Scilab Textbook Companion for Modern Physics for Engineers by S. P. Taneja[1]

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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.

Contents

List of Scilab Codes

Chapter 1

Interference of Light

Scilab code Exa 1.1 fringe width

```
//Example 1.1 // fringe width
clear;
clc;
//given data :
d=5D-4;// distance between slits in m
w=5890D-10;// wavelength in m
D=0.5;//distance between source and screen in m
b=D*w/d;//fringes width
disp(b,"width of fringes in meter")
```

Scilab code Exa 1.2 slit separation

```
//Example 1.2 // double slit separation
clear;
clc;
//given data :
w=5100D-10;// wavelength in m
D=2;//distance between source and screen in m
```

```
n=10;// number of fringes
x=0.02;//width of all n fringes in m
b=x/n;//fringes width
d=D*w/b;//double slit width
disp(d,"double slit separation in meter")
```

Scilab code Exa 1.3 wave length

```
//Example 1.3 // wavelength of ligth
clc;
clear;
//given data :
d=19D-4;// distance between slits in m
D=1;//distance between source and screen in m
b=.31D-3;//fringes width in m
w=b*d/D;// wavelength in m
w=w*1D10;// to convert in A
disp(w,"wavelength of light in A(angstrom)")
```

Scilab code Exa 1.4 position of fringe

```
//Example 1.4 // position of fringe
clc;
clear;
//given data :
d=2D-3;// distance between slits in m
w=5890D-10;// wavelength in m
D=0.04;//distance between source and screen in m
n=10;// number of fringe which is to locate
x=n*D*w/d;//position of fringe
disp(x,"position of nth fringes in meter")
```

Scilab code Exa 1.5 Distance between coherent source

```
//Example 1.5 // distance between coherent source
clc;
//given data :
b=9.424D-4;//fringes width in m
w=5890D-10;// wavelength in m
a=0.05;// distance between source & prism in m
c=0.75;// distance between prism & screen in m
D=a+c;//distance between source and screen in m
d=(D*w)/b;//distance between coherent source
disp(d,"distance between coherent source in meter")
```

Scilab code Exa 1.6 Fringe width

```
//Example 1.6 // fringe width
clc;
//given data :
a=0.10;// distance between source & prism in m
c=1;// distance between prism & screen in m
u=1.5;//referactive index of bi-prism
al=%pi/180;//angle in radian
d=2*a*(u-1)*al;// distance between slits in m
w=5900D-10;// wavelength in m
D=a+c;//distance between source and screen in m
b=D*w/d;//fringes width
disp(b,"width of fringes in meter")
```

Scilab code Exa 1.8 Vertex angle

```
//Example 1.8 // angle of vertex of biprism
clc;
clear;
//given data :
u=1.5;//referactive index of bi-prism
b=.2D-3;//fringes width in m
al=%pi/180;//angle in radian
w=5D-7;// wavelength in m
a=0.25;// distance between source & prism in m
c=1.75;// distance between prism & screen in m
D=a+c;//distance between source and screen in m
d=D*w/b;//distance between slits in m
a1=d/(2*a*(u-1));// angle in radian
al=a1*180/%pi;// angle in degree
vert=180-2*al;// vertex angle
disp(vert,"angle of vertex of biprism in degree")
```

Scilab code Exa 1.9 wavelength

```
//Example 1.9 // wavelength of ligth
clc;
clear;
//given data :
u=1.5;//referactive index of bi-prism
a=50;// distance between source & prism in cm
c=50;// distance between prism & screen in cm
A=179;// angle of bi-prism in degree
D=a+c;//distance between source and screen in cm
b=.0135;//fringes width in cm
al=(180-A)/2;// angle with base in degree
al=al*%pi/180;//to convert in radian
w=2*al*(u-1)*a*b/D// wavelength in cm
disp(w*1D8,"wavelength of light in Angstrom")
```

Scilab code Exa 1.10 Fringe width

```
//Example 1.10 // fringe width
clc;
clear;
//given data :
b1=0.087;// initally fringe width in mm
//when distance given in ratio
r=.75;// ratio
b=b1/r
disp(b,"width of fringes in mm")
```

Scilab code Exa 1.11 distance between coherent sources

```
//Example 1.11 // separation between coherent source
clc;
clear;
//given data :
u=1.5;//referactive index of bi-prism
al=2*%pi/180;//angle in radian
a=.1;// distance between source & prism in m
d=2*a*(u-1)*al;// distance between slits in m
disp(d,"separation between coherent source in meter"
   )
```

Scilab code Exa 1.12 Refractive Index of sheet

```
//Example 1.12 // refractive index of sheet
clc;
```

```
clear;
//given data :
w=5460D-10;// wavelength in m
n=6;// number of fringe shifted
t=6.3D-6;//thickness of material
u=(n*w)/t +1; // equation for fefractive index
disp(u,"refractive index of sheet")
```

Scilab code Exa 1.14 Thickness of plate

```
//Example 1.4 // thickness of plate
clc;
clear;
//given data :
u=1.5;//referactive index of glass plate
r=60;// refraction angle in degree
r=r*%pi/180;// to convert in radian
w=5890D-10;// wavelength in m
//for least thickness
t=w/(2*u*cos(r));
t=t*1D10;// to convert in angstrom
disp(t,"thickness of plate in A")
```

Scilab code Exa 1.15 Film Thickness

```
//Example 1.15 // flim thickness
clc;
clear;
//given data :
u=1.5;//referactive index of oil
i=30;// incident angle in degree
i=i*%pi/180;//to convert in radian
n=8;//8th dark band
```

```
w=5890D-10;// wavelength in m
r=sqrt(1-(sin(i)/u)^2);//cos of received angle
t=n*w/(2*u*r);//formula of thickness
t=t*1D3;//to convert in mm
disp(t*1D-3,"flim thickness in m")
```

Scilab code Exa 1.16 Order of interference

```
//Example 1.16 // order of dark band
clc;
clear;
//given data :
u=4/3;//referactive index of soap flim
t=1.5D-6;//thickness of soap flim
i=60;//incident angle in degree
i=i*%pi/180;// incident angle in radian
w=5D-7;// wavelength in m
r=sin(i)/u;//sin of refracted angle
R=asin(r);//refracted angle in radian
n=2*u*t*cos(R)/w
n=floor(n)
disp(n,"order of dark band")
```

Scilab code Exa 1.17 Fringe Width

```
//Example 1.17 // fringe width
clc;
clear;
//given data :
x=.15;// air flim base width in m
w=6D-7;// wavelength in m
ab=0.05D-3;//length wire in m
u=1;//refractive index of air
```

```
theta=ab/x;
b=w/(2*u*theta);//fringes width
disp(b,"width of fringes in meter")
```

Scilab code Exa 1.18 Wavelength of light

```
//Example 1.18 // wavvelength of light
clc;
//given data :
b=.5D-2;//distace between succesive fringes in m
u=1.4;//refractive index of cellophane
a=10;//angle of wedge in sec
a=a*%pi/(60*60*180);//to convert in radian
w=2*u*a*b;
w=w*1D10;//to convert in A
disp(w,"wavelength of light used in A")

//note: Pi is taken as 22/7 in the textbook.
```

