Scilab Textbook Companion for Materials Science by R. S. Khurmi and R. S. Sedha[1]

Created by
Vijay Kant Kala
B.tech
Electronics Engineering
KIET
College Teacher
Ms. Swati
Cross-Checked by
Lavitha Pereira And Mukul R. Kulkarni

February 14, 2014

[1]Funded 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: Materials Science

Author: R. S. Khurmi and R. S. Sedha

Publisher: S. Chand & company, New Delhi

Edition: 1

Year: 2012

ISBN: 81-219-0146-4

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 2

structure of atoms

Scilab code Exa 2.1 radius

```
1 //Example 2.1 : radius of the first bohr"s orbit
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',5)
7 ep=8.854*10^-12;//
8 h=6.626*10^-34;//
9 m=9.1*10^-31;//in Kg
10 e=1.602*10^-19;//
11 r1=((ep*(h^2))/((%pi*m*(e^2))));//
12 disp(r1*10^10,"radius,r1(in angstrom) = ")
```

Scilab code Exa 2.2 radius

```
1
2 //Example 2.2 : radius of the second bohr"s orbit
3 clc;
```

```
clear;
close;
//given data :
format('v',6)
r1_h=0.529; // radius for hydrozen atom in Angstrum
n1=1;// for the first bohr's orbit of electron in
   hydrozen atom
Z1=1; // for the first bohr's orbit of electron in
   hydrozen atom
k=(r1_h*Z1)/n1^2; // where k is constant
n2=2; // for the second bohr orbit
Z2=2; //for the second bohr orbit
r2_he=k*(n2^2/Z2);
disp(r2_he,"radius of the second bohr orbit,r2(
   Angstrom) = ")
```

Scilab code Exa 2.3 ratio of energy

```
// Example 2.3: to prove
clc;
clear;
close;
Z=1;//assume
n1=1;//orbit 1
n2=2;//orbit 2
n3=3;//orbit 3
e1=((-13.6*Z)/(n1^2));//energy for the first orbit
e2=((-13.6*Z)/(n2^2));//energy for the second orbit
e3=((-13.6*Z)/(n3^2));//energy for the third orbit
e31=e3-e1;//energy emitted by an electron jumping
   from orbit nuber 3 to orbit nimber 1
e21=e2-e1;//energy emitted by an electron jumping
   from orbit nuber 2 to orbit nimber 1
re=e31/e21;//ratio of energy
disp(re,"ratio of energy for an electron to jump
```

```
from orbit 3 to orbi 1 and from orbit 2 to orbit
1 is 32/27")
```

Scilab code Exa 2.4 velocity

```
1  //Example 2.4 : velocity
2  clc;
3  clear;
4  close;
5  //given data :
6  format('v',8)
7  h=6.626*10^-34;
8  e=1.6*10^-19;
9  epsilon_o=8.825*10^-12;
10 n=1;
11 Z=1;
12 vn=(Z*e^2)/(2*epsilon_o*n*h);
13 disp(vn,"velocity ,vn(m/s) = ")
```

Scilab code Exa 2.5 orbital frequency

```
1  //Example 2.5 : velocity
2  clc;
3  clear;
4  close;
5  //given data :
6  n=1;
7  Z=1;
8  k=6.56*10^15; // k is constant
9  fn=k*(Z^2/n^3);
10 disp(fn,"orbital frequency ,fn(Hz) = ")
```

Scilab code Exa 2.6.a energy of photon emitted

```
1 //Example 2.6.a : the energy of the photon emitted
2 clc;
3 clear;
4 close;
5 format('v',5);
6 //given data :
7 Z=1;//for hydrozen
8 n1=3;
9 n2=2;
10 E3=-(13.6*Z^2)/n1^2;
11 E2=-(13.6*Z^2)/n2^2;
12 del_E=E3-E2;
13 disp(del_E,"the energy of photon emitted,del_E(eV) =
    ")
```

Scilab code Exa 2.6.b frequency

```
1 //Example 2.6.b : frequency
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',9)
7 Z=1;//for hydrozen
8 n1=3;
9 n2=2;
10 m=6.626*10^-34;// mass of electron in kg
11 E3=-(13.6*Z^2)/n1^2;
12 E2=-(13.6*Z^2)/n2^2;
13 del_E=E3-E2;
```

```
14 E=del_E*1.6*10^-19;// in joules
15 v=(E/m);
16 disp(v,"frequency of the photon emitted,v(Hz) = ")
```

Scilab code Exa 2.6.c wavelength

```
1 //Example 2.6.c : wave length of the photon emitted
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',9)
7 Z=1;//for hydrozen
8 n1=3;
9 n2=2;
10 m=6.626*10^-34;// mass of electron in kg
11 C=3*10^8;
12 E3=-(13.6*Z^2)/n1^2;
13 E2=-(13.6*Z^2)/n2^2;
14 del_E=E3-E2;
15 E=del_E*1.6*10^-19;
16 v=E/m;
17 lamda=C/v;
18 disp(lamda,"wavelength of the photon emitted,(m) = "
   )
```

Chapter 3

crystal structure

Scilab code Exa 3.1 miller indices

```
1  //Example 3.1: miller indices
2  clc;
3  clear;
4  close;
5  //given data
6  x1=1;//
7  x2=1;//
8  x3=2;//
9  h1=1/x1;//
10 h2=1/x2;//
11 h3=1/x3;//
12 disp("Miller indices of the plane (112) are: "+
       string(h1)+","+string(h2)+","+string(h3))
13 x11=0;//
14 x21=0;//
15 x31=1;//
16 h11=%inf;//
17 h21=%inf;//
18 h31=1/x31;//
19 disp("Miller indices of the plane (001) are : "+
       string(h11)+","+string(h21)+","+string(h31))
```

```
x111=1;//
x211=0;//
x311=1;//
h111=1/x111;//
h211=%inf;//
h311=1/x311;//
disp("Miller indices of the plane (101) are : "+
   string(h111)+","+string(h211)+","+string(h311))
```

Scilab code Exa 3.2 miller indices

```
//Example 3.2: miller indices
clc;
clear;
close;
//given data
x1=0;//
x2=2;//
x3=0;//
h1=%inf;//
h2=1/x2;//
h3=%inf;//
disp("Miller indices of the plane (020) are: "+
   string(h1)+","+string(h2)+","+string(h3))
x11=1;//
x21=2;//
x31=0;//
h11=1/x11;//
h21=1/x21;//
h31=%inf;//
disp("Miller indices of the plane (120) are : "+
   string(h11)+","+string(h21)+","+string(h31))
x111=2;//
x211=2;//
x311=0;//
```

```
23 h111=1/x111;//
24 h211=1/x211;//
25 h311=%inf;//
26 disp("Miller indices of the plane (220) are : "+
      string(h111)+","+string(h211)+","+string(h311))
27 //miller indices for plane (120) is calculated wrong
      in the book
```

Scilab code Exa 3.3 miller indices

```
1 // Example 3.3: miller indices
2 clc;
3 clear;
4 close;
5 x=1/2;//
6 x1=1/x;//
7 r2=0;//
8 r3=0;//
9 x10=-1;//
10 x2=1/-x10;//
11 r4=0;//
12 r5=0;//
13 disp("miller indices (Case 1) of the given plane are
      "+string(x1)+" : "+string(r2)+" : "+string(r3)+"
      ")
14 disp("miller indices (Case 2) of the given plane are
      "+string(x2)+" : "+string(r3)+" : "+string(r4)+"
      ")
```

