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

Created by
Piyush Ahuja
B.Tech
Electrical Engineering
NIT Kurukshetra
College Teacher
None
Cross-Checked by
K. V. P. Pradeep

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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

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Chapter 1

Interference of Light

Scilab code Exa 1.1 fringe width

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

Scilab code Exa 1.2 slit separation

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

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

Scilab code Exa 1.3 `wave length`

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

Scilab code Exa 1.4 `position of fringe`

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

Scilab code Exa 1.5 `Distance between coherent source`

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

Scilab code Exa 1.6 `Fringe width`

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

Scilab code Exa 1.8 `Vertex angle`

11

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

Scilab code Exa 1.9 `wavelength`

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

Scilab code Exa 1.10 `Fringe width`

```
1 //Example 1.10 // fringe width
2 clc;
3 clear;
4 //given data :
5 b1=0.087;// initally fringe width in mm
6 //when distance given in ratio
7 r=.75;// ratio
8 b=b1/r
9 disp(b,"width of fringes in mm")
```

Scilab code Exa 1.11 `distance between coherent sources`

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

Scilab code Exa 1.12 `Refractive Index of sheet`

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

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

Scilab code Exa 1.14 Thickness of plate

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

Scilab code Exa 1.15 Film Thickness

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

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

Scilab code Exa 1.16 Order of interference

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

Scilab code Exa 1.17 Fringe Width

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

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

Scilab code Exa 1.18 `Wavelength of light`

```
1  //Example 1.18 // wavvelength of light
2  clc;
3  //given data :
4  b=.5D-2;//distace between succesive fringes in m
5  u=1.4;//refractive index of cellophane
6  a=10;//angle of wedge in sec
7  a=a*%pi/(60*60*180);//to convert in radian
8  w=2*u*a*b;
9  w=w*1D10;//to convert in A
10 disp(w,"wavelength of light used in A")
11
12 //note: Pi is taken as 22/7 in the textbook.
```

Scilab code Exa 1.19 `Wedge angle`

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

Scilab code Exa 1.20 No of Dark bands

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

Scilab code Exa 1.21 Radius of lens

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

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

Scilab code Exa 1.22 Wavelength of light

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

Scilab code Exa 1.23 Distance between rings

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

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

Scilab code Exa 1.24 Refractive Index of liquid

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

Scilab code Exa 1.25 Diameter of Ring

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

Scilab code Exa 1.26 Thickness of film

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

Scilab code Exa 1.27 Refractive Index

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

Scilab code Exa 1.28 Thickness of film

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

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

Scilab code Exa 1.29 Distance between position of mirrors

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

Scilab code Exa 1.30 Velocity of Light in liquid

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

Scilab code Exa 1.31 `Film Thickness`

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

Scilab code Exa 1.32 `wavelength of light`

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

Scilab code Exa 1.33 `diameter of ring`

```scilab
1  //Example 1.33 // diameter of ring
2  clc
3  clear;
4  //given data :
5  n1=4;//order of ring
6  n2=12;// order of ring
7  m=n2-n1;//difference of ring order
8  n=20;// order of ring to find
9  //let k=4*wavelength**R
10 d1=.4;// diameter of first ring in cm
11 d2=.7;//diameter of second ring in cm
12 k=(d2^2-d1^2)/m;
13 d=sqrt(n*k);// diameter of ring in cm
14 disp(d,"diameter of ring in cm")
15
16 //note: Wrong answer in the textbook.
```

Chapter 2

diffraction of light

Scilab code Exa 2.1 half angular width of central maxima

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

Scilab code Exa 1.2 wavelength of light

```
1 //Example 2.2 // Wavelength of light
2 clc;
3 clear;
```

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

Scilab code Exa 2.3 `slit width`

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

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

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

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

Scilab code Exa 2.5 `wavelength of light`

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

Scilab code Exa 2.6 `No of lines in grating`

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

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

Scilab code Exa 2.7 order of spectrum

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

Scilab code Exa 2.8 Angular separation between lines

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

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

Scilab code Exa 2.9 lines no of lines in grating

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

Scilab code Exa 2.10 difference of wavelength

```
1  //Example 2.10 //Difference of wavelengths
2  clc;
3  clear;
4  //given data
5  d_theta=.01;// change of diffraction angle
```