Scilab code Exa 1.19 Wedge angle

```
//Example 1.19 // angle of wedge
clc;
clear;
//given data :
x=1D-2;//distace of mth dark band
w=6D-7;// wavelength in m
m=10;//number of dark band
a=m*w/(2*x)
disp(a,"angle of wedge in radian")
//note: answer in textbook is in seconds
```

Scilab code Exa 1.20 No of Dark bands

```
//Example 1.20 // number of dark band
clc;
clear;
//given data :
t=0.01;//thickness of oil film
t=t*1D-3;//to convert in m
u=1.4;//refractive index of oil
w1=4D-7;// first wavelength in m
w2=5D-7;// second wavelength in m
a=%pi/4;//flim placed at angle
cosr=sqrt(1-(sin(a)/u)^2);//formula
n1=2*u*t*cosr/w1;
n2=2*u*t*cosr/w2;
n1=floor(n1);//to convert in integer
n2=floor(n2);//to convert in integer
n=n1-n2;//number of dark band
disp(n,"number of dark band")
```

Scilab code Exa 1.21 Radius of lens

```
//Example 1.21 // radius of lens
clc;
clear;
//given data :
w=5890D-10;//wavelength used in m
d=.01;//diameter of dark ring in m
r=%pi/6;//angle that light passes in radian
n=3;// order of ring
u=1;// refractive index of medium  between lens  and
    plate
```

```
R=u*(d^2)*cos(r)/(4*n*w);// radius of lens in m
disp(R,"radius of lens in m")
```

Scilab code Exa 1.22 Wavelength of light

```
//Example 1.22 // wavelength used
clc;
clear;
//given data :
R=3;//radius of lens in m
n=8;// order of bright ring
D=.72D-2;// diameter of bright ring in m
u=1;// refractive index of medium between lens and
    plate
w=(D^2)/((2*n-1)*2*R);// wavelength used in m
w=w*1D10;//to convert in A
disp(w,"wavelength of light used in A")
```

Scilab code Exa 1.23 Distance between rings

```
//Example 1.23 // distance between rings
clc;
clear;
//given data :
R1=100;//radii of curvature in cm
R2=R1;// given
w=5400D-8;// wavelength of light in m
n1=5;// order of ring for case one
r1=sqrt(n1*w/((1/R1)+(1/R2)));//radii of curvature
    in cm
n2=15;// order of ring for second case
r2=sqrt(n2*w/(1/R1+1/R2));// radii of curvature in
    cm
```

```
d=r2-r1;// distance between rings
disp(d,"distance between rings in cm")
```

Scilab code Exa 1.24 Refractive Index of liquid

```
//Example 1.24 // refractive index
clc;
clear;
//given data :
d1=.3;// diameter of ring in cm
d2=.25;//diameter of ring(in cm) after placing in
   medium
u=(d1/d2)^2;// refractive index of medium
disp(u,"refractive index of medium")
```

Scilab code Exa 1.25 Diameter of Ring

```
//Example 1.25 // diameter of bright ring
clc;
clear;
//given data :
w=6D-7;// wavelength used in m
R1=3;//radius of curvature of convex lens in m
R2=4;//radius of curvature of concave lens in m
n=13;// order of ring
r=sqrt((2*n-1)*w/(2*(1/R1-1/R2)));// radius of ring
disp(2*r,"diameter of bright ring in m")
```

Scilab code Exa 1.26 Thickness of film

```
//Example 1.26 // thickness of flim
clc;
clear;
//given data :
u=1.5;// refractive index  of flim between lens and
    plate
m=10;//no. of fringes shifted in experiment
w=5890D-10;// wavelength of light used in m
t=m*w/(2*(u-1));// thickness of plastic flim in m
t=t*1D9;// to convert in nm
disp(t,"thickness of flim in nm(nanometer)")
```

Scilab code Exa 1.27 Refractive Index

```
//Example 1.27 // refractive index
clc;
clear;
//given data :
n=150;//no. of frnges shifted
w=4D-7;// wavelength of light used
l=.2;//length of tube in m
u=n*w/(2*l) +1
disp(u,"refractive index of medium ")
```

Scilab code Exa 1.28 Thickness of film

```
//Example 1.28 // thickness of flim
clc;
clear;
//given data :
w=589D-9;//wavelength of light used in m
u=1.45;// refractive index of medium between lens
    and plate
```

```
n=6.5;// fringes shifted
t=n*w/(2*(u-1));// thickness of flim in m
t=t*1D9;//to convert in nano meter
disp(t,"thickness of flim in nm(nanometer)")
```

Scilab code Exa 1.29 Distance between position of mirrors

```
//Example 1.29 // distance between successive poitions of movable mirror
clc;
clear;
//given data :
w1=5896D-8;//one wavelength of light used in cm
w2=5890D-8;// second wavelength of light used in cm
d=w1*w2/(2*(w1-w2));// distance between sucessive position of mirror in cm
disp(d,"dustance between sucessive position of mirror in cm")
```

Scilab code Exa 1.30 Velocity of Light in liquid

```
//Example 1.30 // velocity of light in medium
clc;
clear;
//given data :
d1=.3;// diameter of ring in cm
d2=.25;//diameter of ring(in cm) after placing in medium
c=3D8;//speed of light in m/s
u=(d2/d1)^2;// refractive index of medium
v=u*c;// velocity of light in fluid
disp(v,"velocity of light in liquid in m/s")
```

Scilab code Exa 1.31 Film Thickness

```
//Example 1.31 // thickness of flim
clc;
clear;
//given data :
w1=6.1D-5;//wavelength of light fall in cm
w2=6D-5;// wavelength of light fall in cm
u=1.33;// refractive index soap flim
si=4/5;//sine of incident angle
t=w1*w2/(2*(w1-w2)*sqrt(u^2-si^2))
disp(t,"thickness of flim in cm")
```

Scilab code Exa 1.32 wavelength of light

```
//Example 1.32 // wavelength of light
clc;
//given data :
n1=5;//order of ring
n2=25;// order of ring
m=n2-n1;//difference of ring order
R=100;//radius of curvature in cm
d1=.3;//diameter of ring n cm
d2=.8;//diameter of ring in cm
w=(d2^2-d1^2)/(4*R*m);//wavelength in cm
disp(w,"wacelength of light in cm")
```

Scilab code Exa 1.33 diameter of ring

```
//Example 1.33 // diameter of ring
clc
clear;
//given data :
n1=4;//order of ring
n2=12;// order of ring
m=n2-n1;//difference of ring order
n=20;// order of ring to find
//let k=4*wavelength**R
d1=.4;// diameter of first ring in cm
d2=.7;//diameter of second ring in cm
k=(d2^2-d1^2)/m;
d=sqrt(n*k);// diameter of ring in cm
disp(d,"diameter of ring in cm")

//note: Wrong answer in the textbook.
```

Chapter 2

diffraction of light

Scilab code Exa 2.1 half angular width of central maxima

```
//Example 2.1 // Half angular width of differation
   pattern
clc;
clear;
//given data :
w=6D-7;// wavelength of monochromatic light in m
a=12D-7;// slit width in m
theta=asin(w/a);//half angular width of central
   bright maxima
theta=theta*180/%pi;// to convert in degree
disp(theta,"Half angular width of central bright
   maxima in degree")
```