Scilab code Exa 3.4 miller indices

```
1 // Example 3.4: miller indices
2 clc;
```

```
clear;
close;
a=0.529;//
b=1;//
c=0.477;//
a1=0.264;//
b1=1;//
c1=0.238;//
r1=round(a/a1);//
r2=b/b1;//
r3=round(c/c1);//
disp("miller indices of the given plane are "+string
   (r1)+" : "+string(r2)+" : "+string(r3)+" ")
```

Scilab code Exa 3.5 miller indices

```
//Example 3.5: miller indices
clc;
clear;
close;
//given data
x1=1;//
x2=1;//
x3=0;//
h1=1/x1//
h2=1/x2;//
h3=%inf;//
disp("Miller indices of the plane (110) are: "+
   string(h1)+","+string(h2)+","+string(h3))
x11=1;//
x21=1;//
x31=1;//
h11=1/x11;//
h21=1/x21;//
h31=1/x31;//
```

```
19 disp("Miller indices of the plane (111) are : "+
     string(h11)+","+string(h21)+","+string(h31))
```

Scilab code Exa 3.9 atoms per unit cell

```
1  // Example 3.9: atoms per unit cell
2  clc;
3  clear;
4  close;
5  c=8;//corners
6  f=6;//faces
7  nf=(1/2)*f;//no. of atoms in all six faces
8  nc=(1/8)*c;//no. of atoms in all corners
9  ta=nf+nc;//
10 disp(ta,"total number of atoms are")
```

Scilab code Exa 3.10 diameter

```
1  //Example 3.10 : largest diameter
2  clc;
3  clear;
4  close;
5  //given data :
6  format('v',6)
7  a=3.61; // edge length in angstrum
8  r=(a*sqrt(2))/4;
9  d=2*r;
10 disp(d,"largest diameter,d(angstrom) = ")
```

Scilab code Exa 3.11 volume change

```
1 //Example 3.11 : volume change in percentage
2 clc;
3 clear;
4 close;
5 //given data :
6 r_bcc=0.1258; // in nm
7 r_fcc=0.1292;// in nm
8 a_bcc=(r_bcc*4)/sqrt(3);
9 a_fcc=(r_fcc*4)/sqrt(2);
10 v_fcc=(a_fcc)^3;// in nmn^3
11 v_bcc=(a_bcc)^3; // in nm^3
12 V=((v_fcc-v_bcc)/v_bcc)*100;
13 disp(V,"volume change in percentage ,V(%) = ")
```

Scilab code Exa 3.12 number of atoms

```
1
2 //Example 3.12 : number of atom/mm^2
3 clc;
4 clear;
5 close;
6 format('v',8)
7 //given data :
8 a=3.03*10^-7; // lattice constant in mm
9 A=1/a^2;// for 100 planes
10 B=0.707/a^2;//for(110) planes
11 C=0.58/a^2;// for(111) planes
12 disp(A,"number of atom for (100) plane, = ")
13 disp(B,"number of atoms for (110) plan, = ")
14 disp(C,"number of atoms for (111) plan, = ")
```

Scilab code Exa 3.13 number of atoms

```
1
2 //Example 3.13 : number of atom/mm^2 of planes
3 clc;
4 clear;
5 close;
6 //given data :
7 format('v',9)
8 a=2.87*10^-7; // lattice constant in mm
9 A=1/a^2;// for 100 planes
10 B=1.414/a^2;//for(110) planes
11 C=1.732/a^2;// for(111) planes
12 disp(A,"number of atom for (100) plane, = ")
13 disp(B,"number of atoms for (110) plan, = ")
14 disp(C,"number of atoms for (111) plan, = ")
```

Scilab code Exa 3.14 number of atoms

```
1
2 //Example 3.14 : number of atom/mm^2 surface area
3 clc;
4 clear;
5 close;
6 //given data :
7 a=4.93*10^-7; // lattice constant in mm
8 A=2/a^2;// for 100 planes
9 B=1.414/a^2;//for(110) planes
10 C=2.31/a^2;// for(111) planes
11 disp(A,"number of atoms for (100) plane) = ")
12 disp(B,"number of atoms for (110) plan = ")
13 disp(C,"number of atoms for (111) plan = ")
```

Scilab code Exa 3.15 planar density

```
1 //Example 3.15 : planar density
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',9)
7 a=0.143*10^-6; // atomic radius in mm
8 A=2.31/(a^2);// for(111) planes
9 disp(A,"atom,A(atoms/mm^2) = ")
10 // answer is wrong in book
```

Scilab code Exa 3.16 volume

```
1 //Example 3.16 : volume
2 clc;
3 clear;
4 close;
5 format('v',7)
6 //given data :
7 a=0.2665; // in mm
8 c=0.4947;// in mm
9 V=(3*sqrt(3)*a^2*c)/2;
10 disp(V,"volume,V(mm^3) = ")
```

Scilab code Exa 3.17 packing efficiency and lattice parameter

```
1
2 //Example 3.17 : find the packing efficiency and
    lattice parameter
3 clc;
4 clear;
5 close;
6 format('v',5)
```

```
7 //given data :
8 r=1.22// in angstrum
9 a=(4*r)/sqrt(3);
10 efficiency=(%pi*sqrt(3))/8;
11 disp(efficiency,"efficiency = ")
12 disp(a,"lattice parameter,a(angstrom) = ")
```

Scilab code Exa 3.18 interplanar distance

```
1 //Example 3.18 : interplanar distance
2 clc;
3 clear;
4 close;
5 //given data :
6 h=1;
7 k=1;
8 l=1;
9 //d=a/sqrt(h^2+k^2+l^2)
10 dBYa=1/sqrt(h^2+k^2+l^2);
11 disp("Interplanor distance(Angstrom) is a*"+string(
   dBYa));
```

Scilab code Exa 3.19 interplanar spacing

```
1 //Example 3.19 : spacing
2 clc;
3 clear;
4 close;
5 //given data :
6 h1=2;
7 k1=0;
8 l1=0;
9 h2=2;
```

```
k2=2;
l2=0;
h3=1;
k3=1;
l3=1;
r=1.246;
a=(4*r)/sqrt(2);// in angstrum
//d=a/sqrt(h^2+k^2+l^2)
d1=a/sqrt(h1^2+k1^2+l1^2);
d2=a/sqrt(h2^2+k2^2+l2^2);
d3=a/sqrt(h3^2+k3^2+l3^2);
disp(d1,"d_200 spacind,d1(angstrom) = ")
disp(d2,"d_220 spacind,d2(angstrom) = ")
disp(d3,"d_111 spacind,d3(angstrom) = ")
```

Scilab code Exa 3.20 interplanar spacing

```
//Example 3.20 : interplaner spacing d_220
clc;
clear;
close;
format('v',6)
//given data :
a=0.316;// in nm
h=2;
k=2;
l=0;
d=a/sqrt(h^2+k^2+l^2);
disp(d,"inter planer spacing d_220,d(nm) = ")
// answer is wrong in book
```