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

Scilab code Exa 2.11 `dispersive power`

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

Scilab code Exa 2.12 `resolving power and wavelength`

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

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

Scilab code Exa 2.13 resolving power

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

Scilab code Exa 2.14 resolving power

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

Scilab code Exa 2.15 radius of first half of zone plate

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

Scilab code Exa 2.16 position of spot

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

Scilab code Exa 2.17 radii of zones

```scilab
1  //Example 2.17 //radii of transparent zone
2  clc;
3  clear;
4  //given data
5  f=1;//focal length in m
6  n=1;//order of zone
```

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

Scilab code Exa 2.18 focal length of zone

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

Scilab code Exa 2.19 angular separation

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

```
12  theta1=theta1*180/%pi;//angular width in degree
13  disp(theta1,"angular width in degree")
14  w2=5896D-8;//second wavelength of sodium in cm
15  //part b
16  theta2=asin(n*w2/c)//angular width in radian
17  theta2=theta2*180/%pi;//angular width in degree
18  disp(theta2,"angular width in degree")
19  theta=theta2-theta1;//angular sepration degree
20  disp(theta,"angular sepration in degree")
21  w=(w1+w2)/2;//mid wavelength
22  dw=6D-8;// change of wavelength in cm
23  n=1;//order of spectrum
24  N=w/(n*dw);//no. of lines will appear
25  N=floor(N);// N should be integer
26  if(1/c>N)
27      disp(N,"No. of lines will appear")
28  else
29      disp("they can not be seen differently ")
30  end
```

Chapter 3

polarization of light

Scilab code Exa 3.1 angle of refraction

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

Scilab code Exa 3.2 refractive index of glass

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

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

Scilab code Exa 3.3 thickness of refracting crystal

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

Scilab code Exa 3.4 thickness of half wave plate

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

Scilab code Exa 3.5 thickness of quarter wave plate

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

Scilab code Exa 3.6 thickness of calcite plate

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

Scilab code Exa 3.7 `amount of optical rotation`

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

Scilab code Exa 3.8 `phase retardation`

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

Scilab code Exa 3.9 `specific rotation`

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

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

Scilab code Exa 3.10 strength of solution

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

Scilab code Exa 3.11 optical thickness of quarter wave plate

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

Chapter 4

Laser

Scilab code Exa 4.1 `Coherence Length`

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

Scilab code Exa 4.2 `Coherence Length`

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

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

Scilab code Exa 4.3 Degree of Non monochromacity

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

Chapter 5

Fiber Optics

Scilab code Exa 5.1 Numerical Aperture

```
1  //Example 5.1
2  clc;
3  // 1st part //critical angle
4  u1=1.48;// refractive index of cladding
5  u2=1.5;// refractive index of core
6  u=1;// refractive index of air
7  theta=asin(u1/u2);// critical angle in radian
8  theta=theta*180/%pi;// to convert in degree
9  disp(theta,"critical angle in degree")
10  // 2nd part //fractional refractive index
11  Fr=(u2-u1)/u2;// fractional refractive index
12  Fr=Fr*100;// to convert in percent
13  disp(Fr,"fractional refractive index in percentage")
14  // 3rd part // acceptance angle
15  A=asin(sqrt(u2^2-u1^2));// Acceptance angle in
       radian
16  disp(A,"Acceptance angle in radian")
17  // 4th part //numerical aperture
18  NA=sin(A);// Numerical aperture
19  disp(NA,"Numerical aperture ")
```

Scilab code Exa 5.2 `Number of Modes`

```
1  //Example 5.2
2  clc;
3  // 1st part // V number
4  NA=.22;// Numerical aperture
5  a=50/2;// radius of core
6  w=.850;//wavelength in um
7  V=2*%pi*a*NA/w;// V number
8  disp(V,"V number")
9  // 2nd part // number of modes
10 N=(V^2)/4;// number of modes
11 disp(N,"number of modes")
```