Scilab code Exa 1.2 wavelength of light

```
//Example 2.2 // Wavelength of light
clc;
clear;
```

```
//given data :
a=.2D-3;//slit width in m
D=2;// screen is placed at distance in m
x=5D-3;// first minima lies at distance to central maxima
w=(a*x)/D;// wavelength of light in m
w=w*1D10;// to convert in A
disp(w,"wavelength of light used in A")
```

Scilab code Exa 2.3 slit width

```
//Example 2.3 // slit width
clc;
clear;
//given data :
w=6D-7;// wavelength of light used in m
D=2;// screen is placed at distance in m
x=5D-3;// first minima lies at distance to central maxima
a=(w*D)/x;//slit width in m
disp(a,"slit width in m")
```

Scilab code Exa 2.4 angular width and linear width of central maxima

```
//Example 2.4 // Angular width & linear width of central maxima
clc;
clear;
//given data :
w=589D-9;// wavelength of light used in m
D=1;// screen is placed at distance in m
a=.1D-3;//slit width in m
theta=asin(w/a);//half angular width in radian
```

```
angle=2*theta;// angular width in radian
disp(angle,"Angular width of central maxima in radian")
y=D*angle;// linear width of central maxima in m
y=y*100;// to convert in cm
disp(y,"linear width of central maxima in cm")
```

Scilab code Exa 2.5 wavelength of light

```
//Example 2.5 // wavelength of light used
clc;
clear;
//given data :
c=1/5000;// grating element
theta=%pi/6;//spectral line deviated
n=2;//order of spectral line
w=(c*sin(theta))/(n);//wavelength in cm
w=w*1D8;//to convert in A
disp(w,"wavelength of ligth used in A")
```

Scilab code Exa 2.6 No of lines in grating

```
//Example 2.6 // minimum number of lines in grating
clc;
clear;
//given data :
w1=589D-9;//wavelength of one sodium line
w2=5896D-10//wavelength of second line
dw=w2-w1;//change of wavelength
w=(w1+w2)/2;// mid wavelength
n=1;//order of spectrum
N=w/(n*dw);//number of lines in grating
N=floor(N);//no. should be integer
```

```
disp(N,"number of lines in grating")
```

Scilab code Exa 2.7 order of spectrum

```
//Example 2.7 // order of spectrum
clc;
clear;
//given data :
w=5D-5;//wavelength of light used in cm
c=1/5000;//grating element
n=c/w;//order of spectrum
disp(n,"order of spectrum")
```

Scilab code Exa 2.8 Angular separation between lines

```
//Example 2.8 //angular separtion
clc;
clear;
//part a
c=1/5000;//grating element
w1=5890D-8;// in first case first wavelength used in cm
n=2;//order of spectrum
theta=asin((n*w1)/c);//angular separton in radian
theta=theta*180/%pi;//to convert in degree
disp(theta,"angular width in degree")
//part b
w2=5896D-8;// in second case second wavelength used in cm
n=2;//order of spectrum
theta1=asin((n*w2)/c);//angular separton in radian
theta1=theta1*180/%pi;//to convert in degree
disp(theta1,"angular width in degree")
```

```
a=theta1-theta;//angular separation in degree
disp(a,"angular separation in degree")
//part c
w=5893D-8;// mid wavelength
dw=w2-w1;// change in wavelength
n=2;//order of spectrum
N=w/(dw*n);//no. of lines in grating
N=floor(N);//N should be integer
disp(N,"no. of lines in grating")
```

Scilab code Exa 2.9 lines no of lines in grating

```
//Example 2.9 //No. of lines in grating
clc;
clear;
//given data
w1=54D-6;// first wavelength used in cm
w2=405D-7;// second wavelength used in cm
//first wavelength order superimposed on next
   higher order
theta=%pi/6;//angle of diffraction in radian
c=(w1*w2/(w1-w2))/sin(theta);//grating element
N=1/c;// no. of lines per cm
N=round(N);// N should be integer
disp(N,"No. of lines in grating")
```

Scilab code Exa 2.10 difference of wavelength

```
//Example 2.10 //Difference of wavelengths
clc;
clear;
//given data
d_theta=.01;// change of diffraction angle
```

```
theta=%pi/6;// diffraction angle
w=5000;// wavelength used in A
dw=w*d_theta*cotg(theta)//change of wavelength in A
disp(dw,"difference of wavelength in A")
```

Scilab code Exa 2.11 dispersive power

```
//Example 2.11 // Dispersive power
clc;
clear;
//given data :
c=1/4000;// grating element
w=5D-5;// wavelength of light in cm
n=3;// order of spectrum
D=n/(c*sqrt(1-((n*w/c)^2)));//dispersive power in
    radian per cm
disp(D,"Dispersive power in rad/sec")
// in book there is calculation mistake
```

Scilab code Exa 2.12 resolving power and wavelength

```
//Example 2.12 //Difference of wavelengths
clc;
clear;
//part a
l=5;// length of grating
N=16000;// no. of lines per inch on the grating
w=6000;// wavelength used in A
n=2;// order of specrum
T=N*l;//total no. of lines on grating
R=T*n;// resolving power
disp(R,"resolving power..")
//part b
```

```
dw=w/(T*n);// wavelength can be resolved in A
disp(dw,"wavelength can be resolved in A")
```

Scilab code Exa 2.13 resolving power

```
//Example 2.14 //Resolving power
clc;
clear;
//given data
c=12.5D-5;// grating element in cm
w=5D-5;// wavelength used in cm
N=40000;//no. of lines on grating
n=c/w;// order for maximum resolving power
n=floor(n);//n should be integer
P=n*N;// maximum resolving power
disp(P,"Resolving power ")
```

Scilab code Exa 2.14 resolving power

```
//Example 2.14 //Resolving power
clc;
clear;
//given data
c=12.5D-5;// grating element in cm
w=5D-5;// wavelength used in cm
N=40000;//no. of lines on grating
n=c/w;// order for maximum resolving power
n=floor(n);//n should be integer
P=n*N;// maximum resolving power
disp(P,"Resolving power ")
```

Scilab code Exa 2.15 radius of first half of zone plate

```
//Example 2.14 //Radius of half period element
clc;
clear;
//given data
f=50;//focal length of convex lens in cm
w=5D-5;// wavelength used in cm
n=1;// order of principal maxima
r=sqrt(n*f*w);// radius of half period element
disp(r,"Radius of half period element in cm")
```

Scilab code Exa 2.16 position of spot

```
//Example 2.16 //position of brightest spot
clc;
clear;
//given data
d=.2;// diameter of ring
n=1;//order of ring
w=5D-5;//wavelength used in cm
r=d/2;// radius of ring
f=(r^2)/(w*n);//position of brightest spot
disp(f,"position of brightest spot in cm")
```