Scilab code Exa 3.21 ratio of cubic lattice sepration between the successive lattice planes

```
// Example 3.21: interplanar spacing d220
clc;
clear;
close;
format('v',5)
a=1;//constant assume
a1=[1;0;0];//lattice planes
a2=[1;1;0];//lattice planes
a3=[1;1;1];//lattice planes
d100=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2));//
   interplanar distance between (100)planes
d110=a/(sqrt(a2(1,1)^2+a2(2,1)^2+a2(3,1)^2));//
   interplanar distance between (110)planes
d111=a/(sqrt(a3(1,1)^2+a3(2,1)^2+a3(3,1)^2));//
   interplanar distance between (111)planes
disp("ratio of interplanar distances is "+string(
   d100)+":"+string(d110)+":"+string(d111)+"")
```

Scilab code Exa 3.22 perpendicular distance

```
// Example 3.22: perpendicular distance
clc;
clear;
close;
a=1;//constant assume
a1=[1;1;1];//lattice planes
a2=[2;2;2];//lattice planes
d1=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2));//
   perpendicular distance between origin and (111)
   planes
d2=a/(sqrt(a2(1,1)^2+a2(2,1)^2+a2(3,1)^2));//
   perpendicular distance between origin and (222)
   planes
d22 = d1-d2;//perpendicular distance between the
   planes (111) and (222)
```

```
11 disp(d22,"perpendicular distance between the planes
   (111) and (222)")
```

Scilab code Exa 3.23 angle

```
1 // Example 3.23: angle between planes (122) and
   (111)
2 clc;
3 clear;
4 close;
5 a=1;// assume
6 a1=[1;2;2];//lattice planes
7 a2=[1;1;1];//lattice planes
8 d1=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2));//
   perpendicular distance between origin and (111)
   planes
9 d2=a/(sqrt(a2(1,1)^2+a2(2,1)^2+a2(3,1)^2));//
   perpendicular distance between origin and (222)
   planes
10 cphi= ((a1(1,1)*a2(1,1))+(a1(2,1)*a2(2,1))+(a1(3,1)*
   a2(3,1)))*(d1*d2);//
11 d=acosd(cphi);// in degree
12 d1=floor(d);//
13 d2=d-d1;//
14 disp("angle between planes (122) and (111) is "+
   string(d1)+" degree "+string(round(60*d2))+"
   minutes")
```

Scilab code Exa 3.24 concentration of iron atoms

```
1 //Example 3.24 : concentration of iron
2 clc;
3 clear;
```

```
close;
format('v',9)
//given data :
d=7.87;
N=6.023*10^23; // avogadro's number
A=55.85;// atomic weight
I=A/N;// mass of iron atom
atom=d/I;
disp(atom,"number of atoms(atoms/cm^3) =  ")
```

Scilab code Exa 3.25 lattice constants

```
//Example 3.25 : lattice constant
clc;
clear;
close;
//given data :
format('v',6)
n=2;
A=55.8;
N=6.023*10^26; // avogadro's number in /kg-mole
b=7.87*10^3;// in kg/m^3
a=((A*n)/(N*b))^(1/3);
disp(a*10^10,"lattice constant,a(angstrom)")
```

Scilab code Exa 3.26 density

```
//Example 3.26 : density
clc;
clear;
close;
//given data :
format('v',5)
```

```
n=4;
N=6.023*10^23; // avogadro's number
r=1.278*10^-8;// in cm
A=63.5;
a=(r*4)/sqrt(2);// in cm
b=(A*n)/(a^3*N);
disp(b,"density of copper,b(g/cc) = ")
```

Scilab code Exa 3.27 number of atoms

```
//Example 3.27 : number of atoms
clc;
clear;
close;
//given data :
n=4;
N=6.023*10^23; // avogadro's number
A=55.85;
a=2.9*10^-8;
b=7.87;//density in g/cc
//a^3=(A*n)/(N*b)
n=round((a^3*N*b)/A);
disp(n,"number of atoms,n = ")
```

Scilab code Exa 3.28 lattice constants

```
//Example 3.28 : lattice constant
clc;
clear;
close;
//given data :
d=6250;//density
N=6.02*10^23;//avogadro's number
```

```
8  n=4;
9  m=60.2*10^-3;// atomic mass
10 M=(n*m)/N;
11 V=M/d;
12 a=V^(1/3)*10^9;
13 disp(a,"the lattice constant,a(nm) = ")
14 //ANSWER IS WRONG IN THE TEXT BOOK
```

Scilab code Exa 3.29 number of atoms

```
1  //Example 3.29 : the number of atoms
2  clc;
3  clear;
4  close;
5  //given data :
6  d=7.87;//in g/cm^3
7  A=55.85;
8  a=2.9*10^-8;// in cm
9  N=6.02*10^23;//avogadro's number
10 n=(d*a^3*N)/A;
11 disp(round(n),"the number of atom,n = ")
```

Scilab code Exa 3.30 number of vacancies in copper

```
1  // Example 3.30: calculate the number of vacancies
      in the copper
2  clc;
3  clear;
4  close;
5  B=1.38*10^-23;//boltzman constant in J/atom-K
6  B1=8.62*10^-5;// bolzman constant in ev/atom-K
7  Qv=0.9;// eV/atom
8  t=27;// room temperatyre in degree celsius
```

```
pcu=8.4;//in g/cm^3
Acv=63.5;// in g/mol
T=t+273;//temperture in kelvin
Nv=6.023*10^23;//
P=8.4;//
Ns=(Nv*P)/Acv;// number of regular lattice sites
Nv1=Ns*exp(-Qv/(B1*T));//
disp(Nv1,"number of vacancies in copper in vacancies
   /cm^3")
//answer is wrong in the textbook
```

Scilab code Exa 3.31 interplanar spacing

```
//Example 3.31 : interplanar spacing
clc;
clear;
close;
//given data :
format('v',5)
theta=20.3;//in degree
lamda=1.54;// in angstrum
n=1;
a=sind(theta)
d=lamda/(2*a);
disp(d,"interplanar spacing,d(angstrom) = ")
```

Scilab code Exa 3.32 interatomic spacing

```
//Example 3.32 : interatomic spacing
clc;
clear;
close;
//given data :
```

```
format('v',9)
theta=30;//in degree
lamda=1.54;// in angstrum
n=1;
a=sind(theta)
d=lamda/(2*a);
disp(d,"interatomic spacing,d(angstrom) = ")
```

Scilab code Exa 3.33 order of Braggs reflection

```
//Example 3.33 : number of per order
clc;
clear;
close;
//given data :
format('v',5)
theta=90;//in degree
lamda=1.54;// in angstrum
a=sind(theta)
d=1.181;
n=(2*d*a)/lamda;
disp(n,"number of order,n = ")
```

Scilab code Exa 3.34 size of unit cell

```
// Example 3.34: size of unit cell
clc;
clear;
close;
n=1;//
a=1;//assume
h=0.58;//wavelnegth in armstrong
th=9.5;//reflection angle in degree
```

```
a1=[2;0;0];//miller indices
d200=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2));//
   interplanar distance between (200)planes
a=((n*h)/(2*d200*sind(th)));//zsize of unit cell
disp(a,"size of unit cell in   ")
//amswer is wrong in the textbook
```

