Scilab Textbook Companion for Material Science by B. S. Narang[1]

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January 13, 2016

[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: Material Science

Author: B. S. Narang

Publisher: CBS, New Delhi

Edition: 1

Year: 1982

ISBN: 9788123900148

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

General Introduction

Scilab code Exa 1.1 Find the ionisation current

```
1 //Initialisation of variables
2 clc
3 C=20/(9*10^11)//converting cms to farads
4 F=154-100//fall in potential
5 R=F/60//rate of fall in potential
6 I=C*R//ionization current
7 printf('ionization current is %e amp \n',I)//
    correction applied
```

Chapter 2

The electron

Scilab code Exa 2.1 Calculate e by m ratio

```
1 //Initialisation of variables
2 clc
3 v=3e9//cms per second
4 X=.06//e.s unit
5 R=300//cms
6 //(m*v^2/r)=X*e
7 electronbymass=v^2/(R*X)
8 printf('e/m ratio is %e esu \n',electronbymass)
```

Scilab code Exa 2.2 Calculate e by m ratio of electron

```
1 //Initialisation of variables
2 clc
3 e=1.603e-20//electron volts
4 t=6.6e-9
5 m=9.11e-28//mass of electron
6 V=500e8//e.m.u
7 d=5//cm
```

```
X=V/d//e.m.u per cm
f=X*e//force on electron
a=f/m//acceleration of electron
v=a*t//velocity of electron
dist=.5*a*t^2//distance travelled
printf('velocity of electron is %e cm per s \n',v)
printf('distance travelled is %d cms \n',dist)
```

Scilab code Exa 2.3 Calculate velocity acquired and distance travelled by electron

```

//Initialisation of variables
clc
a=10^(-5)
d=1
e=4.8*10^(-10)
g=980
X=4*%pi*a^3*d*g/(3*e)
printf('field required to keep drop stationary is %e
    esu per cm \n',X)
```

Scilab code Exa 2.4 Calculate electric field required to keep electron stationary

```
//Initialisation of variables
clc
m=9.1*10^(-28)//mass on electron
e=4.8*10^(-10)//charge on electron
ev=1.6e-12//electron volt in ergs
v=10^9//cms/sec
E=0.5*m*v^2//energy in ergs
Ev=E/ev
```

```
 9 printf('energy is %e ergs \n',E)
10 printf('energy is %f electron volt \n',Ev)
```

Chapter 4

The Bohr Atom Model

Scilab code Exa 4.1 Calculate velocity of electron in innermost orbit of hydrogen

```
1 //Initialisation of variables
2 clc
3 e=1.6e-19//coulomb
4 o=8.85e-12//farad per metre
5 h=6.625e-34//joule sec
6 v=sqrt(e^4/(4*o^2*h^2))
7 printf('velocity is %e metre per second \n',v)
```

Scilab code Exa 4.2 Calculate energy in ground state of Hydrogen atom

```
1
2 //Initialisation of variables
3 clc
4 Z=1
5 n=1
6 m=9.11e-31//kg
7 e=1.6e-19//coulomb
```

```
o=8.85e-12//farad per metre
h=6.625e-34//joule sec
E=Z^2*m*e^4/(8*o^2*h^2*n^2)//relation 4.12
printf('energy is %e joules \n',E)
```

Scilab code Exa 4.3 Calculate ionization potential of hydrogen

```
//Initialisation of variables
clc
Z=1
m=9.11e-31//kg
e=1.6e-19//coulomb
o=8.85e-12//farad per metre
h=6.625e-34//joule sec
V=Z^2*m*e^3/(8*o^2*h^2)
printf('ionization potential is %f volts \n',V)
```

Scilab code Exa 4.4 Calculate second ionization potential of helium

```
//Initialisation of variables
clc
Z=2
m=9.11e-31//kg
e=1.6e-19//coulomb
o=8.85e-12//farad per metre
h=6.625e-34//joule sec
V=Z^2*m*e^3/(8*o^2*h^2)
printf('second ionization potential is %f volts \n',
   V)
```

Chapter 6

Quantum Theory

Scilab code Exa 6.1 Calculate energy equivalent in electron volts

```
1 //Initialisation of variables
2 clc
3 mo=9.028e-28//grams
4 c=3e10
5 E=mo*c^2
6 ev=1.6e-12//electron volt
7 EineV=E/ev
8 EinMeV=EineV/10^6
9 printf('energy in million electron volt is %f MeV \n
    ',EinMeV)
```

