefficient matrix
49 X=A^-1*B; // solution matrix
50 I1=X(1); //mA
51 I2=X(2); //mA
52 disp(I2,I1,"(b) Diode current I1 & I2 in mA are : ")
    ;

```

Scilab code Exa 6.3 Calculate the break region

```

1 //Example 6_3
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 r1BYr2=10000; //multiplying factor
8 //r=Eta*VT/I0*eps^(-V/Eta/VT)
9 //log(r1BYr2)=(-V1/Eta/VT)/(-V2/Eta/VT)=delV/Eta/VT
10 VT=26; //mV
11 Eta=2; //for silicon
12 delV=log(r1BYr2)*Eta*VT;
13 disp(delV,"Break region for Si(mV)");
14 Eta=1; //for Germanium
15 delV=log(r1BYr2)*Eta*VT;
16 disp(delV,"Break region for Ge(mV)");
17 //Answer in the book is not accurate.

```

Scilab code Exa 6.4 Peak and dc load current

```

1 //Example 6_4
2 clc;

```



```

3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Rf=30;//ohm
8 RL=990;//ohm
9 Vrms=110;//V
10 //Part (a)
11 Vm=Vrms*sqrt(2);//V
12 Im=Vm/(Rf+RL)*1000;//mA
13 disp(Im,"(a) Peak Load Current(mA)");
14 //Part (b)
15 format('v',5);
16 Idc=Im/%pi;//mA
17 disp(Idc,"(b) The dc Load Current(mA)");
18 //Part (c)
19 Irms=Im/2;//mA
20 disp(Irms,"(c) The ac Load Current(mA)");
21 //Part (d)
22 format('v',4);
23 Vdc=-Im*RL/1000/%pi;//mA
24 disp(Vdc,"(d) The dc diode Voltage(mV)");
25 //Part (e)
26 format('v',5);
27 Pi=(Irms*10^-3)^2*(Rf+RL);//W
28 disp(Pi,"(e) Total Input Power(W)");
29 //Part (f)
30 format('v',6);
31 VNL=Vm/%pi;//V
32 VFL=Idc*RL/1000;//V
33 Reg=(VNL-VFL)/VFL*100;//%(Regulation)
34 disp(Reg,"(f) % Regulation(%)");
35 //Answer not accurate in the book & unit of answer
    for part(d) is wrong.

```

Scilab code Exa 6.8 dc load current and power

```
1 //Example 6_8
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 Rf=500; //ohm
8 RL=2000; //ohm
9 Vrms=280; //V
10 Vm=Vrms*sqrt(2); //V
11 //Part (a)
12 Idc=2*Vm/%pi/(Rf+RL); //A
13 Idc=Idc*1000; //mA
14 disp(Idc,"(a) The dc load current(mA) : ");
15 //Part (b)
16 Idc_tube=Idc/2; //mA
17 disp(Idc_tube,"(b) Direct current in each tube(mA) :
    ");
18 //Part (c)
19 v2=Vm*Rf/(Rf+RL); //V
20 v1=-2*Vm+v2; //V
21 Vrms=sqrt(1/2/%pi*integrate('v2^2*(sin(alfa))^2','
    alfa',0,%pi)+1/2/%pi*integrate('v1^2*(sin(alfa))
    ^2','alfa',%pi,2*%pi)); //V
22 Vrms=floor(Vrms); //V
23 disp(Vrms,"(c) The ac voltage across each diode(V) :
    ");
24 //Part (d)
25 Pdc=(Idc/1000)^2*RL; //W
26 disp(Pdc,"(d) The dc output power(W) : ");
27 //Part(e)
28 Reg=Rf/RL*100; // %
29 disp(Reg,"(e) % Regulation : ");
30 //Answer in the textbook is not accurate.
```

Scilab code Exa 6.10 Full scale reading

```
1 //Example 6_10
2 clc;
3 clear;
4 close;
5 format('v',4);
6 Rm=20;//ohm(meter resistance)
7 Rs=5;//kohm(series resistance)
8 Im=1;//mA
9 Idc=2*Im/%pi;//mA
10 RL=Rm+Rs*1000;//ohm
11 Vm=Idc/1000*%pi*RL/2;//V
12 v0_max=2*sqrt(2)*Vm;//V
13 disp(v0_max,"Full scale reading(V) : ");
```

Scilab code Exa 6.11 dc output voltage and PIV