Scilab code Exa 3.35 Bragg angle

```
// Example 3.35: bragg angle
clc;
clear;
close;
n=1;//
a=3.57;//in
h=0.54;//wavelnegth in
a1=[1;1;1];//miller indices
d111=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2));//
   interplanar distance between (111)planes
snd=((n*h)/(2*d111));//
th=asind(snd);// bragg angle in degree
d1=floor(th);//
d2=th-floor(d1);//
disp("angle between planes (122) and (111) is "+
   string(d1)+" degree "+string(round(60*d2))+"
   minutes")
//wavelength is given wrong in example it is 0.54
   and it is taken as 1.54
```

Scilab code Exa 3.36 interplanar spacing and Miller Indices

```
// Example 3.36: interplanner spacing and miller
   indices
```

```
clc;
clear;
close;
a=3.16;// in
h=1.54;// in
n=1;//
th=20.3;// in degree
d=((n*h)/(2*sind(th)));// interplanner spacing in
x=a/d;//
y=x^2;//
disp(d,"interplanner spacing in    is")
disp("miller indices are (110) , (011) or (101)")
```

Scilab code Exa 3.37 interplanar spacing and diffraction angke

```
// Example 3.36: interplanner spacing and
   diffraction angle
clc;
clear;
close;
a=.2866;// in
h=0.1542;// in nm
n=1;//
a1=[2;1;1];//miller indices
d211=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2));//
   interplanar distance between (211)planes
snd=((n*h)/(2*d211));//
th=asind(snd);// bragg angle in degree
d1=floor(th);//
d2=th-floor(d1);//
disp("angle between planes (122) and (111) is "+
   string(d1)+" degree "+string(round(60*d2))+"
   minutes")
disp(d211,"interplanner spacing in    is")
//answer is wrong in the textbook
```

Chapter 5

Electron Theory of Metals

Scilab code Exa 5.1.a probability

```
1 // Example 5.1.a: probability for diamond
2 clc, clear
3 // given :
4 format('v',9)
5 Eg=5.6; // in eV
6 k=86.2*10^-6; // in eVk^-1
7 T=273+25; // in K
8 E_Ef=Eg/2;
9 f_E=1/(1+exp(E_Ef/(k*T)));
10 disp(f_E,"probability for diamond,f_E = ")
```

Scilab code Exa 5.1.b probability

```
1 // Example 5.1.b: probability for silicon
2 clc, clear
3 // given :
4 Eg=1.07; // in eV
5 k=86.2*10^-6; // in eVk^-1
```

```
T=273+25; // in K
E_Ef=Eg/2;
f_E=1/(1+exp(E_Ef/(k*T)));
disp(f_E,"probability for diamond,f_E = ")
// answer is wrong in book
```

Scilab code Exa 5.2 resistance

```
// Example 5.2: resistance
clc, clear
// given :
l=1; // length in m
A=4*10^-4; // area of cross section in m^2
p=0.01*10^-2; // resistivity in ohm-m
R=p*(l/A);
disp(R,"resistance of wire,R(ohm) = ")
```

Scilab code Exa 5.3 resistance

```
// Example 5.3: resistance
clc, clear
// given :
format('v',5)
p=1.7*10^-8; //  resistivity i ohm-m
d=0.0005; // diameter of the wire in m
l=31.4; // length in m
A=(%pi*d^2)/4;
R=p*(l/A);
disp(R,"resistance of wire,R(ohm) = ")
```

Scilab code Exa 5.4 conductivity

```
// Example 5.4: conductivity
clc, clear
// given :
format('v',8)
V=.432; // voltage drop across the wire in volts
I=10; // current through the wire in A
l=1; // length in m
d=1*10^-3; // diameter in m
R=V/I;
A=(%pi*d^2)/4;
p=(R*A)/l;
b=1/p;
disp(b,"conductivitty ,b(ohm^-1.m^-1) = ")
```

Scilab code Exa 5.5 drift velocity

```
// Example 5.5: drift velocity
clc, clear
// given :
format('v',5)
n=10^19; // in m^3
b=0.01; // conductivity in ohm^-1. m^-1
V=0.17; // in volts
d=.27*10^-3; // in m
e=1.602*10^-19; // in C
m=9.1*10^-31; // in kg
E=V/d; // in volt/m
v=((b*E)/(n*e));
disp(v,"drift velocity of electron ,v (m/sec) = ")
```

Scilab code Exa 5.6 conductivity

```
// Example 5.6: conductivity
clc, clear
// given :
e=1.6*10^-19; // in C
T=300; // temerature in K
t=2*10^-14; // time in sec
c=63.54; // atomic weight of copper in a.m.u
m=9.1*10^-31; // mass in kg
// we know that 63.45 grams of copper contains
   6.023*10^23 free electrons since one atom
   contributes one electron.the volume of 63.54 gram
    of copper is 8.9 cubic centimetre(c.c).
n=6.023*10^23/(c/8.9); //number of electrons per
   unit volume(c.c)
n1=n*10^6; // the number of electrons per m^3
b=(e^2*n1*t)/m;
disp(b,"conductivity ,b(mho/m) = ")
```

Scilab code Exa 5.7 mobility of electrons

```
// Example 5.7: mobility of electrons
clc, clear
// given :
format('v',8)
e=1.602*10^-19; // in C
m=9.1*10^-31; // in kg
t=10^-14; // time in sec
mu=(e*t)/m;
disp(mu,"mobility of electrons ,mu(m^2/volts.sec) = "
   )
```

Scilab code Exa 5.8 mobility of electrons

```
// Example 5.8: mobility
clc, clear
// given :
format('v',6)
d=10.5; // density of silver in gm/c.c
w=107.9; // atomic weight
b=6.8*10^5; // conductivity in mhos/cm
e=1.602*10^-19; // in C
N=6.023*10^23;
n=(N*d)/w;
mu=b/(e*n);
disp(mu,"mobility of electron ,mu(m^2/volt-sec) = ")
```

Scilab code Exa 5.9 mobility of electrons and drift velocity

```
// Example 5.9: mobility and drift velocity
clc, clear;
// given :
b=6.5*10^7; // conductivity in ohm^-1.m^-1
e=1.602*10^-19; // in C
n=6*10^23; //
E=1; // in V/m
mu=b/(e*n);
v=mu*E;
disp(mu,"mobility ,mu(m^2/volt-sec) = ")
disp(v,"drift velocity ,v(m/sec) = ")
// mobility and drift is calculated wrong in book
```

Scilab code Exa 5.10 density and drift velocity

```
//Example 5.10 : density and drift velocity
clc;
clear;
```

```
close;
//given data :
format('v',9)
e=1.602 *10^-19;
b=58*10^6;// in ohm^-1 m^-1
mu_n=3.5*10^-3;// in m^2/V s
E=0.5; // in V/m
n=b/(e*mu_n);
disp(n,"density ,n(m^-3) = ")
v=mu_n*E;
disp(v,"drift velocity ,v(m/s) = ")
```

