

Scilab Textbook Companion for  
Materials Science  
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# Book Description

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

**Exa** Example (Solved example)

**Eqn** Equation (Particular equation of the above book)

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

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

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# 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;
```



```

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

```

---

### Scilab code Exa 2.3 ratio of energy

```

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

```

from orbit 3 to orbit 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))
```

```

20 x111=1; //
21 x211=0; //
22 x311=1; //
23 h111=1/x111; //
24 h211=%inf; //
25 h311=1/x311; //
26 disp(" Miller indices of the plane (101) are : "+
        string(h111)+" ,"+string(h211)+" ,"+string(h311))

```

---

### Scilab code Exa 3.2 miller indices

```

1 //Example 3.2: miller indices
2 clc;
3 clear;
4 close;
5 //given data
6 x1=0; //
7 x2=2; //
8 x3=0; //
9 h1=%inf; //
10 h2=1/x2; //
11 h3=%inf; //
12 disp(" Miller indices of the plane (020) are: "+
        string(h1)+" ,"+string(h2)+" ,"+string(h3))
13 x11=1; //
14 x21=2; //
15 x31=0; //
16 h11=1/x11; //
17 h21=1/x21; //
18 h31=%inf; //
19 disp(" Miller indices of the plane (120) are : "+
        string(h11)+" ,"+string(h21)+" ,"+string(h31))
20 x111=2; //
21 x211=2; //
22 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;

```

```

3 clear;
4 close;
5 a=0.529; //
6 b=1; //
7 c=0.477; //
8 a1=0.264; //
9 b1=1; //
10 c1=0.238; //
11 r1=round(a/a1); //
12 r2=b/b1; //
13 r3=round(c/c1); //
14 disp("miller indices of the given plane are "+string
      (r1)+" : "+string(r2)+" : "+string(r3)+" ")

```

---

#### Scilab code Exa 3.5 miller indices

```

1 //Example 3.5: miller indices
2 clc;
3 clear;
4 close;
5 //given data
6 x1=1; //
7 x2=1; //
8 x3=0; //
9 h1=1/x1 //
10 h2=1/x2; //
11 h3=%inf; //
12 disp("Miller indices of the plane (110) are: "+
      string(h1)+" ,"+string(h2)+" ,"+string(h3))
13 x11=1; //
14 x21=1; //
15 x31=1; //
16 h11=1/x11; //
17 h21=1/x21; //
18 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 angstrom
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 nm^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 nm
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/mm2 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/a2; // for 100 planes
10 B=1.414/a2; //for (110) planes
11 C=1.732/a2; // 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/mm2 surface area
3 clc;
4 clear;
5 close;
6 //given data :
7 a=4.93*10-7; // lattice constant in mm
8 A=2/a2; // for 100 planes
9 B=1.414/a2; //for (110) planes
10 C=2.31/a2; // 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;

```

```

10 k2=2;
11 l2=0;
12 h3=1;
13 k3=1;
14 l3=1;
15 r=1.246;
16 a=(4*r)/sqrt(2); // in angstrom
17 //d=a/sqrt(h^2+k^2+l^2)
18 d1=a/sqrt(h1^2+k1^2+l1^2);
19 d2=a/sqrt(h2^2+k2^2+l2^2);
20 d3=a/sqrt(h3^2+k3^2+l3^2);
21 disp(d1,"d_200 spacind ,d1(angstrom) = ")
22 disp(d2,"d_220 spacind ,d2(angstrom) = ")
23 disp(d3,"d_111 spacind ,d3(angstrom) = ")

```

---

### Scilab code Exa 3.20 interplanar spacing

```

1 //Example 3.20 : interplaner spacing d_220
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 a=0.316; // in nm
8 h=2;
9 k=2;
10 l=0;
11 d=a/sqrt(h^2+k^2+l^2);
12 disp(d,"inter planer spacing d_220 ,d(nm) = ")
13 // answer is wrong in book

```

---

### Scilab code Exa 3.21 ratio of cubic lattice separation between the successive latti

```

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

