Scilab Textbook Companion for Engineering Physics by K. V. Kumar[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

Scilab code Exa 1.1 To calculate the location of screen from slits

```
//Example 1_1
clc();
clear;
//To calculate the location of screen from slits
d=0.08              //units in cm
d=d*10^-2           //units in mts
betaa=6*10^-4         //units in mts
v=8*10^11             //units in kHz
c=3*10^8              //units in mts
lamda=c/(v*10^3)             //units in mts
d=(betaa*d)/lamda              //units in mts
printf("The distance of the screen from the slits is
    %.2fmts",d)
```

Scilab code Exa 1.2 To calculate the wavelength

```
//Example 1_2
clc();
clear;
//To calculate the wavelength
//First case to calculte the wavelengths of the
    light source to obtain fringes 0.46*10^-2 mts
lamda1=4200    //units in armstrongs
lamda1=lamda1*10^-10   //units in mts
betaa=0.64*10^-2     //units in mts
D_d=betaa/lamda1      //units in mts
//Second caseDistance between slits and screen is
    reduced to half
beeta1=0.46*10^-2     //units in mts
lamdaD_d=beeta1*2              //units in mts
lamda=(lamda1*lamdaD_d)/betaa            //units in
    mts
lamda=lamda*10^10      //units in armstrongs
printf("The wavelength of the Light source is %.1
    fArmstrongs",lamda)
```

Scilab code Exa 1.3 To compare the intensity at a point distance 1mm from the center to that at its center and to find minimum dist from center of point

```
//Example 1_3
clc();
clear;
//To compare the intensity at a point distance 1mm
    from the center to that at its center and to find
     minimum dist from center of point
//Path difference=(Y*d)/D
y=1      //units in mm
y=y*10^-3     //units in mts
```

```
D=1       //units in mts
d=1      //units in mm
d=d*10^-3       //units in mts
pathdifference=(y*d)/D          //units in mts
lamda=5893      //units in armstrongs
lamda=lamda*10^-10    //units in mts
phasedifference=(2*pathdifference)/lamda    //units in pi radians
ratioofintensity=(cos((phasedifference/2)*%pi))^2
printf("The ratio of intensity with central maximum is %.4f\n",ratioofintensity)
pathdifference=lamda/4
distance=(pathdifference*D)/d         //units in mts
printf("The Distance of the point on the screen from center is %fmts",distance)
```

Scilab code Exa 1.4 To find the ratio of maximum intensity to minimum intensity

```
//Example 1_4
clc();
clear;
//To find the ratio of maximum intensity to minimum intensity
I1=10              //units in watts per square mts
I2=25              //units in watts per square mts
I1_I2=I1/I2
a1_a2=sqrt(I1_I2)
Imax_Imin=(a1_a2+1)^2/(a1_a2-1)^2
printf("The ratio of maximum intensity to minimum intensity is %f",Imax_Imin)
```

Scilab code Exa 1.5 To Calculate the amplitude ratio of the sources

```
//Example 1_5
clc();
clear;
//To Calculate the amplitude ratio of the sources
Imax=9
Imin=1
Imax_Imin=Imax/Imin
amax_amin=sqrt(Imax_Imin)
 a1_a2=amax_amin-1
 printf("the ratio of amplitudes %d/%d",a1_a2,1)
```

Scilab code Exa 1.6 To find the distance between the slits

```
//Example 1_6
clc();
clear;
//find the distance between the slits
lamda=500           //units in nm
lamda=500*10^-9
D=2                  //units in mts
f=100
d1=5                //units in cm
d1=5*10^-2          //units in mts
betaa=d1/f         //unitd in mts
//the distance between the slits
d=(lamda*D)/betaa    //units in mts
```

```
d=d*10^3                //units in mm
printf("distance between slits is %dmm",d)
```