Scilab code Exa 2.17 radii of zones

```
//Example 2.17 //radii of transparent zone
clc;
clear;
//given data
f=1;//focal length in m
n=1;//order of zone
```

```
w=5893D-10;// wavelength used in m
r=sqrt(n*f*w);//radius of transparent zone
disp(r,"radius of tranparent in m")
n=3;//next order
r=sqrt(n*f*w);//radius of transparent zone
disp(r,"radius of tranparent in m")
n=5;//next order
r=sqrt(n*f*w);//radius of transparent zone
disp(r,"radius of tranparent in m")
```

Scilab code Exa 2.18 focal length of zone

```
//Example 2.18 // focal length of zone plate
clc;
clear;
//given data :
r=200;// radius of curvature in cm
f=r;//principal focal length in cm
disp(f,"principal focal length in cm")
```

Scilab code Exa 2.19 angular separation

```
//Example 2.19 //Angular sepration
clc;
clear;
//given data
n=1;// order of spectrum
wi=.5;// width of grating in cm
N=2500;//total no. of lines
c=wi/N;//grating element
w1=589D-7;// first wavelength of sodium in cm
//part a
theta1=asin(n*w1/c)//angular width in radian
```

```
theta1=theta1*180/%pi;//angular width in degree
disp(theta1,"angular width in degree")
w2=5896D-8;//second wavelength of sodium in cm
//part b
theta2=asin(n*w2/c)//angular width in radian
theta2=theta2*180/%pi;//angular width in degree
disp(theta2,"angular width in degree")
theta=theta2-theta1;//angular sepration degree
disp(theta,"angular sepration in degree")
w=(w1+w2)/2;//mid wavelength
dw=6D-8;// change of wavelength in cm
n=1;//order of spectrum
N=w/(n*dw);//no. of lines will appear
N=floor(N);// N should be integer
if(1/c>N)
    disp(N,"No. of lines will appear")
else
    disp("they can not be seen differently ")
end
```

Chapter 3

polarization of light

Scilab code Exa 3.1 angle of refraction

```
//Example 3.1 // Angle of Polarization
clc;
clear;
//given data :
u=1.54;//refractive index of glass
i=atan(u);//incidence angle in radian
r=%pi/2 -i;//refraction angle  in radian brewester's
    law
r=r*180/%pi;// to convert in degree
disp(r,"angle of refraction in degree")
```

Scilab code Exa 3.2 refractive index of glass

```
//Example 3.2 // Refractive index of glass
clc;
clear;
//given data :
i=%pi/3;// incidence angle in radian
```

```
//reflected and refracted rays are perpendicular to
   each other
u=tan(i);//Refractive  index
disp(u,"Refractive index of glass")
```

Scilab code Exa 3.3 thickness of refracting crystal

```
//Example 3.3 // Thickness of doubly refracting
   crystal
clc;
clear;
//given data :
Uo=1.55;//refractive index for O ray
Ue=1.54;//refractive index for E ray
w=6D-7;// wavelength of light used in m
p=w/2;// path difference in m
t=w/(2*(Uo-Ue));//thickness of  in m
disp(t*1D2,"thickness of doubly refracting crystal
   in cm")
```

Scilab code Exa 3.4 thickness of half wave plate

```
//Example 3.4 // Thickness of half wave plate
clc;
//given data :
Uo=1.54;//Refractive index for Ordinary light
r=1.007;//ratio of velocity of ordinary to
   extraordinary
Ue=r*Uo;//refractive index for extraordinary light
w=5893D-10;// wavelength of light used in m
t=w/(2*(Uo-Ue));// thickness of half wave plate in m
t=abs(t);// thickness always positive
disp(t,"Thickness of half wave plate in m")
```

Scilab code Exa 3.5 thickness of quarter wave plate

```
//Example 3.5 // Thickness of quarter wave plate
clc;
clear;
//given data :
Uo=1.652;//refractive index for O ray
Ue=1.488;//refractive index for E ray
w=546D-9;// wavelength of light used in m
p=w/2;// path difference in m
t=w/(4*(Uo-Ue));//thickness of  in m
t=t*100;// to convert in cm
disp(t,"thickness of quarter wave plate in cm")
```

Scilab code Exa 3.6 thickness of calcite plate

```
//Example 3.6 // Thickness of Calcite plate
clc;
clear;
//given data :
Uo=1.658;//refractive index for O ray
Ue=1.486;//refractive index for E ray
w=589D-9;// wavelength of light used in m
n=1;//integer for odd multiples
t=(2*n-1)*w/(4*(Uo-Ue));//thickness of Calcite plate
    in m
t=t*100;// to convert in cm
disp(t,"thickness of Calcite plate in cm")
```

Scilab code Exa 3.7 amount of optical rotation

```
//Example 3.7 // Amount of optical rotation
clc;
clear;
//given data :
Ur=1.55810;// refractive index for right handed
    polarized
Ul=1.55821;//refractive index for left handed
    polarized
w=4D-7;//wavelength of light used in m
d=.002;// thickness of plate in m
R=%pi*d*(Ul-Ur)/w;// rotation in radian
R=R*180/%pi;// to convert in degree
disp(R,"Amount of optical rotation in degree")
// in book it is wrongly calculated
```

Scilab code Exa 3.8 phase retardation

```
//Example 3.8 // Phase retardation
clc;
clear;
//given data :
Uo=1.5508;//refractive index for O ray
Ue=1.5418;//refractive index for E ray
w=5D-7;// wavelength of light used in m
t=.000032;// thickness of plate in m
p=2*%pi*(Uo-Ue)*t/w;//phase retardation in radian
disp(p,"phase retardation in radian")
```

Scilab code Exa 3.9 specific rotation

```
//Example 3.9 // Specific rotation
```

```
clc;
clear;
//given data :
theta=6.5;// angle of rotation in degree
l=2;// length of sugar solution in decimeter
C=.05;// concentration of sugar solution
S=theta/(l*C);//specific rotation in degree
disp(S,"specific rotation of sugar solution in
   degree")
```

Scilab code Exa 3.10 strength of solution

```
//Example 3.10 // Strength of solution
clc;
clear;
//given data :
l=2;//length of solution in decimeter
theta=12;// angle of rotation in degree
S=60;//specific rotation in degree
C=theta/(S*l);// concentration in gm/cc
disp(C,"strength of solution in gm/cc")
```

Scilab code Exa 3.11 optical thickness of quarter wave plate

```
//Example 3.5 // Thickness of quarter wave plate
clc;
clear;
//given data :
b=.172;//bifringe of plate
w=6D-7;// wavelength of light used in m
t=w/(4*(b));//thickness of  in m
t=t*100;// to convert in cm
disp(t,"thickness of quarter wave plate in cm")
```

Chapter 4

Laser

Scilab code Exa 4.1 Coherence Length

```
//Example 4.1 // Coherence length for laser
clc;
//given data :
v=3000;// bandwidth in Hz
c=3D8;//speed of light in m/s
t=1/v;//Coherence time in sec
l=c*t;//coherence length in m
l=l/1D3;// to convert in km
disp(l,"Coherence length for laser in km")
```

Scilab code Exa 4.2 Coherence Length

```
//Example 4.2 // transverse Coherence length
clc;
//given data :
theta=32;//angle on slit in second
theta=32*%pi/(60*180);// to convert in radian
w=5D-5;// wavelength of light used in cm
```

```
C=w/theta;//coherence length in cm
disp(C,"transverse coherence length in cm")
```