Scilab code Exa 5.3 `Refractive Index`

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

Scilab code Exa 5.4 `Numerical Aperture`

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

Chapter 6

oscillatory motion

Scilab code Exa 6.1 Equilibrium position time

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

Scilab code Exa 6.2 Maximum velocity in SHM

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

Scilab code Exa 6.3 Period of Oscillation

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

Scilab code Exa 6.4 period of oscillation

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

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

Scilab code Exa 6.6 oscillation time

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

Scilab code Exa 6.7 Equilibrium position time

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

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

```scilab
1  //Example 6.8
2  clc;
3  clear;
4  //part a :
5  Ao=.1;// amplitude at minimum frequency in mm
6  A=100;//maximum amplitude
7  Q=A/Ao;//quality factor
8  disp(Q,"Quality factor")
9  //part b
10 w=100;//resonance frequency in rad/sec
11 T=Q/w;//energy decay time
12 disp(T,"energy decay time in sec")
13 //part c
14 hw=1/(2*T);// half width of power resonance curve
15 disp(hw,"half width of power resonance curve in rad/
      sec")
```

Scilab code Exa 6.9 amplitude of oscillations and relative phase

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

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

Chapter 7

electromagnetic waves

Scilab code Exa 7.1 Energy of plane wave

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

Scilab code Exa 7.2 impedence of medium and peak magnetic field

```
1 //Example 7.2
2 clc;
3 clear;
4 // 1st part //impedence of medium
5 ur=1;//relative permeability
6 er=2;//relative permitivity
```

```
7  uo=(4D-7*%pi);// permeability(free space) in H/m
8  eo=8.85D-12;// permitivity(free space) in Farad/m
9  u=ur*uo;//permeability(medium) in H/m
10 e=er*eo;//permitivity(medium) in Farad/m
11 Z=sqrt(u/e);// impedence of medium
12 disp(Z,"impedence of medium in ohm")
13 // 2nd part //peak magnetic field intensity
14 Eo=5;//peak electric field strength in V/m
15 Ho=Eo/Z;// Intensity of magnetic field in A/m
16 disp(Ho,"Intensity of magnetic field in A/m")
17 // 3rd part //velocity of electromagnetic wave
18 v=1/sqrt(u*e);//velocity in m/s
19 disp(v,"velocity of magnetic field in m/s")
```

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

```
1  //Example 7.3
2  clc;
3  clear;
4  // 1st part //wavelength of wave
5  f=3D11;//frequency of wave in Hz
6  c=3D8;// speed of light in m/s
7  w=c/f;// wavelength in m
8  disp(w,"wavelength of wave in m")
9  // 2nd part // amplitude of Oscillating magnetic
       field
10 Eo=50;// amplitude of electric field in V/m
11 Bo=Eo/c;// ocillating magnetic field in Tesla
12 format('e',10);Bo
13 disp(Bo,"approx amplitude of oscillating magnetic
       field in T")
```