Scilab code Exa 1.7 To Calculate the fringe width

```
//Example 1_7
clc();
clear;
//Calculate the fringe width
d=0.2                       //units in mm
d=0.2*10^-3                 //units in mts
lamda=550                   //units in nm
lamda=550*10^-9             //units in mts
D=1                         //units in mts
betaa=(lamda*D)/d           //units in mts
betaa=betaa*10^3            //units in mm
printf("Fringe width on a screen at a distance of 1m
    from the slits is %.2fmm",betaa)
```

Scilab code Exa 1.8 To Calculate the Angular position of the 10th maximum and first minimum

```
//Example 1_8
clc();
clear;
//To Calculate the Angular position of the 10th
    maximum and first minimum
//The distance from centre where 10th maximum is
    obtained by
```

```
lamda=5460                        //units in angstrom
lamda=5460*10^-10                 //units in mts
n=10
d=0.1                            //units in mm
d=0.1*10^-3                      //units in mts
D=2                             //units in mts
x10=(n*lamda*D)/d               //units in mts
//angular position with respect to center is
tantheta=(x10/D)                  //units in radians
z=atan(tantheta)*(180/%pi)          //units in degrees
printf("Angular position of 10th maximum is theta=%
   .3f degrees",z)
x1=(lamda*D)/(2*d)                  //units n mts
printf("\n The distance from centre where 1st
   minimum is obtained is %f metres",x1)
tantheta1=(x1/D)                  //units in radians
z1=atan(tantheta1)*(180/%pi)          //units in degrees
printf("\n Angular  position with respect to center
   is theta=%.3f degrees",z1)
```

Scilab code Exa 1.9 To Find the least distance of that point from central maximum

```
//Example 1_9
clc();
clear;
//To Find the least distance of that point from
   central maximum
lamda1=650                          //units in nm
lamda1=650*10^-9                    //units in mts
lamda2=500                          //units in nm
lamda2=500*10^-9                    //units in mts
D=1                                 //units in mts
```

```
d=0.5                                //units in mm
d=0.5*10^-3                          //units in mts
n_m=lamda2/lamda1
printf("This means that 10th bright fringe of 650 nm coincides with 13th fringe of wavelength 500 nm")
n=10                                 //least distance of that point from central maximum
x=((n*lamda1*D)*10^3)/d
printf("\n least distance of that point from central maximum is %d mm",x)
```

Scilab code Exa 1.10 To Find the thickness of the glass plate

```
//Example 1_10
clc();
clear;
//To Find the thickness of the glass plate
lamda=4800                          //units in Angstrom
lamda=4800*10^-10                   //units in mts
n=5
u1=1.4                              //first refractive index
u2=1.7                              //second refractive index
t=(n*lamda)/(u2-u1)                         //units in mts
printf("thickness of glass plate is %f mts",t)
```

Scilab code Exa 1.11 To find the refractive index of oil

```
//Example 1_11
clc();
clear;
//To find the refractive index of oil
v=0.2        //units in cm
area=1   //units in m^2
area=area*10^4    //units in cm^2
t=v/area     //units in cm
n=1
lamda=5.5*10^-5       //units in cm
r=0       //units in degrees
u=(n*lamda)/(2*t*cos(r))
printf("Refractive index of oil is u=%.2f",u)
```

Scilab code Exa 1.12 To calculate the fringe width

```
//Example 1_13
clc();
clear;
//To calculate the fringe width
dist1=0.005       //units in mm
dist2=15    //units in cm
alpha=dist1/dist2 //units in radians
lamda=6000*10^-9    //units in cm
betaa=(lamda)/(2*alpha)     //units in

printf("Fringe width beta=%.3fcm",betaa)

//In text book answer is printed wrong as 0.09 cm
   answer is 0.009 cm
```

Scilab code Exa 1.13 To calculate the fringe width

```
//Example 1_13
clc();
clear;
//To calculate the fringe width
D=0.005                             //units in mm
d=15                               //units in cm
lemda=6000                         //units in angstroam
lemda=6000*10^-8                   //units in cm
alpha=D/d                          //units in radians
beta=lemda/(2*alpha)
printf("fringe width is %.2f cm",beta)
```