```
1 //Example 6_11
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 V1=220;//V
8 N1ByN2=10/1;//turns ratio
9 V2=V1/N1ByN2;//V
10 Vm=sqrt(2)*V2;//V
11 Vdc=0.318*Vm;//V
12 disp(Vdc,"(a) dc output voltage(V) : ");
13 format('v',6);
14 PIV=Vm;//V
```

```
15 disp(PIV,"(b) PIV(V) : ");
```

Scilab code Exa 6.12 Maximum and average Power

```
1 //Example 6_12
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 V1=230;//V
8 N2ByN1=1/3;//turns ratio
9 RL=200;//ohm
10 V2=V1*N2ByN1;//V
11 Vm=sqrt(2)*V2;//V
12 Im=Vm/RL;//A
13 Pmax=Im^2*RL;//W
14 disp(Pmax,"Maximum load power(W) : ");
15 format('v',5);
16 Vdc=0.318*Vm;//V
17 Idc=Vdc/RL;//A
18 Pdc=Idc^2*RL;//W
19 disp(Pdc,"Average value of load power(W) : ");
20 //Answer in the textbook is not accurate.
```

Scilab code Exa 6.13 Maximum value of voltage

```
1 //Example 6_13
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
```

```

7 Vdc=30; //V
8 rf=25; //ohm
9 RL=500; //ohm
10 Idc=Vdc/RL; //A
11 Im=%pi*Idc; //A
12 Vi_max=Im^2*(rf+RL); //V
13 disp(Vi_max," Voltage required at input(V) : ");
14 //Answer in the textbook is not accurate.

```

Scilab code Exa 6.14 AC voltage and efficiency

```

1 //Example 6_14
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 Vdc=100; //V
8 rf=20; //ohm
9 RL=500; //ohm
10 Idc=Vdc/RL; //A
11 Im=%pi*Idc; //A
12 Vm=Im*(RL+rf); //V
13 disp(Vm," (a) The ac voltage required(V) : ");
14 format('v',5);
15 Eta=0.406/(1+rf/RL)*100; //%(Rectification Efficiency
)
16 disp(Eta," Rectification Efficiency (%) : ");

```

Scilab code Exa 6.15 dc output voltage

```

1 //Example 6_15
2 clc;

```

```

3 clear;
4 close;
5 format('v',4);
6 //given data :
7 //v=50*sin(100*%pi*t)
8 Vm=50;//V
9 f=50;//Hz
10 rf=20;//ohm
11 RL=5000;//ohm
12 Im=Vm/(rf+RL)*1000;//mA
13 disp("(a) Current is "+string(Im)+"*sin(100*%pi*t)
      for %pi <100*%pi*t<2*%pi & it will be zero for 0
      <100*%pi*t<%pi");
14 format('v',5);
15 Vdc=Im/1000/%pi*RL;//V
16 disp("(b) Output Voltage , Vo = "+string(Vdc)+"*sin
      (100*%pi*t) for %pi <100*%pi*t<2*%pi & it will be
      zero for 0 <100*%pi*t<%pi ");
17 //Assuming diode is ideal
18 disp("(c) Voltage across diode , v = "+string(Vdc)+"*
      sin(100*%pi*t) for 0 <100*%pi*t<%pi & it will be
      zero for %pi <100*%pi*t<2*%pi ");

```

Scilab code Exa 6.16 Value of capacitance

```

1 //Example 6_16
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 Vrms=230;//V
8 f=50;//Hz
9 Gamma=0:0.001:0.005;//Ripple factor (Gamma<=0.005)
10 IL=0.5;//A

```

```

11 Gamma=Gamma(4); //Taken for the solution
12 Vm=sqrt(2)*Vrms; //V
13 Vdc=Vm/%pi; //V
14 Idc=IL; //A
15 RL=Vdc/Idc; //ohm
16 C=1/(2*sqrt(3)*f*RL*Gamma)*1000; //mF
17 disp(C," Value of capacitance(mF) : ");
18 //Answer in the textbook is not accurate.

```

Scilab code Exa 6.17 calculate ripple factor

```

1 //Example 6_17
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 RL=3.15; //kohm
8 rf=20; //ohm
9 //v=230*sin(314*t)
10 Vm=230; //V
11 f=50; //Hz
12 Irms=0.707*Vm/(rf+RL*1000); //A
13 Im=Vm/(rf+RL*1000); //A
14 Idc=0.637*Im
15 Gamma=sqrt((Irms/Idc)^2-1); //Ripple factor
16 disp(Gamma," Ripple factor : ");

```

Scilab code Exa 6.18 dc output voltage and frequency