Scilab code Exa 7.4 solar energy

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

Scilab code Exa 7.5 Dielelctric constant

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

Chapter 8

Dielectrics

Scilab code Exa 8.1 `polarisation and Energy density`

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

Scilab code Exa 8.2 `Dipole moment of slab`

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

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

Scilab code Exa 8.3 `electric susceptibility`

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

Scilab code Exa 8.4 `Dipole moment`

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

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

Chapter 14

crystal structure and x ray diffraction

Scilab code Exa 14.4 `wavelength and angle`

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

Scilab code Exa 14.5 `wavelength and speed of neutron`

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

Scilab code Exa 14.6 `spacing`

```
1  //Example 14.6 // spacing d
2  clc;
3  clear;
4  // 1st part
5  theta=5+28/60;// given glancing angle in degree
6  n=1;//order of reflections
7  lamda=.586;// wavelength in A
8  theta=theta*%pi/180;//to convert in degree
9  d=n*lamda/(2*sin(theta));// spacing
10 disp(d,"spacing in A")
11 // in question there is a mistake
12 // 2nd part
13 theta=12+1/60;// given glancing angle in degree
14 n=2;//order of reflections
```

```
15  theta=theta*%pi/180;//to  convert  in  degree
16  d=n*lamda/(2*sin(theta));// spacing
17  disp(d,"spacing  in  A")
18  //3rd  part
19  theta=18+12/60;// given  glancing  angle  in  degree
20  n=3;//order  of  reflections
21  theta=theta*%pi/180;//to  convert  in  degree
22  d=n*lamda/(2*sin(theta));// spacing
23  disp(d,"spacing  in  A")
24
25  //The  glancing  angle  is  taken  differently  in  the
         solution
```

Scilab code Exa 14.7 `glancing angle`

```
 1  //Example  14.7  // glancing   angle
 2  clc;
 3  clear;
 4  //given  data :
 5  // 1st  part
 6  lamda=1.549;// wavelength  in  A
 7  d=4.255;// in  ter  planer  spacing  in  A
 8  n=1;//order  of  reflection
 9  theta=asin(n*lamda/(2*d));// glacing  angle  in  radian
10  theta=theta*180/%pi;// to  convert  in  degree
11  disp(theta,"glancing  angle  in  degree")
12  // 2nd  part
13  n=2;//order  of  reflection
14  theta=asin(n*lamda/(2*d));// glacing  angle  in  radian
15  theta=theta*180/%pi;// to  convert  in  degree
16  disp(theta,"glancing  angle  in  degree")
```

Scilab code Exa 14.10 `Energy to create defect`

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

Scilab code Exa 14.11 Number of defects

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

Scilab code Exa 14.12 fraction of vacancy sites

```
1  //Example 14.12 // fraction of vacancy sites
2  clc;
3  clear;
4  //given data :
5  f=1D-10;// fraction of vacancy sites
6  T1=500;// temperature in degree
7  T2=2*T1;// condition given
8  T1=T1+273;// to convert in kelvin
9  T2=T2+273;// to convert in kelvin
10 f1=exp(T1*log(f)/T2);//new fraction
11 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

```
1  //Example 16.1 //de−broglie wavelength
2  clc;
3  clear;
4  //given data :
5  h=6.62D-34;// plank's constant in joules−sec
6  m=9.1D-31;// mass of electron in Kg
7  V=1.25D3;// Potential difference in kV
8  E=V*1.6D-19;// energy associated to potential in
       joule
9  lamda=h/sqrt(2*m*E);// formula to calculate
10 disp(lamda,"de broglie wavelength in m ")
11
12 //in book it is  wronglly calculated
```

Scilab code Exa 16.2 Energy of Neutrons

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

Scilab code Exa 16.3 frequency and energy of photon

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

Scilab code Exa 16.4 de broglie wavelength of neutrons

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

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

Scilab code Exa 16.5 `de broglie wavelength`

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

Scilab code Exa 16.6 `energy of photoelectrons emitted`

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

```
 9  E=h*(v-c/lamda);// energy in joules
10  E=E/1.6D-19;// to convert in eV
11  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

```
1  //Example 17.1 //Uncertainty in angle of Emergence
2  clc;
3  clear;
4  //given data :
5  E=3.2D-17;//energy of enectron in J
6  m=9.1D-31;// mass of electron in kg
7  h=6.626D-34;// plank's constant in J.sec
8  r=1D-6;//radius of circular hole in m
9  p=sqrt(2*m*E);// momentum in Kg.m/sec
10 delta_x=2*r;// uncetainty in position in m
11 delta_p=h/(delta_x);// uncertainty in momentum in Kg
      .m/sec
12 delta_theta=delta_p/p;//uncertainty in angle of
      emergence
13 disp(delta_theta," Uncertainty in angle of Emergence
       in radian");
14
15  //in book it is wrongly calculated
```