Scilab code Exa 4.3 Degree of Non monochromacity

```
//Example 4.3 // Degree of non−monochromacity
clc;
//given data :
t=1D-10;//coherence time in sec
c=3D8;//speed of light in m/s
w=54D-8;// wavelength of non−monochromacity in m
B=1/t;//bandwidth in Hz
v=c/w;//frequency of  source
D=B/v;// degree of non−monochromacity
disp(D,"degree of non−monochromacity")
```

Chapter 5

Fiber Optics

Scilab code Exa 5.1 Numerical Aperture

```
//Example 5.1
clc;
// 1st part //critical angle
u1=1.48;// refractive index of cladding
u2=1.5;// refractive index of core
u=1;// refractive index of air
theta=asin(u1/u2);// critical angle in radian
theta=theta*180/%pi;// to convert in degree
disp(theta,"critical angle in degree")
// 2nd part //fractional refractive index
Fr=(u2-u1)/u2;// fractional refractive index
Fr=Fr*100;// to convert in percent
disp(Fr,"fractional refractive index in percentage")
// 3rd part // acceptance angle
A=asin(sqrt(u2^2-u1^2));// Acceptance angle in
    radian
disp(A,"Acceptance angle in radian")
// 4th part //numerical aperture
NA=sin(A);// Numerical aperture
disp(NA,"Numerical aperture ")
```

Scilab code Exa 5.2 Number of Modes

```
//Example 5.2
clc;
// 1st part // V number
NA=.22;// Numerical aperture
a=50/2;// radius of core
w=.850;//wavelength in um
V=2*%pi*a*NA/w;// V number
disp(V,"V number")
// 2nd part // number of modes
N=(V^2)/4;// number of modes
disp(N,"number of modes")
```

Scilab code Exa 5.3 Refractive Index

```
//Example 5.3 // refractive index
clc;
// given data
NA=.22;//Numerical Aperature
Fr=.012;//Fractional refractive index
u1=NA/sqrt(Fr*(2-Fr));// refractive index of core
u2=sqrt(u1^2-NA^2);// refractive index of clad
disp(u1,"Refractive index of core")
disp(u2,"Refractive index of clad")
```

Scilab code Exa 5.4 Numerical Aperture

```
//Example 8.2 // Numerical Aperture & acceptance
   angle
clc;
//given data :
u1=1.62;//refractive index of core
u2=1.52;// refractive index of clad
A=asin(sqrt(u1^2-u2^2));// acceptance angle in
   radian
NA=sin(A);// numerical aperture
A=A*180/%pi;// to convert in degree
disp(A,"Acceptance angle in degree")
disp(NA,"Numerical Aperture")
```

Chapter 6

oscillatory motion

Scilab code Exa 6.1 Equilibrium position time

```
//Example 6.1 // Equilibrium position time
clc;
clear;
//given data :
A=.05;//Amplitude of SHM in m
T=6;// period in sec
Xo=A;// equilibrium position at t=0 position in m
X=.025;//equilibrium position  in m
w=2*%pi/T;// angular frequency in rad/sec
ph=asin(Xo/A);// phase angle in radian
t=(asin(X/A)-ph)/w// time for equilibrium position
    in sec
t=abs(t);// it take positive magnitude
disp(t,"time to move from Equilibrium position in
    sec")
```

Scilab code Exa 6.2 Maximum velocity in SHM

```
//Example 6.2 // Maximum velocity in SHM
clc;
clear;
//given data :
A=.06;// Amplitude of SHM in m
T=31.4;// period in sec
w=2*%pi/T;// angular frequency in rad/sec
V=A*w;// maximum velocity in m/s
disp(V,"Maximum velocity in m/s" )
```

Scilab code Exa 6.3 Period of Oscillation

```
//Example 6.3 // Period of Oscillation
clc;
clear;
//given data :
l=1;// length of pendulum in m
m=1;// mass of pendulum in kg
g=9.8;//acceleration of gravity in m/s2
T=2*%pi*sqrt(l/g);//time period
disp(T,"Period of Oscillation in sec")
```

Scilab code Exa 6.4 period of oscillation

```
//Example 6.4 // Period of Oscillation
clc;
clear;
//given data :
m1=8;// mass suspended in kg
l=.32;// length of spring stretched in m
m=.5;// new mass suspended in kg
g=9.8;//acceleration of gravity in m/s2
k=m1*g/l;// force constant  of spring in N/m
```

```
disp(k)
T=2*%pi*sqrt(m/k);// time period of Oscillation
disp(T,"Time Period of Oscillation sec")
// in book it is wrongly calculated
```

Scilab code Exa 6.6 oscillation time

```
//Example 6.6 // oscillation time
clc;
clear;
//given data :
r=10;//ratio of energies
Q=1D4;//quality factor
v=250;// frequency of fork in cycles/s
w=2*%pi*v;//angular frequency in rad/sec
T=Q/w;// relaxation time in sec
t=T*log(r);// time in sec
disp(t,"time to become new energy in sec")
```

Scilab code Exa 6.7 Equilibrium position time

```
//Example 6.7 // Equilibrium position time
clc;
clear;
//given data :
r=exp(2);//ratio of amplitude
Q=2D3;//quality factor
v=240;// frequency of fork in cycles/s
w=2*%pi*v;//angular frequency in rad/sec
T=Q/w;// relaxation time in sec
t=2*T*log(r);//time for ne amplitude
disp(t,"time to become for new amplitude in sec")
```

Scilab code Exa 6.8 Q factor and half width of power resonance

```
//Example 6.8
clc;
clear;
//part a :
Ao=.1;// amplitude at minimum frequency in mm
A=100;//maximum amplitude
Q=A/Ao;//quality factor
disp(Q,"Quality factor")
//part b
w=100;//resonance frequency in rad/sec
T=Q/w;//energy decay time
disp(T,"energy decay time in sec")
//part c
hw=1/(2*T);// half width of power resonance curve
disp(hw,"half width of power resonance curve in rad/
    sec")
```

Scilab code Exa 6.9 amplitude of oscillations and relative phase

```
//Example 6.9 // amplitude of oscillations &
    relative phase
clc;
clear;
//given data :
m=.1;//suspended mass in kg
k=100;// force constant in N/m
Fo=2;// maximum driving force in N
p=1;// constant in Ns/m
Wo=sqrt(k/m);//angular frequency in rad/sec in
    steady state;
```

```
W=50;//angular frequency in rad/sec
f=Fo/m;
d=p/(2*m);//damping constant
B=f/sqrt(((Wo^2)-(W^2))^2+4*(d^2)*(W^2));//amplitude of Oscillation in m
delta=atan(2*d*W/(Wo^2-W^2));// relative phase in radian
disp(B,"amplitude of oscillations in m")
delta=delta*180/%pi +180;// to convert in 0 t0 180 in degree
disp(delta,"relative phase in degree")
```