Scilab code Exa 6.2 Calculate energy equivalent in electron volts

```
1 //Initialisation of variables
2 clc
3 amu=1.6558e-24
4 c=3e10
5 ev=1.6e-12//electron volt
```

```
E=amu*c^2/ev
EinMeV=E/10^6
printf('energy in million electron volt is %d MeV \n
    ',EinMeV)
```

Scilab code Exa 6.3 Calculate velocity at which mass is double the rest mass

```
//Initialisation of variables
clc
c=3e10
//eauating m=2*mo and cancelling we get
v=sqrt(.75*c^2)// cm per s
printf('required velocity is %e cm per sec \n',v)
```

Scilab code Exa 6.4 wavelength associated with electron when it reach anode

```
//Initialisation of variables
clc
m=9.11e-28
e=4.803e-10
h=6.62e-27
V=100/300//e.s.u
//.5*m*v^2=V*e
v=sqrt(2*V*e/m)
l=h/(m*v)
printf('wavelength associated is %e cms \n',l)
```

Chapter 8

crystal and crystal structure

Scilab code Exa 8.1 Calculate density of copper

```
1 //Initialisation of variables
2 clc
3 r=1.278e-8
4 n=4//number of molecules per unit cell
5 M=63.54//for copper
6 a=4*r/sqrt(2)
7 N=6.023e23
8 d=n*M/(a^3*N)
9 printf('density is %f gm per cms \n',d)
```

Scilab code Exa 8.2 Calculate minimum ratio for CN of 3

```
1 //Initialisation of variables
2 clc
3 ratio=1/cosd(30)-1
4 printf('minimum ratio is %f \n',ratio)
```

Scilab code Exa 8.3 Calculate atomic packing factor

```
1 //Initialisation of variables
2 clc
3 n=4//number of atoms in a cell for copper
4 //APF=n*4*%pi*r^3/(a^3)
5 APFCu=4*4*%pi*2*sqrt(2)/(4*16*4)
6 printf('APF for copper is %f \n',APFCu)//correction
7
8 r=0.98//armstrom
9 R=1.81//armstrom
10 APFNaCl=((4*4*%pi*r^3/3)+(4*4*%pi*R^3/3))/((4/3)*(2*
   r+2*R)^3)
11 printf('APF for NaCl is %f \n',APFNaCl)//correction
```

Scilab code Exa 8.4 how many atoms per square metre are there in a plane of lead

```
1 //Initialisation of variables
2 clc
3 n=2//number of atoms in plane
4 r=3.5e-8/2//armstrom
5 //interatomic distance=2*r
6 a=4*r/sqrt(2)
7 Area=a^2
8 AtomsperArea=n/Area
9 printf('atoms per cm cube is %e\n',AtomsperArea)//
   correction
```

Chapter 9

Xrays

Scilab code Exa 9.1 Find maximum speed of electron in xray

```
1 //Initialisation of variables
2 clc
3 V=20e3//volts
4 m=9e-31//mass of electron
5 e=1.6e-19//charge of electron
6 v=sqrt(2*V*e/m)
7 printf('maximum speed of electron is %e metre per
    second \n',v)
```

Scilab code Exa 9.2 calculate number of electrons striking target and their speed

```
1 //Initialisation of variables
2 clc
3 m=9e-31//mass of electron
4 e=1.6e-19//charge of electron
5 V=5000//volts
6 v=sqrt(2*V*e/m)
```

```
7 printf('maximum speed of electron is %e metre per
    second \n',v)
```

Scilab code Exa 9.3 find the rate of production of heat

```
1 //Initialisation of variables
2 clc
3 energy=0.1/100//energy converted
4 amp_watt=5/1000
5 m=9e-31//mass of electron
6 e=1.6e-19//charge of electron
7 V=100000//volts
8 v=sqrt(2*V*e/m)
9 EnConv=V*energy*amp_watt
10 EnConvinJ=4.18*EnConv
11 printf('maximum speed of electron is %e metre per
    second \n',v)
12 printf('Rate of production of heat is %f calories
    per second \n',EnConvinJ)
```

Scilab code Exa 9.4 calculate inter atomic spacing

```
1 //Initialisation of variables
2 clc
3 h=1
4 k=1
5 l=1
6 dhkl=1.75e-8//
7 a=dhkl*sqrt(h^2+k^2+l^2)
8 printf('inter atomic spacing is %e cms \n',a)
```

Chapter 10

ultrasonic

Scilab code Exa 10.1 calculate frequency of fundamental note

```
1 //Initialisation of variables
2 clc
3 l=3e-3//vibrating length
4 E=8e10//young modulus
5 d=2500//kg per m3
6 N=(1/(2*l))*sqrt(E/d)
7 printf('frequency is %e Hz \n',N)
```