```

1 //Example 6_18
2 clc;
3 clear;

```

```

4  close;
5  format('v',4);
6  //given data :
7  Vp=230;//V
8  fin=50;//Hz
9  RL=200;//ohm
10 NsByNp=1/4;//turns ratio
11 Vs=Vp*NsByNp;//V
12 Vrms=Vs;//V
13 Vm=Vrms*sqrt(2);//V
14 Idc=2*Vm/%pi/RL;//A
15 RL=150;//ohm
16 Vdc=Idc*RL;//V
17 disp(Vdc,"dc output Voltage(V) : ");
18 //Because of two output pulses
19 fout=2*fin;//Hz
20 disp(fout,"Pulse frequency of the output(Hz) : ");

```

Scilab code Exa 6.19 Maximum dc voltage

```

1  //Example 6_19
2  clc;
3  clear;
4  close;
5  format('v',5);
6  //given data :
7  Vp=220;//V
8  fi=50;//Hz
9  RL=1.5;//kohm
10 Np=1000;//turns
11 Ns=100;//turns
12 Vs=Vp*Ns/Np;//V
13 Vrms=Vs*sqrt(2);//V
14 Vm=Vrms/2;//V(Across half secondary winding)
15 Idc=2*Vm/%pi/(RL*1000);//A

```



```
16 Vdc=Idc*RL*1000; //V
17 disp(Vdc,"dc output Voltage(V) : ");
18 //Answer in the textbook is not accurate.
```

Scilab code Exa 6.20 Calculate input voltage

```
1 //Example 6_20
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 Vdc=30; //V
8 RL=1; //kohm
9 Gamma=0.015; //Ripple factor
10 Idc=Vdc/RL; //mA
11 C=2900/Gamma/(RL*1000); //micro F
12 disp(C,"Filter capacitor(micro F) : ");
13 format('v',6);
14 Vm=Vdc+5000*Idc/1000/C; //V
15 V2=2*Vm/sqrt(2); //V
16 disp(V2,"Required input Voltage(V) : ");
17 //Answer in the textbook is not accurate.
```

Scilab code Exa 6.21 Inductance and output voltage

```
1 //Example 6_21
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 IL=0.1; //A
```

```

8 C=40; ///micro F
9 R=40; //ohm
10 Vrms=40; //V
11 Gamma=0.0001; //Ripple factor
12 n=2; //For 2 stage filter
13 L=1.76/C*(0.472/Gamma)^(1/n); //H
14 disp(L,"(a) Value of inductance(H) : ");
15 Vdc=2*sqrt(2)*Vrms/%pi-IL*R; //V
16 disp(Vdc,"(b) Output Voltage(V) : ");

```

Scilab code Exa 6.22 dc output voltage and ripple voltage

```

1 //Example 6_22
2 clc;
3 clear;
4 close;
5 format('v',7);
6 //given data :
7 IL=50; //micro A
8 C=4; ///micro F
9 C1=4; ///micro F
10 L=20; ///H(Choke Inductance)
11 R=200; //ohm(Choke Resistance)
12 V=300; //V
13 Idc=IL/1000; //mA
14 Vdc=V*sqrt(2)-4170*Idc/C-Idc*R; //V
15 disp(Vdc,"Output Voltage(V) : ");
16 r=3300*Idc/C/C1/L/R; //Ripple factor
17 Vrms=r*Vdc; //V
18 disp(Vrms,"Ripple Voltage(V) : ");
19 //Answer in the textbook is wrong. calculation &
    value putting mistake.

```

Chapter 7

BJT Fundamentals

Scilab code Exa 7.1 Base and collector current

```
1 //Ex_7_1
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',6);
7 alfa=0.90;//current gain
8 ICO=15;//micro A(reverse saturation current)
9 IE=4;//mA(Emitter current)
10 IC=ICO*10^-3+alfa*IE;//mA
11 IB=IE-IC;//mA
12 IB=IB*1000;//micro A
13 disp(IC," Collector Current (mA)");
14 disp(IB," Base Current (micro A)");
```

Scilab code Exa 7.2 Value f alfa

```
1 //Ex_7_2
```

```

2  clc;
3  clear;
4  close;
5  //given data :
6  format('v',6);
7  Beta=90; // unitless
8  IC=4; //mA(Collector Current)
9  alfa=Beta/(1+Beta); //current gain
10 IB=IC/Beta; //mA(Base Current)
11 IE=IC+IB; //mA(Emitter current)
12 disp(alfa,"Value of alfa");
13 disp(IB*1000,"Base Current(micro A)");
14 disp(IE,"Emmitter Current(mA)");

```

Scilab code Exa 7.3 Calculate the collector current