Scilab code Exa 17.2 Uncertainty in frequency and uncertainty in velocity

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

Chapter 18

free electron theory

Scilab code Exa 18.1 Fermi Energy

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

Scilab code Exa 18.2 Energy difference

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

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

Chapter 19

band theory of solids

Scilab code Exa 19.1 density of electrons and holes

```
 1  //Example 19.1 // density of electrons and holes
 2  clc;
 3  clear;
 4  //given data :
 5  //2(2%pikm/h2)^1.5=p(assume) it is a constant
 6  p=4.83D21;//constant
 7  T=300;//temperature in kelvin
 8  E=.7;//semiconductor with gap in eV
 9  k=1.38D-23;// Boltzmann constant
10  d=k*T/1.6D-19;// to convert in eV
11  ni=p*((300)^1.5)*exp(-1*E/d);//formula for
       concentration of intrinsic charge carrier
12  disp(ni,"density of electrons and holes in per m3")
13  // in book it is wrongly calculated
```

Scilab code Exa 19.2 position of fermi level

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

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

Scilab code Exa 19.3 `position of fermi level`

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

Scilab code Exa 19.4 `Hall coefficient and Hall voltage`

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

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

Scilab code Exa 19.5 energy of electron

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

```
 8  m=9.1D-31; // mass of electron in Kg
 9  E=p^2/(m*2); // formula for energy
10  disp(p,"electron momentum in Kg m/s")
11  E=E/1.6D-19; // ro convert in ev
12  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

```
1  //Example  21.1 //  electron  spin  magnetic  dipole
       moment
2  clc ;
3  clear ;
4  //given  data :
5  ub =5.6D -5;// electron  spin  magnetic  moment  in  eV
6  kbT =1/40;// approximate  value  kb( constant ) &  at  room
       temperature   in  eV
7  u=ub/kbT ;// formula
8  if (u <1)
9      disp (u ,"electron  spin  magnetic  dipole  moment &
           kbT/ub >>1")
10
11     else
12         disp (u ,"kbT/ub <<1  so  it  is   wrong")
13         end
```

Scilab code Exa 21.2 diamagnetic susceptibility

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

Chapter 22

superconductivity

Scilab code Exa 22.1 critical field and transition temperature

```
1  //Example 22.1 // critical field & transition
       temperature
2  clc;
3  clear;
4  //given data :
5  T=4.2;//to calculate critical field at T (kelvin)
6  Hc1=1.4D5;// critical magnetic field in amp/m
7  Hc2=4.2D5;//critical magnetic field in amp/m
8  T1=14;//temperature in kelvin
9  T2=13;//temperature ]in kevin
10 Tc=sqrt(.5*((T2^2-T1^2)*(Hc1+Hc2)/(Hc1-Hc2)+T1^2+T2
       ^2));// transition temperature
11 H=Hc1/(1-(T1/Tc)^2);//field at 0 degree
12 Hc=H*(1-(T/Tc)^2)
13 disp(Tc,"transition temperature in kelvin")
14 disp(Hc,"Critical field at T in amp/m")
15
16 //little error due to approximations in book
```

Scilab code Exa 22.2 `critical temperature`

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

Scilab code Exa 22.3 `critical current density`

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

Scilab code Exa 22.4 `penetration depth`

```
1 //Example 22.4 // penetration depth
2 clc;
3 clear;
4 //given data :
5 w=750;// penetration depth in A
```

```
 6  T=3.5; // temperature in kelvin
 7  Tc=4.12; // critical temperature in kelvin
 8  d=13.55D3; // density of mercury
 9  N=6.023D23; // avogadro number
10  M=200D-3; // molecular weight in kg
11  wo=w*(1-(T/Tc)^4)^.5; // formula
12  disp(wo,"penetration depth in A(angstrom)")
13  //n0=d*N/M;//normal electron density at 0 degre
14  //n=n0*(1-(T/Tc)^4);//electron density at T
15  //disp(n)
16
17  //according to question the answer is upto Wo only.
```