Chapter 7

electromagnetic waves

Scilab code Exa 7.1 Energy of plane wave

```
//Example 7.1 // Energy of plane wave
clc;
clear;
//given data :
u=(4D-7*%pi);// permeability(free space) in H/m
e=8.85D-12;// permitivity(free space) in Farad/m
H=1;// magnetic field in amp/m
E=H*sqrt(u/e);// formula to calculate
disp(E,"magnitude of Energy of plane wave in V/m")
```

Scilab code Exa 7.2 impedence of medium and peak magnetic field

```
//Example 7.2
clc;
clear;
// 1st part //impedence of medium
ur=1;//relative permeability
er=2;//relative permitivity
```

```
uo=(4D-7*%pi);// permeability(free space) in H/m
eo=8.85D-12;// permitivity(free space) in Farad/m
u=ur*uo;//permeability(medium) in H/m
e=er*eo;//permitivity(medium) in Farad/m
Z=sqrt(u/e);// impedence of medium
disp(Z,"impedence of medium in ohm")
// 2nd part //peak magnetic field intensity
Eo=5;//peak electric field strength in V/m
Ho=Eo/Z;// Intensity of magnetic field in A/m
disp(Ho,"Intensity of magnetic field in A/m")
// 3rd part //velocity of electromagnetic wave
v=1/sqrt(u*e);//velocity in m/s
disp(v,"velocity of magnetic field in m/s")
```

Scilab code Exa 7.3 wavelength of wave and amplitude of magnetic field

```
//Example 7.3
clc;
clear;
// 1st part //wavelength of wave
f=3D11;//frequency of wave in Hz
c=3D8;// speed of light in m/s
w=c/f;// wavelength in m
disp(w,"wavelength of wave in m")
// 2nd part // amplitude of Oscillating magnetic
   field
Eo=50;// amplitude of electric field in V/m
Bo=Eo/c;// ocillating magnetic field in Tesla
format('e',10);Bo
disp(Bo,"approx amplitude of oscillating magnetic
   field in T")
```

Scilab code Exa 7.4 solar energy

```
//Example 7.4 // solar energy
clc;
clear;
//given data :
r=1.5D11;//distance from sun to earth
P=3.8D26;//power radiated by sun
N=P/(4*%pi*(r^2));// poyting vector (average energy)
N=N*60/4.2D4 ;//to convert watt/m2 into cal/cm2.min
N=ceil(N);
disp(N," average solar energy in cal/cm2.min")
```

Scilab code Exa 7.5 Dielelctric constant

```
//Example 7.5 // Dielelctric constant
clc;
clear;
//given data :
v=.62;// velocity factor of coaxial
Er=1/v^2;// relative permittivity constant
disp(Er,"dielectric constant of insulator")
```

Chapter 8

Dielectrics

Scilab code Exa 8.1 polarisation and Energy density

```
//Example 8.1 // Dielectric
clc;
clear;
//given data :
k=3;// Dielectric constant
E=1D6;// field intensity in V/m2
e=8.85D-12;// permitivity in C2/N.m2
P=e*(k-1)*E;// polarisation in C/m2
disp(P,"polarisation in C/m2")
D=k*e*E;// displacement vector in C/m2
disp(D,"Displacement in C/m2")
ED=.5*k*e*E^2;// Energy Density in Joules/m3
disp(ED,"Energy density in joules/m3")
```

Scilab code Exa 8.2 Dipole moment of slab

```
//Example 8.2 // Dipole moment of slab
clc;
```

```
clear;
//given data :
D=5D-4;// displacement vector magnitude in m2
P=4D-4;// Polarisation  vector magnitude  in m2
E=D-P;// Field Intensity in m2
V=.5;// volume of slab in m3
k=D/E;// dielectric contant
p=P*V;//total dipole moment in m5
disp(k,"Dielectric constant")
disp(p,"total dipole contant in m5")
```

Scilab code Exa 8.3 electric susceptibility

```
//Example 8.3 // electric susceptibility
clc;
clear;
//given data :
k=1.000038;//dielectric constant
x=k-1;//electric susceptibility
disp(x,"electric susceptibility")
```

Scilab code Exa 8.4 Dipole moment

```
//Example 8.4 // Dipole moment
clc;
clear;
//given data :
E=100;// Field Intensity in V/m
k=1.000074;// dielectric contant
e=8.85D-12;// permitivity in Farad/m
p=22.4D-3;// dipole moment
N=6D23/(22.4D-3);// no. of atoms per unit volume at
   NTP
```

```
p=e*(k-1)*E/N;//   dipole moment in C-m
disp(p,"total moment in C-m")
```

Chapter 14

crystal structure and x ray diffraction

Scilab code Exa 14.4 wavelength and angle

```
//Example 14.4 // wavelength & angle
clc;
clear;
//given data :
d=2.82;//spacing between successive planes in A
theta=8+35/60;//in degree
theta=theta*%pi/180;// to convert in radian
n=1;// order of reflection
lamda=2*d*sin(theta) /n;//de-broglie equation
disp(lamda,"wavelength of NaCl in A ")
n=2;//to find angleof reflection
theta=asin(n*lamda/(2*d));//angle of reflection
   radian
theta=theta*180/%pi;// to convert in degree
disp(theta,"angle of reflection in degree")
```

Scilab code Exa 14.5 wavelength and speed of neutron

```
//Example 14.5 // wavelength & speed of neutron
clc;
clear;
//given data :
n=1;// given first reflection
d=3.84;//spacing between successive planes in A
m=1.67D-27;// mass of neutron in kg
theta=30;//in degree
theta=theta*%pi/180;// to convert in radian
lamda=2*d*sin(theta) /n;//de-broglie equation
disp(lamda,"wavelength of neutron in A ")
h=6.626D-34;// plank's constant in joules-sec
lamda=lamda*1D-10;// to convert in m
v=h/(m*lamda);// e-Broglie relation
disp(v,"speed of neutron in m/s")
// in book it is wrongly calculated
```

Scilab code Exa 14.6 spacing

```
//Example 14.6 // spacing d
clc;
clear;
// 1st part
theta=5+28/60;// given glancing angle in degree
n=1;//order of reflections
lamda=.586;// wavelength in A
theta=theta*%pi/180;//to convert in degree
d=n*lamda/(2*sin(theta));// spacing
disp(d,"spacing in A")
// in question there is a mistake
// 2nd part
theta=12+1/60;// given glancing angle in degree
n=2;//order of reflections
```

```
theta=theta*%pi/180;//to convert in degree
d=n*lamda/(2*sin(theta));// spacing
disp(d,"spacing in A")
//3rd part
theta=18+12/60;// given glancing angle in degree
n=3;//order of reflections
theta=theta*%pi/180;//to convert in degree
d=n*lamda/(2*sin(theta));// spacing
disp(d,"spacing in A")

//The glancing angle is taken differently in the
    solution
```

Scilab code Exa 14.7 glancing angle

```
//Example 14.7 // glancing  angle
clc;
clear;
//given data :
// 1st part
lamda=1.549;// wavelength in A
d=4.255;// in ter planer spacing in A
n=1;//order of reflection
theta=asin(n*lamda/(2*d));// glacing angle in radian
theta=theta*180/%pi;// to convert in degree
disp(theta,"glancing angle in degree")
// 2nd part
n=2;//order of reflection
theta=asin(n*lamda/(2*d));// glacing angle in radian
theta=theta*180/%pi;// to convert in degree
disp(theta,"glancing angle in degree")
```