```

1  //Ex_7_3
2  clc;
3  clear;
4  close;
5  format('v',6);
6  //given data :
7  alfa=0.90; //current gain
8  IC0=15; //micro A(reverse saturation current)
9  IB=0.5; //mA(Base Current)
10 Beta=alfa/(1-alfa); //unitless
11 IC=Beta*IB+(1+Beta)*IC0/1000; //mA(Collector Current)
12 disp(IC,"Collector Current(mA)");

```

Scilab code Exa 7.4 Value of Beta

```

1  //Ex_7_4
2  clc;

```

```

3 clear;
4 close;
5 format('v',6);
6 //given data :
7 IB=20;///micro A(Base Current)
8 IC=5;///mA(Collector Current)
9 Beta=IC*1000/IB;///unitless
10 disp(Beta,"Beta=");

```

Scilab code Exa 7.5 Value of IE

```

1 //Ex_7_5
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 IB=50;///micro A(Base Current)
8 IC=5;///mA(Collector Current)
9 IE=IC+IB/1000;///mA
10 Beta=IC*1000/IB;///unitless
11 alfa=IC/IE;///current gain
12 disp(IE,"Emitter Current(mA)");
13 disp(Beta,"Beta=");
14 disp(alfa,"alfa=");
15 disp("Verify that alfa=Beta/(Beta+1)");
16 disp(string(alfa==Beta/(Beta+1)));
17 disp("Verify that Beta=alfa/(1-alfa)");
18 disp(string(Beta==round(alfa/(1-alfa))));

```

Scilab code Exa 7.6 Value of alfa and beta

```

1 //Ex_7_6

```

```

2  clc;
3  clear;
4  close;
5  format('v',6);
6  //given data :
7  IE=10; //mA
8  IB=5; //mA(Base Current)
9  IC=IE-IB; //mA(Collector Current)
10 BetaR=IC/IB; //unitless
11 alfaR=IC/IE; //current gain
12 disp(BetaR,"BetaR=");
13 disp(alfaR,"alfaR=");
14 //Answer is wrong in the book.

```

Scilab code Exa 7.7 Find current and voltage

```

1  //Ex_7_7
2  clc;
3  clear;
4  close;
5  format('v',6);
6  //given data :
7  Beta=100; //unitless
8  VBE=0.7; //V
9  VCC=10; //V
10 // (a) VE=-0.7; //V
11 disp("For the circuit in fig(a)");
12 VE=-0.7; //V(Constant voltage)
13 R1=10; //kohm
14 R2=10; //kohm
15 IE=(VCC+VE)/R2; //mA
16 IB=IE/(Beta+1); //mA
17 VC=VCC-R1*1000*(IE-IB)/1000; //V
18 disp(VE,"Constant voltage fo the given transistor ,
      VE(V)");

```

```

19 disp(IE,"Emitter current(mA)");
20 format('v',5);
21 IB=IB*1000;///micro A
22 disp(IB,"Base current(micro A)");
23 format('v',6);
24 disp(VC,"VC(V)");
25
26 //(b) VE=-0.7;///V
27 R1=5;///kohm
28 R2=5;///kohm
29 VEE=-15;///V
30 disp("For the circuit in fig(b)");
31 VE=-0.7;///V(Constant voltage)
32 R1=5;///kohm
33 R2=5;///kohm
34 IE=(VCC+VE)/R2;///mA
35 IC=IE*Beta/(Beta+1);///mA
36 VC=VEE+R2*IC;///V
37 disp(VE,"Constant voltage fo the given transistor ,
      VE(V)");
38 disp(IE,"Emitter current(mA)");
39 disp(IC,"Base current(mA)");
40 format('v',5);
41 disp(VC,"VC(V)");

```

Scilab code Exa 7.8 Find the voltage

```

1 //Ex_7_8
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Beta=%inf;///Current gain
8 VBE=0.7;///V

```

```

9 VB=0; //V(For large Beta)
10 VE=VB-VBE; //V
11 disp(VE,VB,"(a) Value of VB(V) & VE(V) are : ");
12 //Part (b)
13 R1=5; //kohm
14 R2=5; //kohm
15 VCC=10; //V
16 VEE=-15; //V
17 VE=VBE; //V
18 VC=VEE+R1/R2*(VCC-VBE); //V
19 disp(VC,VE,"(b) Value of VE(V) & VC(V) are : ");

```

Scilab code Exa 7.9 Find VB IB IE IC