```

---

### Scilab code Exa 3.22 perpendicular distance

```

1 // Example 3.22: perpendicular distance
2 clc;
3 clear;
4 close;
5 a=1;//constant assume
6 a1=[1;1;1];//lattice planes
7 a2=[2;2;2];//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 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;
```



```

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

```

---

#### Scilab code Exa 3.25 lattice constants

```

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

```

---

#### Scilab code Exa 3.26 density

```

1 //Example 3.26 : density
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',5)

```

```

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

```

---

#### Scilab code Exa 3.27 number of atoms

```

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

```

---

#### Scilab code Exa 3.28 lattice constants

```

1 //Example 3.28 : lattice constant
2 clc;
3 clear;
4 close;
5 //given data :
6 d=6250; //density
7 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

```

```

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

```

---

#### Scilab code Exa 3.31 interplanar spacing

```

1 //Example 3.31 : interplanar spacing
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',5)
7 theta=20.3; //in degree
8 lamda=1.54; // in angstrom
9 n=1;
10 a=sind(theta)
11 d=lamda/(2*a);
12 disp(d,"interplanar spacing ,d(angstrom) = ")

```

---

#### Scilab code Exa 3.32 interatomic spacing

```

1 //Example 3.32 : interatomic spacing
2 clc;
3 clear;
4 close;
5 //given data :

```

```

6 format('v',9)
7 theta=30;//in degree
8 lamda=1.54;// in angstrom
9 n=1;
10 a=sind(theta)
11 d=lamda/(2*a);
12 disp(d,"interatomic spacing ,d(angstrom) = ")

```

---

### Scilab code Exa 3.33 order of Braggs reflection

```

1 //Example 3.33 : number of per order
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',5)
7 theta=90;//in degree
8 lamda=1.54;// in angstrom
9 a=sind(theta)
10 d=1.181;
11 n=(2*d*a)/lamda;
12 disp(n,"number of order ,n = ")

```

---

### Scilab code Exa 3.34 size of unit cell

```

1 // Example 3.34: size of unit cell
2 clc;
3 clear;
4 close;
5 n=1;//
6 a=1;//assume
7 h=0.58;//wavelnegth in armstrong
8 th=9.5;//reflection angle in degree

```

```

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

```

---

### Scilab code Exa 3.35 Bragg angle

```

1 // Example 3.35: bragg angle
2 clc;
3 clear;
4 close;
5 n=1; //
6 a=3.57; //in
7 h=0.54; //wavelnegth in
8 a1=[1;1;1]; //miller indices
9 d111=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2)); //
    interplanar distance between (111)planes
10 snd=((n*h)/(2*d111)); //
11 th=asind(snd); // bragg angle in degree
12 d1=floor(th); //
13 d2=th-floor(d1); //
14 disp("angle between planes (122) and (111) is "+
    string(d1)+" degree "+string(round(60*d2))+
    minutes")
15 //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

```

1 // Example 3.36: interplanner spacing and miller
    indices

```

```

2  clc;
3  clear;
4  close;
5  a=3.16; // in
6  h=1.54; // in
7  n=1; //
8  th=20.3; // in degree
9  d=((n*h)/(2*sind(th))); // interplanner spacing in
10 x=a/d; //
11 y=x^2; //
12 disp(d,"interplanner spacing in      is")
13 disp("miller indices are (110) , (011) or (101)")

```

---

Scilab code Exa 3.37 interplanar spacing and diffraction angle

```

1  // Example 3.36: interplanner spacing and
   diffraction angle
2  clc;
3  clear;
4  close;
5  a=.2866; // in
6  h=0.1542; // in nm
7  n=1; //
8  a1=[2;1;1]; //miller indices
9  d211=a/(sqrt(a1(1,1)^2+a1(2,1)^2+a1(3,1)^2)); //
   interplanar distance between (211) planes
10 snd=((n*h)/(2*d211)); //
11 th=asind(snd); // bragg angle in degree
12 d1=floor(th); //
13 d2=th-floor(d1); //
14 disp("angle between planes (122) and (111) is "+
   string(d1)+" degree "+string(round(60*d2))+
   minutes")
15 disp(d211,"interplanner spacing in      is")
16 //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
```