Scilab code Exa 1.14 To calculate the distance from the fringe

```
//Example 1_14
clc();
clear;
//To calculate the distance from the fringe
n=10
lamda=6000*10^-10 //units in mts
alpha=0.01
x=(((2*n)-1)*lamda)/(4*alpha)   //units in mts
printf("Distance from 10th fringe is %.6f mts",x)
```

Scilab code Exa 1.15 To find the diameter of the 5th bright ring

```
//Example 1_15
clc();
clear;
//To find the diameter of the 5th bright ring
n=5
lemda=5460                          //units in angstroam
lemda=5460*10^-8                    //units in cm
u=1.50
f=400                              //units in cm
R=(u-1)*2*f
D=sqrt(2*(2*n-1)*lemda*R)
printf("The diameter of the 5th fringe %.2f mts",D)
```

Scilab code Exa 1.16 To find the wavelength in the visible region

```
//Example 1_16
clc();
clear;
//To find the wavelength in the visible region
u=1.33
t=500                          //units in angstroam
t=500*10^-10                   //units in mts
n=0                           //when n=0
lemda1=(4*u*t)/((2*n)+1)
printf("when n=0 then lemda1 is %.11f mts",lemda1)
n=1                          //when n=1
```

```
lemda2=(4*u*t)/((2*n)+1)
printf("\nwhen n=1 then lemda2 is %.11f mts",lemda2)
n=2                         //when n=1
lemda3=(4*u*t)/((2*n)+1)
printf("\n when n=2 then lemda3 is %.11f mts",lemda3)
n=3                         //when n=1
lemda4=(4*u*t)/((2*n)+1)
printf("\n when n=3 then lemda4 is %.11f mts",lemda4)
printf("\n Of all the wavelengths reflected in the visible region is %.11f mts",lemda3)
```

Scilab code Exa 1.17 To calculate the order of interference of the dark band

```
//Example 1_17
clc();
clear;
//To calculate the order of interference of the dark band
t=1.5*10^-6                                   //units in cm
lemda=5*10^-7                              //units in cm
i=60                                       //units in degree
u=1.33
r=asin((sin(i*%pi/180))/u)*(180/%pi)      //units in degree
n=(2*u*t*cos(r*%pi/180))/lemda
printf("The order of interference of the dark band is %.0f",n)
//In this question,the thickness and lemda values are given wrong
//To get the answer i have followed the values that
```

```
are taken in the answer
```

Scilab code Exa 1.18 To calculate the smallest thickness of the plate

```
//Example 1_18
clc();
clear;
//To calculate the smallest thickness of the plate
lemda=5890                          //units in
   angstroam
lemda=5890*10^-10                   //units in mts
u=1.5
n=1
r=60                                //units in degree
t=(n*lemda)/(2*u*cos(r*%pi/180))*10^10
printf("Thickness of the glass plate is %.0f
   angstroam",t)
```

Scilab code Exa 1.19 To find the diameter of 20th ring

```
//Example 1_19
clc();
clear;
//To find the diameter of 20th ring
D4=0.4                       //units in cm
D12=0.7                      //units in cm
D20=sqrt(2*(D12^2-D4^2)+D4^2)
printf("The diameter of the 20th dark ring is %.4f
   cm",D20)
```

Scilab code Exa 1.20 To calculate the refractive index of the liquid

```
//Example 1_20
clc();
clear;
//To calculate the refractive index of the liquid
D10=1.40                              //units in cm
d10=1.27                             //units in cm
u=D10^2/d10^2
printf("Refractive index of the liquid is %.3f",u)
```

Scilab code Exa 1.21 To find the wavelength of light used

```
//Example 1_21
clc();
clear;
//To find the wavelength of light used
D5=0.3                                //units in cm
D25=0.8                              //units in cm
R=100                               //units in cm
P=20
lemda=(D25^2-D5^2)/(4*P*R)
printf("The wavelength of the light used is %f cm",lemda)
```

Scilab code Exa 1.22 To find the total number of lines

```
//Example 1_22
clc();
clear;
//To calculate the number of lines
theta=18.233   //units in degrees
n=1
lamda=6.56*10^-7   //units in meters
m=(0.02*sin(theta*%pi/180))/(n*lamda)
printf("Number of lines M=%d",m)
```