```

1 //Ex_7_9
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 VEE=5; //V
8 VCC=-5; //V
9 VE=1; //V
10 RB=20; //kohm
11 RE=5; //kohm
12 RC=5; //kohm
13 VBE=0.7; //V
14 VB=VE-VBE; //V
15 IB=VB/RB; //mA
16 IE=(VEE-VE)/RE; //mA
17 IC=IE-IB; //mA
18 VC=VCC+IC*RC; //V
19 Beta=IC/IB; //Current gain
20 Alfa=IC/IE; //Current gain
21 disp(VB,"VB(V) : ");

```



```
22 disp(IB," IB(mA) : ");
23 disp(IE," IE(mA) : ");
24 disp(IC," IC(mA) : ");
25 format('v',5);
26 disp(Beta," Beta : ");
27 disp(Alfa," Alfa : ");
```

Scilab code Exa 7.10 Voltage changes

```
1 //Ex_7_10
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 delVB=0.4; //V
8 delVC=0; //V//No change
9 delVE=delVB; //V//Same change
10 disp(delVC,delVE," delVE(V) & delVC(V) are : ");
```

Scilab code Exa 7.11 Emitter Voltage

```
1 //Ex_7_11
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 VBE=0.7; ///V
8 Beta=100; ///Current Gain
9 //Part (a)
10 VCC=6; ///V
11 VEE=0; ///V
```

```

12 VB=2;////V
13 RE=18;//kohm
14 RC=3;//kohm
15 VE=VB-VBE;//V
16 disp(VE,"(a) Emitter Voltage(V) : ");
17 IE=1;//mA
18 IC=IE*Beta/(1+Beta);//mA
19 VC=VCC-IC*RC;//V
20 if VC>VE then
21     disp("Circuit is in active mode.");
22 end;
23 //Part (b)
24 VEE=6;////V
25 VCC=0;////V
26 VB=1;////V
27 RE=10;//kohm
28 RC=10;//kohm
29 VE=VB+VBE;//V
30 disp(VE,"(b) Emitter Voltage(V) : ");
31 IE=(VEE-VE)/RE;//mA
32 IC=IE;//mA(Assumed nearly equal)
33 VC=VCC+IC*RC;//V
34 if VC>VB then
35     disp("Circuit is in saturation mode.");
36 end;
37 //Part (c)
38 VEE=9.5;////V
39 VCC=-50;////V
40 VB=-5;////V
41 RE=200;//kohm
42 RC=20;//kohm
43 VE=VB+VBE;//V
44 disp(VE,"(c) Emitter Voltage(V) : ");
45 IE=(VEE-VE)/RE;//mA;//mA
46 IC=IE*Beta/(1+Beta);//mA
47 VC=VCC-IC*RC;//V
48 if VC>VE then
49     disp("Circuit is in active mode.");

```

```

50 elseif VC<VE
51     disp(" Circuit is in reverse active mode.")
52 end;
53 //Part (d)
54 VEE=-30;////V
55 VCC=-10;////V
56 VB=-20;////V
57 RE=6; //kohm
58 RC=2; //kohm
59 VE=VB-VBE; //V
60 disp(VE,"(d) Emitter Voltage(V) : ");
61 IE=(VEE-VE)/RE; //mA; //mA
62 IC=IE*Beta/(1+Beta); //mA
63 VC=VCC-IC*RC; //V
64 if VC>VE then
65     disp(" Circuit is in active mode.");
66 end;
67 //Note : Printing error in part (a) in the textbook.
        Answer is also not accurate in the textbook for
        part(c)

```

Chapter 8

BJT Circuits

Scilab code Exa 8.1 Calculate IB IC VCE

```
1 //Ex_8_1
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Beta=100;//unitless
8 Rc=2;//kohm
9 Rb=100;//kohm
10 Vcc=10;//V
11 VBE=0.7;//V
12 //Part (a)
13 IB=(Vcc-VBE)/(Beta*Rc+Rc+Rb);//mA
14 disp(IB,"IB(mA)");
15 format('v',4);
16 IC=Beta*IB;//mA
17 disp(IC,"IC(mA)");
18 format('v',5);
19 VCE=Vcc-(IB+IC)*Rc;//V
20 disp(VCE,"VCE(V)");
21 //Part (b)
```