Scilab code Exa 5.11 velocity

```
//Example 5.11 : velocity
clc;
clear;
close;
//given data :
m=9.109*10^-31; // in kg
e=1.602 *10^-19;
Ef=2.1// in ev
Wf=e*Ef;// in J
vf=sqrt((2*Wf)/m);
disp(vf,"velocity ,vf(m/s) = ")
```

Scilab code Exa 5.12.a velocity

```
//Example 5.12.a : velocity
clc;
clear;
close;
//given data :
```

```
m=9.1*10^-31; // in kg
e=1.602 *10^-19;
Ef=3.75;// in ev
Wf=(e*Ef);// in J
vf=sqrt(((2*Wf)/m));
disp(vf,"velocity ,vf(m/s) = ")
// answer is wrong in book
```

Scilab code Exa 5.12.b mobility of electrons

```

//Example 5.12.b : mobility of electron
clc;
clear;
close;
//given data :
m=9.1*10^-31; // in kg
e=1.602 *10^-19;
Ef=3.75;// in ev
t=10^-14;// in sec
mu=(e*t)/m;
disp(mu,"mobility ,mu(m^2/V-sec) = ")
```

Scilab code Exa 5.13 mean free path

```
//Example 5.13 : the mean free path
clc;
clear;
close;
//given data :
format('v',5)
t=10^-9; // in sec
m=9.109*10^-31; // in kg
```

```
e=1.602 *10^-19;
Ef=7// in ev
Wf=e*Ef;// in J
vf=sqrt((2*Wf)/m);
lamda=vf*t*10^3;
disp(lamda,"the mean free path,lamda(mm) = ")
```

Scilab code Exa 5.14 mobility and average time

```
//Example 5.14 : mobility and average time
clc;
clear;
close;
//given data :
format('v',6)
m=9.109*10^-31; // in kg
e=1.602 *10^-19;
d=8.92*10^3;// in kg/m^3
p=1.73*10^-8;// ohm-m
A=63.5;//atomic weight
N=6.023*10^22; // avogadro's number
n=(N*d)/A;
b=1/p;// conductivity
mu=b/(n*e);
disp(mu,"mobility ,mu(m^2/V-s) = ")
t=(mu*m)/e;
disp(t*10^9,"average time,t(ns) = ")
```

Scilab code Exa 5.15 electrical resistivity

```
//Example 5.15 : electrical resistivity
clc;
clear;
```

```
close;
//given data :
format('v',8)
r=1.86*10^-10;// in m
t=3*10^-14;// in sec
a=2;
m=9.1*10^-31; // in kg
e=1.602 *10^-9;
A=23*10^-3;//in kg/m
N=6.023*10^23; // avogadro's number
M=(a*A)/N;
V=((4/sqrt(3))*r)^3;
d=M/V;
mu=((e*t)/m);
n=(N*d)/A;
b=1.602 *10^-19*n*mu;
p=(1/b);
disp(p,"resistivity ,p(ohm-m) = ")
```

Chapter 7

Mechanical Tests of Metals

Scilab code Exa 7.1 shear modulus

```
1 //Example 7.1 : shear modulus of the material
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',6)
7 E=210; // youngs's modulus in GN/mˆ2
8 v=0.3; // poisson ratio
9 G=E/(2*(1+v));
10 disp(G,"shear modulus,G(GN/mˆ2) = ")
```

Scilab code Exa 7.2 young modulus of elasticity yield point uttimate stress and percentage elongation

```
1 //Example 7.2 : young's modulus of elasticity,yield
    point stress, ultimate stress and percentage
    elongation
2 clc;
```

```
clear;
close;
format('v',9)
//given data :
d=40*10^-3;//in m
W=40*10^3;// load in N
del_l=3.04*10^-5;// in m
L=200*10^-3;// in m
load_max=242*10^3;//in N
l=249*10^-3;// length of specimen in m
l0=(d+L); // in m
A=(%pi*d^2)/4;
b=W/A;
epsilon=del_l/L;
E=(b/epsilon);
disp(E,"young modulus,E(N/m^2) = ")
Y_load=161*10^3;
Y_stress=Y_load/A;
disp(Y_stress,"yield point stress,Y_stress(N/m^2) =
    ")
U_stress=load_max/A;
disp(U_stress,"ultimate stress,U_stress(N/m^2) = ")
p_elongation=((l-l0)/l0)*100;
disp(p_elongation,"percentage elongation,
   p_elongation(%) = ")
//percentage elongation is calculated wrong in
   textbook
```

Scilab code Exa 7.3.a yield point stress

```
// Example 7.3.a: yield point stress
clc;
clear;
close;
format('v',10)
```

```
yl=40;//yeild load in kN
ml=71.5;//maximum load in kN
fl=50.5;//fracture load in kN
glf=79.5;//gauge length of fratture in mm
st=7.75*10^-4;//strain at load of 20kN
d=12.5;//specimen diamtere in mm
sl=62.5;//specimen length in mm
A=(%pi*(d*10^-3)^2)/4;// in meter square
ylp=((yl*10^3)/(A));//yeild point stress in N/m^2
disp(ylp,"yeild point stress in N/m^2")
```

Scilab code Exa 7.3.b ultimate tensile strength

```
// Example 7.3.b: ultimate tensile strength
clc;
clear;
close;
format('v',10)
yl=40;//yeild load in kN
ml=71.5;//maximum load in kN
fl=50.5;//fracture load in kN
glf=79.5;//gauge length of fratture in mm
st=7.75*10^-4;//strain at load of 20kN
d=12.5;//specimen diamtere in mm
sl=62.5;//specimen length in mm
A=(%pi*(d*10^-3)^2)/4;// in meter square
ylp=((yl*10^3)/(A));//yeild point stress in N/m^2
uts=((ml*10^3)/(A));//ultimate tensile strangth in N
   /m^2
disp(uts,"ultimate tensile strangth in N/m^2")
```

Scilab code Exa 7.3.c percentage elongation

```
// Example 7.3.c: percentage elongation
clc;
clear;
close;
format('v',10)
yl=40;//yeild load in kN
ml=71.5;//maximum load in kN
fl=50.5;//fracture load in kN
glf=79.5;//gauge length of fratture in mm
st=7.75*10^-4;//strain at load of 20kN
d=12.5;//specimen diamtere in mm
sl=62.5;//specimen length in mm
a=(%pi*d*10^-3)^2/4;// in meter square
pel=((glf-sl)/sl)*100;//percentage elongation
disp(pel,"percentage elongation is")
```

Scilab code Exa 7.3.d modulus of elasticity

```
// Example 7.3.d:modulus of elasticity
clc;
clear;
close;
format('v',8)
yl=40;//yeild load in kN
ml=71.5;//maximum load in kN
fl=50.5;//fracture load in kN
glf=79.5;//gauge length of fratture in mm
st=7.75*10^-4;//strain at load of 20kN
d=12.5;//specimen diamtere in mm
sl=62.5;//specimen length in mm
A=(%pi*(d*10^-3)^2)/4;// in meter square
ylp=((yl*10^3)/(A));//yeild point stress in N/m^2
uts=((ml*10^3)/(A));//ultimate tensile strangth in N
   /m^2
pel=((glf-sl)/sl)*100;//percentage elongation
```

```
17 strss=((20*10^3)/A);//stress at 20kN in N/m^2
18 mel=strss/st;//modulus of elasticity in N/m^2
19 disp(mel,"modulus of elasticity in N/m^2")
```