Scilab code Exa 1.23 To calculate the smallest thickness of the plate

```
//Example 1_23
clc();
clear;
//To calculate the smallest thickness of the plate
lemda=5890                          //units in
   angstroam
lemda=5890*10^-10                   //units in mts
u=1.5
r=60                          //units in degrees
t=lemda/(2*u*cos(r*%pi/180))*10^10
printf("The smallest thickness of the plate %.0f
   angstroam",t)
```

Scilab code Exa 1.24 To calculate the refractive index of the liquid

```
//Example 1_24
clc();
clear;
//To calculate the refractive index of the liquid
lemda=5.895*10^-7                               //units in mts
D=0.3*10^-2                                     //units in mts
R=1                                             //units in mts
n=5
u=(4*R*n*lemda)/D^2
printf("The reractive index of the liquid is %.2f",u)
```

Scilab code Exa 1.25 To find the value of slit width

```
//Example 1_25
clc();
clear;
//To find the value of the slit width
lemda=6500                                  //units in angstroam
theta=30                                    //units in degrees
a=lemda/sin(theta*%pi/180)
```

```
printf("The value of the slit is %.0f angstroam",a)
```

Scilab code Exa 1.26 To find the amplitude of the resultant wave

```
//Example 1_26
clc();
clear;
//tofind the amplitude of the resultant wave
pathdifference=1/4          //in terns of lamda
phasedifference=(2*%pi)*pathdifference     //In terms
    of lamda
amplitude=2*cos(phasedifference/2)    //in terms of a
printf("Amplitude A=%.3f*a",amplitude)
```

Scilab code Exa 1.27 To find at what wavelength in the visible region are reflected

```
//Example 1_27
clc();
clear;
//To find the wavelength in the visible region
t=5000                              //units in angstroam
t=5000*10^-10                       //units in mts
u=1.33
n=0                          //let us take n=0
lemda=(4*u*t)/(2*n+1)
printf("The wavelength in the infrared region is %
   .10f",lemda)
n=1                          //let us take n=1
```

```
lemda1=(4*u*t)/(2*n+1)
printf("\n The wavelength in the IR region is %.10f"
    ,lemda1)
n=2                         //let us take n=2
lemda3=(4*u*t)/(2*n+1)
printf("\n The wavelength in the visible region is %
    .10f",lemda3)
n=3                       //let us take n=3
lemda4=(4*u*t)/(2*n+1)
printf("\n The wavelength in the UV region is %.10f"
    ,lemda4)
printf("\n\n In all wavelengths reflacted The
    wavelength in the visible region %.10f",lemda3)
```

Scilab code Exa 1.28 To calculate the order of interference

```
//Example 1_28
clc();
clear;
//To calculate the order of interference of the dark
     fringe
u=1.33
t=1.5*10^-4                               //units in cm
i=60                                     //units in degrees
lemda=5*10^-5                            //units in cm
r=asin(sin(60*%pi/180)/u)*180/%pi
n=(2*u*t*cos(r*%pi/180))/lemda
printf("The order of interface of the dark fringe is
     %.0f",n)
```

Scilab code Exa 1.29 To calculate the smallest thickness

```
//Example 1_29
clc();
clear;
//To calculate the smallest thickness of the plate
lemda=5890                                    //units in
   angstroam
//lemda=5890*10^-10                           //units in mts
u=1.5
r=60                                          //units in degrees
t=lemda/(2*u*cos(r*%pi/180))
printf("The smallest thickness of the plate is %.0f
   angstroam",t)
```

Scilab code Exa 1.30 To calculate the thickness of air film

```
//Example 1_30
clc();
clear;
//To calculate the thickness of air film
lemda=500                                     //units in
   nanometers
lemda=500*10^-9                               //units in meters
n=10
D=2                                           //units in
   millimeters
D=2*10-3                                      //units in meters
```

```
R=D^2/(4*n*lemda)                    //units in meters
t=(D^2/(8*R))*10^6
printf("Thickness of air film is %.1f micrometers",t
   )
```