```

22 format('v',8);
23 VCE=7; //V
24 ICB=(Vcc-VCE)/Rc; //mA(ICB=IC+IB)
25 IB=ICB/(1+Beta); //mA
26 IC=ICB*Beta; //mA
27 Rb=(Vcc-VBE-Rc*ICB)/IB; //kohm
28 disp(Rb," Value of Rb(kohm)");

```

Scilab code Exa 8.4 Find Re R1 and R2

```

1 // Ex_8_4
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 Beta=50; // unitless
8 VBE=0.7; //V
9 VCC=22.5; //V
10 Rc=5.6; //kohm
11 VCE=12; //V
12 IC=1.5; //mA
13 S=3; // Stability factor (S<=3)
14 Rec=(VCC-VCE)/IC; //kohm (Rec=Re+Rc)
15 Re=Rec-Rc; //kohm
16 RbBYRe=(S-1)/(1-S/(1+Beta))
17 Rb=RbBYRe*Re; //kohm
18 IB=IC/Beta; //mA
19 V=IB*Rb+VBE+(IB/1000+IC)*Re; //V
20 R1=Rb*VCC/V; //kohm
21 R2=R1*V/(VCC-V); //kohm
22 disp(Re," Value of Re(kohm)");
23 disp(R1," Value of R1(kohm)");
24 disp(R2," Value of R2(kohm)");
25 //Answer in the book is wrong for R1.

```

Scilab code Exa 8.5 Find R1 R2 Re

```
1 //Ex_8_5
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 VCC=20; //V
8 Rc=1.5; //kohm
9 VCE=8; //V
10 IC=4; //mA
11 Beta=50; //unitless\
12 VBE=0.2; //V
13 disp("Part (a)");
14 S=12; //Stability factor
15 IB=IC/Beta; //mA
16 Re=(VCC-VCE-IC*Rc)/(IB+IC); //kohm
17 RbBYRe=(S-1)/(1-S/(1+Beta))
18 Rb=RbBYRe*Re; //kohm
19 IE=IB+IC; //mA
20 VBN=VBE+IE*Re; //V
21 V=VBN+IB*Rb; //V
22 R1=Rb*VCC/V; //kohm
23 IR1=(VCC-VBN)/R1; //mA
24 IR2=IR1-IB; //mA
25 R2=VBN/IR2; //kohm
26 disp(R1,"Value of R1(kohm)");
27 disp(R2,"Value of R2(kohm)");
28 disp(Re,"Value of Re(kohm)");
29 disp("Part (b)");
30 S=3; //Stability factor
31 IB=IC/Beta; //mA
32 Re=(VCC-VCE-IC*Rc)/(IB+IC); //kohm
```

```

33 RbBYRe=(S-1)/(1-S/(1+Beta))
34 Rb=RbBYRe*Re; //kohm
35 IE=IB+IC; //mA
36 VBN=VBE+IE*Re; //V
37 V=VBN+IB*Rb; //V
38 R1=Rb*VCC/V; //kohm
39 IR1=(VCC-VBN)/R1; //mA
40 IR2=IR1-IB; //mA
41 R2=VBN/IR2; //kohm
42 disp(R1," Value of R1(kohm)");
43 disp(R2," Value of R2(kohm)");
44 format('v',5);
45 disp(Re," Value of Re(kohm)");
46 disp(Rb," Value of Rb(kohm)");
47 //Answer in the book is wrong.

```

Scilab code Exa 8.6 Determine Re and stability factor

```

1 //Ex_8_6
2 clc;
3 clear;
4 close;
5 format('v',6);
6 //given data :
7 VBE=0.7; //V
8 Beta=50; // unitless
9 VCE=4; //V
10 VCC=12; //V
11 Rc=4.3; //kohm
12 VEE=-6; //V
13 IC=1.5; //mA
14 S=3; //Stability factor (S<=3)
15 Rec=(VCC-VCE)/IC; //kohm (Rec=Re+Rc)
16 Re=Rec-Rc; //kohm
17 RbBYRe=(S-1)/(1-S/(1+Beta))

```

```
18 Rb=RbBYRe*Re;//kohm
19 IB=IC/Beta;//mA
20 V=IB*Rb+VBE+(IB/1000+IC)*Re;//V
21 R1=Rb*VCC/V;//kohm
22 R2=R1*V/(VCC-V);//kohm
23 disp(Re," Value of Re(kohm)");
24 disp(R1," Value of R1(kohm)");
25 disp(R2," Value of R2(kohm)");
26 //Answer in the book is wrong for R1.
```