```

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

```

---

#### Scilab code Exa 5.2 resistance

```

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

```

---

#### Scilab code Exa 5.3 resistance

```

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

```

---

### Scilab code Exa 5.4 conductivity

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

---

### Scilab code Exa 5.5 drift velocity

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

---

### Scilab code Exa 5.6 conductivity

```

1 // Example 5.6: conductivity
2 clc, clear
3 // given :
4 e=1.6*10^-19; // in C
5 T=300; // temperature in K
6 t=2*10^-14; // time in sec
7 c=63.54; // atomic weight of copper in a.m.u
8 m=9.1*10^-31; // mass in kg
9 // 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).
10 n=6.023*10^23/(c/8.9); //number of electrons per
   unit volume(c.c)
11 n1=n*10^6; // the number of electrons per m^3
12 b=(e^2*n1*t)/m;
13 disp(b," conductivity ,b(mho/m) = ")

```

---

#### Scilab code Exa 5.7 mobility of electrons

```

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

```

---

#### Scilab code Exa 5.8 mobility of electrons

```

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

```

---

**Scilab code Exa 5.9** mobility of electrons and drift velocity

```

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

```

---

**Scilab code Exa 5.10** density and drift velocity

```

1 //Example 5.10 : density and drift velocity
2 clc;
3 clear;

```

```

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

```

---

#### Scilab code Exa 5.11 velocity

```

1 //Example 5.11 : velocity
2 clc;
3 clear;
4 close;
5 //given data :
6 m=9.109*10^-31; // in kg
7 e=1.602 *10^-19;
8 Ef=2.1 // in ev
9 Wf=e*Ef; // in J
10 vf=sqrt((2*Wf)/m);
11 disp(vf,"velocity ,vf(m/s) = ")

```

---

#### Scilab code Exa 5.12.a velocity

```

1 //Example 5.12.a : velocity
2 clc;
3 clear;
4 close;
5 //given data :

```

```

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

```

---

### Scilab code Exa 5.12.b mobility of electrons

```

1
2 //Example 5.12.b : mobility of electron
3 clc;
4 clear;
5 close;
6 //given data :
7 m=9.1*10^-31; // in kg
8 e=1.602 *10^-19;
9 Ef=3.75; // in ev
10 t=10^-14; // in sec
11 mu=(e*t)/m;
12 disp(mu," mobility ,mu(m^2/V-sec) = ")

```

---

### Scilab code Exa 5.13 mean free path

```

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

```

```

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

```

---

#### Scilab code Exa 5.14 mobility and average time

```

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

```

---

#### Scilab code Exa 5.15 electrical resistivity

```

1 //Example 5.15 : electrical resistivity
2 clc;
3 clear;

```



```
4 close;
5 //given data :
6 format('v',8)
7 r=1.86*10^-10; // in m
8 t=3*10^-14; // in sec
9 a=2;
10 m=9.1*10^-31; // in kg
11 e=1.602 *10^-9;
12 A=23*10^-3; //in kg/m
13 N=6.023*10^23; // avogadro 's number
14 M=(a*A)/N;
15 V=((4/sqrt(3))*r)^3;
16 d=M/V;
17 mu=((e*t)/m);
18 n=(N*d)/A;
19 b=1.602 *10^-19*n*mu;
20 p=(1/b);
21 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/m^2
8 v=0.3; // poisson ratio
9 G=E/(2*(1+v));
10 disp(G,"shear modulus ,G(GN/m^2) = ")
```

---

Scilab code Exa 7.2 young modulus of elasticity yield point ultimate stress and pe

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