Scilab code Exa 1.31 To find the wavelength of the light

```
//Example 1_30
clc();
clear;
//To find the wavelength of the light
D5=0.336                                    //units in
   centimeters
D5=0.336*10^-2                             //units in meters
D15=0.59                                  //units in
   centimeters
D15=0.59*10^-2                            //units in meters
m=10
R=100                                    //units in
   centimeters
R=100*10^-2                              //units in meters
lemda=((D15^2-D5^2)/(4*m*R))*10^9
printf("Wavelength of the light is %.0f nanometers",
   lemda)
```

Scilab code Exa 1.32 To find the radius of curvature

```
//Example 1_32
clc();
```

```
clear;
//To find the radius of curvature of the lens
lemda=5900                                    //units in angstroam
lemda=5900*10^-10                             //units in meters
D=0.5                                         //units in centimeters
D=0.5*10^-2                                   //units in meters
n=10
R=D^2/(4*n*lemda)
printf("The radius of the curvature of lens is %.3f meters",R)
```

Scilab code Exa 1.33 To calculate the refractive index of the liquid

```
//Example 1_33
clc();
clear;
//To calculate the refractive index of the liquid
lemda=5.895*10^-7                             //units in meters
D=0.3                                         //units in centimeters
D=0.3*10^-2                                   //units in meters
R=100                                         //units in centimeters
R=100*10^-2                                   //units in meters
n=5
u=(4*R*n*lemda)/D^2
printf("The refractive index of the liquid is %.3f",u)
```

Scilab code Exa 1.34 To calculate index of the liquid

```
//Example 1_34
clc();
clear;
//To calculate the refractive index of the liquid
D1=1.40                          //units in
   centimeters
D1=1.40*10^-2                    //units in meters
D2=1.27                          //units in
   centimeters
D2=1.27*10^-2                    //units in meters
u=(D1/D2)^2
printf("Refractive index of the liquid is %.3f",u)
```

Scilab code Exa 1.35 To calculate the intensity ratio

```
//Example 1_35
clc();
clear;
//To calculate the intensity ratio of the bright and
    dark fringes
I1=1
I2=25
A1=sqrt(I1)
A2=sqrt(I2)
Imax=(A1+A2)^2
Imin=(A2-A1)^2
```

```
printf("The intensity ratio is \n\t Imax:Imin %d:%d"
    ,Imax,Imin)
```

Scilab code Exa 1.36 To find the order which will be visible at this point

```
//Example 1_36
clc();
clear;
//To find the order which will be visible at this
    point
lemda1=6000                              //units in
    angstroam
lemda1=6000*10^-8                        //units in cm
lemda2=4500                              //units in
    angstroam
lemda2=4500*10^-8                        //units in cm
n1=21
n2=(n1*lemda1)/lemda2
printf("The order is %.0f",n2)
```

Scilab code Exa 1.37 To find the separation between the slits

```
//Example 1_37
clc();
clear;
//To find the separation between the slits
lemda=5100                          //units in angstroam
lemda=5100*10^-8                    //units in cm
D=200                               //units in cm
```

```
betaa=0.01                        //units in mts
betaa=0.01*10^-3                        //units in cm
d=(lemda*D)/betaa*10^-3
printf("The separation between the slits is %.2f mts
    ",d)
```

Scilab code Exa 1.38 To calculate the thickness of the mica sheet

```
//Example 1_38
clc();
clear;
//To calculate the thickness of the mica sheet
d=0.1                                   //units in cm
D=50                                   //units in cm
u=1.58
x=0.2                                  //units in cm
t=(x*d)/(D*(u-1))
printf("The thickness of the mica sheet is %.6f cm",
    t)
```

Scilab code Exa 1.39 To calculate the fringe width

```
//Example 1_39
clc();
clear;
//To calculate the fringe width
lemda=5000                             //units in angstroam
lemda=5000*10^-8                       //units in cm
d=0.05                                 //units in cm
```

```
D=50                              //units in cm
betaa=(lemda*D)/d
printf("Fringe width is %.2f cm",betaa)
```