Scilab code Exa 14.10 Energy to create defect

```
//Example 14.10 // Energy to create defect
clc;
clear;
//given data :
a=2.82D-10;// interionic distance in m
T=298;// temperture in kelvin
k=8.625D-5;// Boltzmann constant eV/k
n=5D11;// density of defects in per m3
V=(2*a)^3;//volume of unit cell
p=4;// no. of ion pairs
N=p/V;// no. of ion pairs per m3
E=2*k*T*log(N/n);// energy in eV
disp(E, "Energy to create defect in eV")
```

Scilab code Exa 14.11 Number of defects

```
//Example 14.11 // no. of defects
clc;
clear;
//given data :
k=8.625D-5;// Boltzmann constant eV/k
E=1.4;// energy to create defect in eV
T1=293;// temperature in kelvin
T2=573;// temperature in kelvin
ratio=exp((-E/k)*(1/(2*T1)-1/(2*T2)));// ratio of no
    . of defects at T1 & T2
format('e',10);ratio;
disp(ratio, "ratio of number of Frenkel defect")
ratio=1/ratio;//
disp(ratio,"it can be written as")
```

Scilab code Exa 14.12 fraction of vacancy sites

```
//Example 14.12 // fraction of vacancy sites
clc;
clear;
//given data :
f=1D-10;// fraction of vacancy sites
T1=500;// temperature in degree
T2=2*T1;// condition given
T1=T1+273;// to convert in kelvin
T2=T2+273;// to convert in kelvin
f1=exp(T1*log(f)/T2);//new fraction
disp(f1,"new fraction at new temperature")
```

Chapter 16

difficulties of classical mechanics abd development of wave mechanics

Scilab code Exa 16.1 de broglie wavelength

```
//Example 16.1 //de-broglie wavelength
clc;
clear;
//given data :
h=6.62D-34;// plank's constant in joules-sec
m=9.1D-31;// mass of electron in Kg
V=1.25D3;// Potential difference in kV
E=V*1.6D-19;// energy associated to potential in
    joule
lamda=h/sqrt(2*m*E);// formula to calculate
disp(lamda,"de broglie wavelength in m ")

//in book it is  wronglly calculated
```

Scilab code Exa 16.2 Energy of Neutrons

```
//Example 16.2 //Energy of Neutrons
clc;
clear;
//given data :
m=1.674D-27;// mass of neutron in kg
h=6.60D-34;// plank's constant in joules-sec
lamda=1D-10;// de-broglie wavelength in m
E=h^2/(2*m*lamda^2);// energy of neutrons in joules
E=E/1.6D-19;// to convert in eV
disp(E,"energy of neutons in eV")
```

Scilab code Exa 16.3 frequency and energy of photon

```
//Example 16.3 //frequency & energy of photon
clc;
clear;
//given data :
lamda=4D-7;// de-Broglie wavelength in m
c=3D8;// speed of light in m/s
h=6.62D-34;// plank's constant in joules-sec
v=c/lamda;// frequency of photon in Hz
E=h*v;// energy in joules
E=E/1.6D-19;// Energy in eV
disp(v,"frequency of photon in Hz")
disp(E,"Energy of Photon in eV")
```

Scilab code Exa 16.4 de broglie wavelength of neutrons

```
//Example 16.4 //de-broglie wavelength of neutrons
clc;
clear;
```

```
//given data :
k=1.38D-23;// Boltzmann's Constant in joules per K
T=27;// temperature in degree
m=1.67D-27;// mass of neutron in kg
h=6.62D-34;// plank's constant in joules-sec
T=T+273;// to convert in K
lamda=h/sqrt(2*m*k*T);// De-broglie Wavelength in m
disp(lamda,"De-broglie Wavelength in m")
```

Scilab code Exa 16.5 de broglie wavelength

```
//Example 16.5 //de-broglie wavelength
clc;
clear;
//given data :
m=1.67D-27;// mass of proton in kg
h=6.62D-34;// plank's constant in joules-sec
V=2000;// potential Dfference
ma=4*m;// mass of alpha particle in kg
q=2*1.6D-19;// charge on alpha particle
lamda=h/sqrt(2*ma*q*V);// formula to calculate
disp(lamda,"de-broglie wavelength in m")
```

Scilab code Exa 16.6 energy of photoelectrons emitted

```
//Example 16.6 //energy of photoelectrons emitted
clc;
clear;
//given data :
h=6.62D-34;// plank's constant in joules-sec
c=3D8;//speed of ight
lamda=6D-7;// Threshlod wavelength in m
v=6D14;// frequency  in Hz
```

```
E=h*(v-c/lamda);// energy in joules
E=E/1.6D-19;// to convert in eV
disp(E,"energy of electrons emitted in eV")
```

Chapter 17

uncertainty principle and schrodinger equation

Scilab code Exa 17.1 Uncertainty in angle of Emergence

```
//Example 17.1 //Uncertainty in angle of Emergence
clc;
clear;
//given data :
E=3.2D-17;//energy of enectron in J
m=9.1D-31;// mass of electron in kg
h=6.626D-34;// plank's constant in J.sec
r=1D-6;//radius of circular hole in m
p=sqrt(2*m*E);// momentum in Kg.m/sec
delta_x=2*r;// uncetainty in position in m
delta_p=h/(delta_x);// uncertainty in momentum in Kg
    .m/sec
delta_theta=delta_p/p;//uncertainty in angle of
    emergence
disp(delta_theta," Uncertainty in angle of Emergence
     in radian");

 //in book it is wrongly calculated
```

Scilab code Exa 17.2 Uncertainty in frequency and uncertainty in velocity

```
//Example 17.2 //Uncertainty in frequency &
   uncertainty in velocity
clc;
clear;
//given data :
ha=1.0545D-34;// average  plank's constant in J.sec
h=6.626D-34;// plank's constant in J.sec
t=1D-8;//average time elapse in excitation in sec
E=ha/t;// uncertainty in energy in j
f=E/h;//Uncertainty in Energy in Hz
disp(E,"uncertainty in energy in j")
disp(f,"Uncertainty in Energy in Hz")
```

Chapter 18

free electron theory

Scilab code Exa 18.1 Fermi Energy

```
//Example 18.1 //Fermi Energy
clc;
clear;
//given data :
P=.971D3;// density in Kg/m3
N=6D26;// Avogadro number in atoms/Kg-mole
W=22.99;//atomic weigh of sodium
a=N*P/W;// electron density
m=9.1D-31;// mass of electron in kg
h=6.626D-34;// plank's constant in joules-sec
E=((h^2)/(2*m))*(3*a/%pi)^(2/3);// fermi energy in J
disp(E,"Fermi energy in J")
//in book formula taken wrongly
```

Scilab code Exa 18.2 Energy difference

```
//Example 18.2 // Energy difference
clc;
```

```
clear;
//given data :
h=1.0545D-34;// averge Plank's constant in J-s
m=9.1D-31;// mass of electron in kg
a=1D-10;// dimension of box in meter
E1=((h^2)/(2*m))*(%pi/a)^2;//fermi energy of first
    level in j
E2=2*((h^2)/(m))*(%pi/a)^2;//fermi energy of second
    level in J
D=E2-E1;// difference of energy
disp(D,"energy difference in J")
```