```

4  close;
5  format('v',9)
6  //given data :
7  d=40*10^-3;//in m
8  W=40*10^3;// load in N
9  del_l=3.04*10^-5;// in m
10 L=200*10^-3;// in m
11 load_max=242*10^3;//in N
12 l=249*10^-3;// length of specimen in m
13 l0=(d+L); // in m
14 A=(%pi*d^2)/4;
15 b=W/A;
16 epsilon=del_l/L;
17 E=(b/epsilon);
18 disp(E,"young modulus ,E(N/m^2) = ")
19 Y_load=161*10^3;
20 Y_stress=Y_load/A;
21 disp(Y_stress,"yield point stress ,Y_stress(N/m^2) = ")
22 U_stress=load_max/A;
23 disp(U_stress,"ultimate stress ,U_stress(N/m^2) = ")
24 p_elongation=((l-l0)/l0)*100;
25 disp(p_elongation,"percentage elongation ,
    p_elongation(%) = ")
26 //percentage elongation is calculated wrong in
    textbook

```

---

### Scilab code Exa 7.3.a yield point stress

```

1  // Example 7.3.a: yield point stress
2  clc;
3  clear;
4  close;
5  format('v',10)
6  y1=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=((y1*10^3)/(A)); //yeild point stress in N/m^2
15 disp(ylp," yeild point stress in N/m^2")

```

---

#### Scilab code Exa 7.3.b ultimate tensile strength

```

1 // Example 7.3.b: ultimate tensile strength
2 clc;
3 clear;
4 close;
5 format('v',10)
6 y1=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=((y1*10^3)/(A)); //yeild point stress in N/m^2
15 uts=((ml*10^3)/(A)); //ultimate tensile strangth in N
    /m^2
16 disp(uts," ultimate tensile strangth in N/m^2")

```

---

#### Scilab code Exa 7.3.c percentage elongation

```

1 // Example 7.3.c: percentage elongation

```

```

2  clc;
3  clear;
4  close;
5  format('v',10)
6  y1=40; //yeild load in kN
7  m1=71.5; //maximum load in kN
8  f1=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 s1=62.5; //specimen length in mm
13 a=(%pi*d*10^-3)^2/4; // in meter square
14 pel=((glf-s1)/s1)*100; //percentage elongation
15 disp(pel,"percentage elongation is")

```

---

#### Scilab code Exa 7.3.d modulus of elasticity

```

1  // Example 7.3.d:modulus of elasticity
2  clc;
3  clear;
4  close;
5  format('v',8)
6  y1=40; //yeild load in kN
7  m1=71.5; //maximum load in kN
8  f1=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 s1=62.5; //specimen length in mm
13 A=(%pi*(d*10^-3)^2)/4; // in meter square
14 ylp=((y1*10^3)/(A)); //yeild point stress in N/m^2
15 uts=((m1*10^3)/(A)); //ultimate tensile strangth in N
    /m^2
16 pel=((glf-s1)/s1)*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;
4 close;
```

```

5 format('v',10)
6 y1=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=((y1*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 fs=((fl*10^3)/(A)); //fracture stress in N/m^2
21 disp(fs,"fracture stress in N/m^2")

```

---

### Scilab code Exa 7.3.g modulus of toughness

```

1
2 // Example 7.3.g: modulus of toughness
3 clc;
4 clear;
5 close;
6 format('v',10)
7 y1=40; //yeild load in kN
8 ml=71.5; //maximum load in kN
9 fl=50.5; //fracture load in kN
10 glf=79.5; //gauge length of fratture in mm
11 st=7.75*10^-4; //strain at load of 20kN
12 d=12.5; //specimen diamtere in mm
13 sl=62.5; //specimen length in mm
14 A=(%pi*(d*10^-3)^2)/4; // in meter square

```

```

15 ylp=((y1*10^3)/(A)); //yeild point stress in N/m^2
16 uts=((m1*10^3)/(A)); //ultimate tensile strangth in N
    /m^2
17 pel=((glf-s1)/s1)*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=((y1p*10^-3)^2/(2*mel)); //modulus of resilience
21 fs=((f1*10^3)/(A)); //fracture stress in N/m^2
22 mth=((y1p+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) = ")

```



17 //true breaking stress unit is wrong in the textbook

---

#### Scilab code Exa 7.5.a yield stress