Scilab code Exa 7.3.e modulus of resilience

```
1 // Example 7.3.e: yield point stress
2 clc;
3 clear;
4 close;
5 format('v',6)
6 yl=40;//yeild load in kN
7 ml=71.5;//maximum load in kN
8 fl=50.5;//fracture load in kN
9 glf=79.5;//gauge length of fratture in mm
10 st=7.75*10^-4;//strain at load of 20kN
11 d=12.5;//specimen diamtere in mm
12 sl=62.5;//specimen length in mm
13 A=(%pi*(d*10^-3)^2)/4;// in meter square
14 ylp=((yl*10^3)/(A));//yeild point stress in N/m^2
15 uts=((ml*10^3)/(A));//ultimate tensile strangth in N
   /m^2
16 pel=((glf-sl)/sl)*100;//percentage elongation
17 strss=((20*10^3)/A);//stress at 20kN in N/m^2
18 mel=strss/st;//modulus of elasticity in N/m^2
19 mrs=((ylp*10^-3)^2/(2*mel));//modulus of resilience
20 disp(mrs,"modulus of resilience is")
```

Scilab code Exa 7.3.f fracture stress

```
1 // Example 7.3.f: fracture stress
2 clc;
3 clear;
```

```
close;
format('v',10)
yl=40;//yeild load in kN
ml=71.5;//maximum load in kN
fl=50.5;//fracture load in kN
glf=79.5;//gauge length of fratture in mm
st=7.75*10^-4;//strain at load of 20kN
d=12.5;//specimen diamtere in mm
sl=62.5;//specimen length in mm
A=(%pi*(d*10^-3)^2)/4;// in meter square
ylp=((yl*10^3)/(A));//yeild point stress in N/m^2
uts=((ml*10^3)/(A));//ultimate tensile strangth in N
   /m^2
pel=((glf-sl)/sl)*100;//percentage elongation
strss=((20*10^3)/A);//stress at 20kN in N/m^2
mel=strss/st;//modulus of elasticity in N/m^2
mrs=((ylp*10^-3)^2/(2*mel));//modulus of resilience
fs=((fl*10^3)/(A));//fracture stress in N/m^2
disp(fs,"fracture stress in N/m^2")
```

Scilab code Exa 7.3.g modulus of toughness

```

// Example 7.3.g: modulus of toughness
clc;
clear;
close;
format('v',10)
yl=40;//yeild load in kN
ml=71.5;//maximum load in kN
fl=50.5;//fracture load in kN
glf=79.5;//gauge length of fratture in mm
st=7.75*10^-4;//strain at load of 20kN
d=12.5;//specimen diamtere in mm
sl=62.5;//specimen length in mm
```

```
14 A=(%pi*(d*10^-3)^2)/4;// in meter square
15 ylp=((yl*10^3)/(A));//yeild point stress in N/m^2
16 uts=((ml*10^3)/(A));//ultimate tensile strangth in N
     /m^2
17 pel=((glf-sl)/sl)*100;//percentage elongation
18 strss=((20*10^3)/A);//stress at 20kN in N/m^2
19 mel=strss/st;//modulus of elasticity in N/m^2
20 mrs=((ylp*10^-3)^2/(2*mel));//modulus of resilience
21 fs=((fl*10^3)/(A));//fracture stress in N/m^2
22 mth=((ylp+uts)*(pel/100))/2;//modulus of toughness
     in N/m^2
23 disp(mth,"modulus of toughness in N/m^2")
24 //percentage reduction in area is not calulated in
     the textbook
```

Scilab code Exa 7.4 true breaking and nominal breaking stress

```
1
2 //Example 7.4 : true breaking stress and nominal
     breaking stress
3 clc;
4 clear;
5 close;
6 format('v',4)
7 //given data :
8 d1=12.7; // in mm
9 B_load=14;// in K-N
10 A1=(%pi*d1^2)/4;// original cross section area
11 d2=7.87; // in mm
12 A2=(%pi*d2^2)/4;// final cross sction area
13 T_stress=B_load/A2;
14 disp(T_stress*1000,"true breaking stress,T_stress(N/
     mm^2) = ")
15 N_stress=B_load/A1;
16 disp(N_stress*1000,"nominal breaking stress,N_stress
```

```
    (N/mm^2) = ")
//true breaking stress unit is wrong in the textbook
```

Scilab code Exa 7.5.a yield stress

```
// Example 7.5.a: yield point stress
clc;
clear;
close;
format('v',10)
yl=34;//yeild load in kN
ul=61;//ultimate load in kN
fl=78;//final length in mm
glf=60;//gauge length of fratture in mm
fd=7;//final diamtere in mm
d=12;//specimen diamtere in mm
sl=62.5;//specimen length in mm
A=(%pi*(d)^2)/4;// in meter square
ylp=((yl*10^3)/(A));//yeild point stress in N/mm^2
disp(floor(ylp),"yeild point stress in N/mm^2")
```

Scilab code Exa 7.5.b ultimate tesnile stress

```
// Example 7.5.b: ultimate tensile stress
clc;
clear;
close;
format('v',6)
yl=34;//yeild load in kN
ul=61;//ultimate load in kN
fl=78;//final length in mm
glf=60;//gauge length of fratture in mm
fd=7;//final diamtere in mm
```

```
11 d=12;//specimen diamtere in mm
12 sl=62.5;//specimen length in mm
13 A=(%pi*(d)^2)/4;// in meter square
14 uts=((ul*10^3)/(A));//ultimate tensile strangth in N
      /mm^2
15 disp(uts,"ultimate tensile strangth in N/mm^2")
```

Scilab code Exa 7.5.c percentage reduction

```
1 // Example 7.5.c: percentage reduction
2 clc;
3 clear;
4 close;
5 format('v',4)
6 yl=34;//yeild load in kN
7 ul=61;//ultimate load in kN
8 fl=78;//final length in mm
9 glf=60;//gauge length of fratture in mm
10 fd=7;//final diamtere in mm
11 d=12;//specimen diamtere in mm
12 sl=62.5;//specimen length in mm
13 A=(%pi*(d)^2)/4;// in mm square
14 A1=(%pi*(fd)^2)/4;// in mm square
15 pr=(A-A1)/A;//
16 disp(pr*100,"percentage reduction is")
```

Scilab code Exa 7.5.d percentage elongation

```
1 // Example 7.5.d: percentage elonagtion
2 clc;
3 clear;
4 close;
5 format('v',4)
```

```
yl=34;//yeild load in kN
ul=61;//ultimate load in kN
fl=78;//final length in mm
glf=60;//gauge length of fratture in mm
fd=7;//final diamtere in mm
d=12;//specimen diamtere in mm
sl=62.5;//specimen length in mm
A=(%pi*(d)^2)/4;// in mm square
A1=(%pi*(fd)^2)/4;// in mm square
pr=(fl-glf)/glf;//
disp(pr*100,"percentage elonagtion is")
```

Scilab code Exa 7.6 strain

```
//Example 7.6 : strain
clc;
clear;
close;
format('v',10)
//given data :
b=44.5*10^3;//force
E=1.1*10^5;// in N/mm^2
A=15.2*19.1// in mm^2
epsilon=b/(A*E);
disp(epsilon,"strain ,epsilon (mm) = ")
```