Chapter 19

band theory of solids

Scilab code Exa 19.1 density of electrons and holes

```
 //Example 19.1 // density of electrons and holes
clc;
clear;
//given data :
//2(2%pikm/h2)^1.5=p(assume) it is a constant
p=4.83D21;//constant
T=300;//temperature in kelvin
E=.7;//semiconductor with gap in eV
k=1.38D-23;// Boltzmann constant
d=k*T/1.6D-19;// to convert in eV
ni=p*((300)^1.5)*exp(-1*E/d);//formula for
    concentration of intrinsic charge carrier
disp(ni,"density of electrons and holes in per m3")
// in book it is wrongly calculated
```

Scilab code Exa 19.2 position of fermi level

```
//Example 19.2 // position of fermi level
```

```
clc;
clear;
//given data :
//2(2%pikm/h2)^1.5=p(assume) it is a constant
p=4.83D21;//constant
nd=5D22;// concentration of donor atoms in atoms/m3
T=300;// temperature  in kelvin
k=1.38D-23;// Boltzmann constant
E=k*T*log(p*T^1.5/nd);//formula for calcilation
E=E/1.6D-19;//to convert in eV
disp(E,"position of fermi level in eV")
```

Scilab code Exa 19.3 position of fermi level

```
//Example 19.3 // position of fermi level
clc;
clear;
//given data :
Eo=.3;// initial position in eV
T=300;//initially temperature in kelvin
T1=330;// final temperature in kelvin
E=Eo*T1/T;// (formula to calculate) final position
   in eV
disp(E,"new position of fermi level in eV")
```

Scilab code Exa 19.4 Hall coefficient and Hall voltage

```
//Example 19.4 // Hall coefficient Hall voltage
clc;
clear;
//given data :
p=4.83D21;//constant
a=.428D-9;// unil cell side in m
```

```
E=.15;// fermi level in eV
k=1.38D-23;// Boltzmann constant
h=6.626D-34;// plank constant in J-s
T=300;// temperature in kelvin
me=9.1D-31;// mass of electron in kg
me1=.014*me;// effective mass in kg
mh=.18*me;// effective mass of hole
I=.1;// current in Amp
B=.1;// magnetic field in tesla
b=1D-3;// width of speciman in m
n=2/a^3;// no. of atoms per unit volume
d=k*T/1.6D-19;// to convert in eV
e=1.6D-19;// charge of electron
R=1/(n*e);// Hall constant
disp(R,"Hall coefficient for sodium in m3/C")
// in second part InSb
n1=2*((2*%pi*k*T/h^2)^1.5)*((me1*mh)^(3/4))*exp(-1*.15/(2*d));
// formula for concentration in per m3
R1=1/(n1*e);// Hall coefficient in m3/C
V=R*I*B/b;//  Hall  voltage in V
V1=R1*I*B/b// Hall voltage
disp(V,"Hall voltage of sodium")
disp(R1,"Hall coefficient for Insb in m3/C")
disp(V1,"Hall Voltage of Insb")
```

Scilab code Exa 19.5 energy of electron

```
//Example 19.5 // energy of electron
clc;
clear;
//given data :
h=6.626D-34;// plank constant in J-s
a=.3D-9;// unit cell width in m
p=h/(2*a);// electron momentum
```

```
m=9.1D-31;// mass of electron in Kg
E=p^2/(m*2);// formula for energy
disp(p,"electron momentum in Kg m/s")
E=E/1.6D-19;// ro convert in ev
disp(E,"energy of electron at this momentum in eV")
```

Chapter 21

magnetic properties of solids

Scilab code Exa 21.1 electron spin magnetic dipole moment

```
//Example 21.1 // electron spin magnetic dipole moment
clc;
clear;
//given data :
ub=5.6D-5;//electron spin magnetic moment in eV
kbT=1/40;//approximate value kb(constant) & at room temperature  in eV
u=ub/kbT;//formula
if(u<1)
    disp(u,"electron spin magnetic dipole moment & kbT/ub>>1")

  else
      disp(u,"kbT/ub<<1 so it is  wrong")
      end
```

Scilab code Exa 21.2 diamagnetic susceptibility

```
//Example 21.2 // diamagnetic susceptibility
clc;
clear;
//given data :
r=.53D-8;//(mean radius)bohr radius in cm
N=27D23;//atomic density in per cm2
k=2.8D-13//k=e2/mc2constants e-electron m-mass c=speed of light in cm
X=-2*(N*k/6)*r^2;//formula for 2 electrons
disp(X,"diamagnetic susceptibility of helium atom")
```

Chapter 22

superconductivity

Scilab code Exa 22.1 critical field and transition temperature

```
//Example 22.1 // critical field & transition temperature
clc;
clear;
//given data :
T=4.2;//to calculate critical field at T (kelvin)
Hc1=1.4D5;// critical magnetic field in amp/m
Hc2=4.2D5;//critical magnetic field in amp/m
T1=14;//temperature in kelvin
T2=13;//temperature ]in kevin
Tc=sqrt(.5*((T2^2-T1^2)*(Hc1+Hc2)/(Hc1-Hc2)+T1^2+T2^2));// transition temperature
H=Hc1/(1-(T1/Tc)^2);//field at 0 degree
Hc=H*(1-(T/Tc)^2)
disp(Tc,"transition temperature in kelvin")
disp(Hc,"Critical field at T in amp/m")

//little error due to approximations in book
```

Scilab code Exa 22.2 critical temperature

```
//Example 22.2 // critical temperature
clc;
clear;
//given data :
Tc1=4.185;//critical temperature in kelvin
M=199.5;// isotropic mass
M1=203.4;//isotropic mass
Tc2=Tc1*(M/M1)^.5;// formula
disp(Tc2,"critical temperature in kelvin")
```

Scilab code Exa 22.3 critical current density

```
//Example 22.3 // critical current density
clc;
clear;
//given data :
d=1D-3;//diameter of wire in m
Ho=6.5D4;//critical field at temperature at 0k
Tc=7.18;// critical temperature in kelvin
T=4.2;//temperature in kelvin
Hc=Ho*(1-(T/Tc)^2);//critical field at T kelvin
Jc=4*Hc/d;//formula
disp(Jc,"critical current density in A/m2")
```

Scilab code Exa 22.4 penetration depth

```
//Example 22.4 // penetration depth
clc;
clear;
//given data :
w=750;// penetration depth in A
```

```
T=3.5;// temperature in kelvin
Tc=4.12;// critical temperature in kelvin
d=13.55D3;//density of mercury
N=6.023D23;// avogadro number
M=200D-3;//molecular weight in kg
wo=w*(1-(T/Tc)^4)^.5;//formula
disp(wo,"penetration depth in A(angstrom)")
//n0=d*N/M;//normal electron density at 0 degre
//n=n0*(1-(T/Tc)^4);//electron density at T
//disp(n)

//according to question the answer is upto Wo only.
```