```
1 // Example 7.5.a: yield point stress
2 clc;
3 clear;
4 close;
5 format('v',10)
6 y1=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 meter square
14 ylp=((y1*10^3)/(A)); //yeild point stress in N/mm^2
15 disp(floor(ylp),"yeild point stress in N/mm^2")
```

---

#### Scilab code Exa 7.5.b ultimate tesnile stress

```
1 // Example 7.5.b: ultimate tensile stress
2 clc;
3 clear;
4 close;
5 format('v',6)
6 y1=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 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)
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 fracture 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=(fl-glf)/glf; //
16 disp(pr*100,"percentage elonagtion is")

```

---

#### Scilab code Exa 7.6 strain

```

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

```

---

#### Scilab code Exa 7.7 true stress and true strain

```

1 //Example 7.7 :stress and strain
2 clc;
3 clear;
4 close;
5 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
```

```

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

```

---

#### Scilab code Exa 8.4 grain diameter

```

1 //Example 8.4 : grain diameter
2 clc;
3 clear;
4 close;
5 format('v',6)
6 //given data :
7 N=9;
8 m=8*2^N;
9 grain=1/sqrt(m);
10 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;
```



```

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

```

---

### Scilab code Exa 9.3 maximum length

```

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

```

---

### Scilab code Exa 9.4.a temperture

```

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

```

```

8 C=2; // in micro meter
9 sg=sqrt((2*E*10^9*Y)/(%pi*C*10^-6)); // IN mm/M^2
10 e=10^-2; // per second
11 T=173600/(round(sg*10^-6)-20.6-61.3*(log10(e))); //
    in kelvin
12 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

```

1 // Example 9.4.b: Temperature
2 clc;
3 clear;
4 close;
5 format('v',5)
6 E=350; // in GN/m^2
7 Y=2; // in J/m^2
8 C=2; // in micro meter
9 sg=sqrt((2*E*10^9*Y)/(%pi*C*10^-6)); // IN mm/M^2
10 e=10^-5; // per second
11 T=173600/(round(sg*10^-6)-20.6-61.3*(log10(e))); //
    in kelvin
12 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 ya1=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;
```

```

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

```

---

Scilab code Exa 16.3 concentration of N type impurity

```

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

```

---

Scilab code Exa 16.4 concentration number of electrons carrier

```

1 //Example 16.4 : number of electron carriers
2 clc;
3 clear;
4 close;
5 format('v',9)
6 //given data :

```

```

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

```

---

#### Scilab code Exa 16.5 concentration of impurity

```

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

```

---

#### Scilab code Exa 16.6 intrinsic carrier density

```

1 //Example 16.6 : intrinsic carrier density
2 clc;
3 clear;
4 close;
5 //given data :
6 format('v',10)
7 e=1.602*10^-19;
8 p=3000; // in ohm/m

```

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

---

### Scilab code Exa 16.7 conductivity

```
1 //Example 16.7 : conductivity
2 clc;
3 clear;
4 close;
5 //given data :
6 e=1.602*10^-19;
7 n_i=5.021*10^15; // in m^-3
8 mu_n=0.48; // in m^2/V-sec
9 mu_p=0.013; // in m^2/V-sec
10 sigma=n_i*(e*(mu_n+mu_p));
11 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 charge
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;
```

```

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

```

---

#### Scilab code Exa 18.2.b saturation flux density

```

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

```

---

#### Scilab code Exa 18.3 magnetic moments

```

1 //Example 18.3 : magnetic moment
2 clc;

```

```

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

```

---

#### Scilab code Exa 18.4 power loss

```

1 //Example 18.4 : power loss
2 clc;
3 clear;
4 close;
5 //given data :
6 V=0.01; //in m^3
7 f=50; // in Hz
8 area=600; //in jm^-1
9 Wh=area*V*f;
10 disp(Wh,"power loss ,Wh(watts) = ")

```

---

#### Scilab code Exa 18.5 loss of energy

```

1 //Example 18.4 : los of energy
2 clc;

```

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

---