Scilab code Exa 7.7 true stress and true strain

```
//Example 7.7 :stress and strain
clc;
clear;
close;
format('v',6)
```

```
6 //given data :
7 sigma=450;//in MPa
8 epsilon=0.63;
9 sigma_t=sigma*(1+epsilon);
10 disp(sigma_t,"true stress,sigma_t(MPa) = ")
11 epsilon_t=log(1+epsilon);
12 disp(epsilon_t,"true strain,epsilon_t = ")
```

Scilab code Exa 7.8 greater stress

```
1 // Example 7.8: which part has a greater stress
2 clc;
3 clear;
4 close;
5 l=24;//length in mm
6 b=30;//breadth in mm
7 ld=7000;//load in kg
8 sd=10;//steel bar diamtere in mm
9 sl=5000;//load in kg
10 al=ld/(l*b);//stress on aluminium bar in kg/mm^2
11 a=((%pi*sd^2)/4);//area in mm^2
12 slb=sl/a;//stress on steel bar in kg/mm^2
13 disp("stress on aluminium bar is "+string(al)+" kg/
   mm^2 is less than stress on steel bar "+string(
   slb)+" kg/mm^2 " )
```

Chapter 8

Mechanical Tests of Metals

Scilab code Exa 8.1 critical resolved shear stress

```
1 // Example 8.1: critical resolved shear stress of
     silver
2 clc;
3 clear;
4 close;
5 format('v',5)
6 Ts=15;//tensile stress in Mpa
7 d=[1;1;0];
8 d1=[1;1;1];
9 csda=((d(1,1)*d1(1,1))+(d(2,1)*d1(2,1))+(d(3,1)*d1
     (3,1)))/((sqrt(d(1,1)^2+d(2,1)^2+d(3,1)^2))*sqrt(
     d1(1,1)^2+d1(2,1)^2+d1(3,1)^2));//angle degree
10 d2=[0;1;1];
11 csdb=((d(1,1)*d2(1,1))+(d(2,1)*d2(2,1))+(d(3,1)*d2
     (3,1)))/((sqrt(d(1,1)^2+d(2,1)^2+d(3,1)^2))*sqrt(
     d2(1,1)^2+d2(2,1)^2+d2(3,1)^2));//angle degree
12 t=Ts*csda*csdb;//critical resolved shear stress in
     MPa
13 disp(t,"critical resolved shear stress in MPa")
```

Scilab code Exa 8.2 yield strength

```
1 // Example 8.2: yield strength of material
2 clc;
3 clear;
4 close;
5 format('v',6)
6 ys1=115;// yeild strength in MN/mm^2
7 ys2=215;// yeild strength in MN/mm^2
8 d1=0.04;//diamtere in mm
9 d2=0.01;//diamtere in mm
10 A=[2 10; 1 10];
11 B=[230;215];
12 x=A\B;
13 si=x(1,1);// in MN/mm^2
14 k=x(2,1);//
15 d3=0.016;//in mm
16 sy= si +(k/sqrt(d3));//yeild strength for a grain
     size in MN/mm^2
17 disp(sy,"yeild strength for a grain size in MN/mm^2"
     )
```

Scilab code Exa 8.3 yield stress

```
1 // Example 8.3: yield strength of material
2 clc;
3 clear;
4 close;
5 ys1=120;// yeild strength in MN/mm^2
6 ys2=220;// yeild strength in MN/mm^2
7 d1=0.04;//diamtere in mm
8 d2=0.01;//diamtere in mm
```

```
A=[2 10; 1 10];
B=[240;220];
x=A\B;
si=x(1,1);// in MN/mm^2
k=x(2,1);//
d3=0.025;//in mm
sy= si +(k/sqrt(d3));//yeild strength for a grain
   size in MN/mm^2
disp(sy,"yeild strength for a grain size in MN/mm^2"
   )
```

Scilab code Exa 8.4 grain diameter

```
//Example 8.4 : grain diameter
clc;
clear;
close;
format('v',6)
//given data :
N=9;
m=8*2^N;
grain=1/sqrt(m);
disp(grain,"the grain diameter(mm) = ")
```

Chapter 9

Fracture of Metals

Scilab code Exa 9.1 fracture strength

```
1 //Example 9.1 : difference
2 clc;
3 clear;
4 close;
5 //given data :
6 E=200*10^9; // in N/m^2
7 C=(4*10^-6)/2;// in m
8 gama=1.48; // in J/m^2
9 sigma=sqrt((2*E*gama)/(%pi*C));
10 disp(sigma*10^-6,"fracture strength ,sigma(MN/m^2) =
   ")
```

Scilab code Exa 9.2 fracture strength

```
1 //Example 9.2 : the fracture strength and compare
2 clc;
3 clear;
4 close;
```

```
format('v',10)
//given data :
E=70*10^9; // in N/m^2
C=(4.2*10^-6)/2;// in m
gama=1.1; // in J/m^2
sigma=sqrt((2*E*gama)/(%pi*C));
disp(sigma,"fracture strength,sigma(N/m^2) = ")
```

Scilab code Exa 9.3 maximum length

```
//Example 9.3 : maximum length of surfacef
clc;
clear;
close;
format('v',7)
//given data :
sigma=36;//in MN/m^2
gama=0.27;// in J/m^2
E=70*10^9;//in N/m^2
C=((2*E*gama)/(sigma^2*%pi))*10^-6;
C2=2*C;
disp(C2,"maximum length of surface flow,C2(micro-m)
   =   ")
```

Scilab code Exa 9.4.a temperture

```
// Example 9.4.a: Temperature
clc;
clear;
close;
format('v',6)
E=350;// in GN/m^2
Y=2;// in J/m^2
```

```
C=2;// in micro meter
sg=sqrt((2*E*10^9*Y)/(%pi*C*10^-6));// IN mn/M^2
e=10^-2;// per second
T=173600/(round(sg*10^-6)-20.6-61.3*(log10(e)));//
   in kelvin
disp(T,"temperture in kelvin for ductile to brittle
   transition at a strain rate of 10^-2 per second")
```

Scilab code Exa 9.4.b temperature

```
// Example 9.4.b: Temperature
clc;
clear;
close;
format('v',5)
E=350;// in GN/m^2
Y=2;// in J/m^2
C=2;// in micro meter
sg=sqrt((2*E*10^9*Y)/(%pi*C*10^-6));// IN mn/M^2
e=10^-5;// per second
T=173600/(round(sg*10^-6)-20.6-61.3*(log10(e)));//
   in kelvin
disp(T,"temperture in kelvin for ductile to brittle
   transition at a strain rate of 10^-5 per second")
```

Chapter 15

Composite Materials and Ceramics

Scilab code Exa 15.1 volume ratio of aluminium and boron

```
1 //Example 15.1 : colume ratio of aluminium and boron
2 clc;
3 clear;
4 close;
5 format('v',6)
6 yal=715;// in GN/,^2
7 yfe=210;// in GN/,^2
8 yb=440;// in GN/,^2
9 A=[71 71;71 440];//
10 B=[71;210];//
11 X=A\B;//
12 disp(X(1,1),"volume ratio of aluminium is")
13 disp(X(2,1),"volume ratio of boron is")
```

Chapter 16

Semiconductors

Scilab code Exa 16.1 concentration of conductive electrons

```
1 //Example 16.1 : concentration
2 clc;
3 clear;
4 close;
5 format('v',9)
6 //given data :
7 e=1.602*10^-19;
8 sigma_i=5*10^-4;// in ohm/m
9 mu_n=0.14;// in m^2/V-sec
10 mu_p=0.05;// in m^2/V-sec
11 n_i=sigma_i/(e*(mu_n+mu_p));
12 disp(n_i*10^6,"the concentration ,n_i(/cm^3) = ")
```

Scilab code Exa 16.2 intrinsic carrier density

```
1 //Example 16.2 : intrinsic carrier
2 clc;
3 clear;
```

```
close;
format('v',9)
//given data :
e=1.602*10^-19;
p_i=2*10^-4;// in ohm-m
mu_n=6;// in m^2/V-sec
mu_p=0.2;// in m^2/V-sec
n_i=1/(e*(mu_n+mu_p)*p_i);
disp(n_i,"the intrinsic carrier ,n_i(/m^3) = ")
```

Scilab code Exa 16.3 concentration of N type impurity

```
//Example 16.3 : neglect the intrinsic conductivity
clc;
clear;
close;
format('v',9)
//given data :
e=1.6*10^-19;
sigma=10^-12;// in mhos/m
mu_n=0.18;// in m^2/V-sec
n=sigma/(e*mu_n);
N=n;
disp(N,"in (/m^3) = ")
```

Scilab code Exa 16.4 concentration number of electrons carrier

```
//Example 16.4 : number of electron carriers
clc;
clear;
close;
format('v',9)
//given data :
```

```
e=1.6*10^-19;
p=20*10^-2;// in ohm-m
mu_n=100*10^-4;// in m^2/V-sec
n=1/(e*mu_n*p);
disp(n,"number of electrons carrier ,n(/m^3) = ")
```

Scilab code Exa 16.5 concentration of impurity

```
//Example 16.5 : concentration of impurity
clc;
clear;
close;
format('v',9)
e=1.6*10^-19;//
l=10;//in mm
d=1;//in mm
r=100;//in ohms
up=0.19;//mobilty of electrons in V-sec
a=(%pi*((d*10^-3)^2))/4;//area in m^2
p=((r*a))/(l*10^-3);//resistivity in Ohm-cm
n=((1/(p*e*up)));//concentration in per m^3
disp(n,"impurity concentration is in per m^3")
```

Scilab code Exa 16.6 intrinsic carrier density

```
//Example 16.6 : intrinsic carrier density
clc;
clear;
close;
//given data :
format('v',10)
e=1.602*10^-19;
p=3000;// in ohm/m
```

```
sigma=1/p;// in ohm/m
mu_n=0.14;// in m^2/V-sec
mu_p=0.05;// in m^2/V-sec
n_i=sigma/(e*(mu_n+mu_p));
disp(n_i,"the concentration ,n_i(/m^3) = ")
```

Scilab code Exa 16.7 conductivity

```
//Example 16.7 : conductivity
clc;
clear;
close;
//given data :
e=1.602*10^-19;
n_i=5.021*10^15; // in m^-3
mu_n=0.48;// in m^2/V-sec
mu_p=0.013;// in m^2/V-sec
sigma=n_i*(e*(mu_n+mu_p));
disp(sigma,"the conductivity ,sigma(ohm^-1 m^-1) = ")
```

Chapter 17

Insulating Materials

Scilab code Exa 17.1 greater charge

```
1  // Example 17.1: greater chanrge
2  clc;
3  clear;
4  close;
5  format('v',10)
6  er1=6;//
7  d1=0.25;// in mm
8  a=1;// assume
9  er2=2.6;//
10 d2=0.1;// in mm
11 c1=(er1/d1);// in ampere
12 c2=(er2/d2);// in amperes
13 disp(" C1 "+string(c1)+"A will hold the more charge
     than C2 "+string(c2)+"A ")
```

Chapter 18

Magnetic Materials

Scilab code Exa 18.1 magnetization and flux density

```
1 //Example 18.1 : magnetization and flux density
2 clc;
3 clear;
4 close;
5 //given data :
6 mu0=4*%pi*10^-7;
7 H=10^4;// in A/m
8 Xm=3.7*10^-3;// room temperature
9 mu_r=1+Xm;
10 B=mu0*mu_r*H;
11 M=Xm*H;
12 disp(B,"the flux density ,B(Wb/m^2) = ")
13 disp(M,"magnetization ,M(A/m) = ")
```

Scilab code Exa 18.2.a saturation magnetisation

```
1 //Example 18.2.a : saturation magnetization
2 clc;
```

```
clear;
close;
//given data :
mu_b=9.27*10^-24;// A.m^2
p=8.9; // in g/cm^3
Na=6.023*10^23;// avogadro's number
A=58.71; // in g/mol
n=((p*Na)/A)*10^6;
Ms=0.60*mu_b*n;
disp(Ms,"saturation magnetization ,Ms(A/m) = ")
```

Scilab code Exa 18.2.b saturation flux density

```
//Example 18.2.b : saturation flux density
clc;
clear;
close;
//given data :
format('v',5)
mu0=4*%pi*10^-7;
mu_b=9.27*10^-24;// A.m^2
p=8.9; // in g/cm^3
Na=6.023*10^23;// avogadro's number
A=58.71; // in g/mol
n=((p*Na)/A)*10^6;
Ms=0.60*mu_b*n;
Bs=mu0*Ms;
disp(Bs,"saturation flux density ,Bs(tesla) = ")
```

Scilab code Exa 18.3 magnetic moments

```
//Example 18.3 : magnetic moment
clc;
```

```
clear;
close;
//given data :
format('v',9)
mu0=4*%pi*10^-7;
mu_b=9.27*10^-24;// A.m^2
p=8.9; // in g/cm^3
Na=6.023*10^23;// avogadro's number
A=58.71; // in g/mol
n=((p*Na)/A)*10^6;
Bs=0.65;//in Wb/m^2
Ms=Bs/mu0;
m_mu_b=Ms/n;
disp(m_mu_b,"saturation magnetisation ,m_mu_b(A.m^2)
   = ")
```

Scilab code Exa 18.4 power loss

```
//Example 18.4 : power loss
clc;
clear;
close;
//given data :
V=0.01;//in m^3
f=50;// in Hz
area=600;//in jm^-1
Wh=area*V*f;
disp(Wh,"power loss ,Wh(watts) = ")
```

Scilab code Exa 18.5 loss of energy

```
//Example 18.4 : los of energy
clc;
```

```
clear;
close;
//given data :
mass=10;// in kg
energy_loss=250;// in J/m^2
//energy loss at the rate of 50 cycles/s
E=energy_loss*50;// in J/m^3
E_loss=E*3600;//in J/m^3
D=7500;//density in kg/m^3
Volume=mass/D;
energy_loss_per_hour=E_loss/Volume;
disp(energy_loss_per_hour,"energy_loss_per_hour(J/
   hour) = ")
```