Scilab code Exa 1.40 To calculate the wavelength of source of light

```
//Example 1_40
clc();
clear;
//To calculate the wavelength of source of light
betaa=0.30                        //units in cm
d=0.04                           //units in cm
D=180                           //units in cm
lemda=((betaa*d)/D)*10^8
printf("The wavelength of source of light is %.0f
   angstroam",lemda)
//In text book answer is printed wrong as 6700A But
   the correct answer is  6667 A
```

Scilab code Exa 1.41 To calculate the wavelength of monochromatic light

```
//Example 1_41
clc();
clear;
//To calculate the wavelength of monochromatic light
betaa=0.4                           //units in mm
betaa=0.4*10^-1                    //units in cm
d=0.1                             //units in cm
D=80                             //units in cm
```

```
lemda=(d*betaa)/D*10^8
printf("The wavelength of monochromatic light is %.0
   f angstroam",lemda)
```

Scilab code Exa 1.42 To find the fringe width

```
//Example 1_42
clc();
clear;
//To find the fringe width
lemda=5000                          //units in angstroam
lemda=5000*10^-8                    //units in cm
d=0.05                              //units in cm
D=50                                //units in cm
betaa=(lemda*D)/d
printf("Fringe width is %.2f cm",betaa)
```

Scilab code Exa 1.43 To find the thickness of the soap film

```
//Example 1_43
clc();
clear;
//To find the thickness of the soap film
lemda=7000                          //units in angstroam
lemda=7000*10^-8                    //units in cm
u=1.33
n=2
t=(((2*n)+1)*(lemda/2))/(2*u)
printf("Thickness of the soap film is %.8f cm",t)
```

Scilab code Exa 1.44 To find the refractive index of the transparent sheet

```
//Example 1_44
clc();
clear;
//To find the refractive index of the transparent
   sheet
lemda=5460*10^-8                    //units in cm
t=6.3*10^-4                        //units in cm
n=6
u=(n*lemda)/t+1
printf("The refractive index of the transparent
   sheet is %.2f",u)
```

Scilab code Exa 1.45 To calculate the thickness of the glass plate

```
//Example 1_45
clc();
clear;
//To calculate the thickness of the glass plate
lemda=5000                         //units in angstroam
lemda=5000*10^-8                  //units in cm
u=1.56
n=16
t=(n*lemda)/(u-1)
printf("Thickness of the glass plate is %.6f cm",t)
```

Scilab code Exa 1.46 To find the least thickness of the glass plate

```
//Example 1_46
clc();
clear;
//To find the least thickness of the glass plate
lemda=6000                              //units in angstroam
lemda=6000*10^-8                        //units in cm
u=1.5
r=50                                    //units in degree
n=1                                     //n=1 for least
   thickness
t=(n*lemda)/(2*u*cos(r*%pi/180))
printf("Least Thickness of the glass plate is %.7f
   cm",t)
```

Scilab code Exa 1.47 To find the thickness of the glass plate

```
//Example 1_47
clc();
clear;
//To find the thickness of the glass plate
lemda=5000                            //units in angstroam
lemda=5000*10^-8                      //units in cm
s_beta=6
u=1.5
t=((s_beta)*lemda)/(u-1)
```

```
printf("The thickness of the glass plate is %.4f cm"
    ,t)
```

Scilab code Exa 1.48 To calculate the refractive index of the liquid

```
//Example 1_48
clc();
clear;
//To calculate the refractive index of the liquid
D8=1.42                         //units in cm
d8=1.25                        //units in cm
u=(D8)^2/(d8)^2
printf("The refractive index of the liquid is %.2f",
    u)
```

Scilab code Exa 1.49 To find the thickness of the thinnest film

```
//Example 1_49
clc();
clear;
//To find the thickness of the thinnest film
u=1.33
lemda=6000                       //units in angstroam
lemda=6000*10^-8                 //units in cm
i=0                             //units in degrees
r=0                             //units in degrees
n=1
t=(n*lemda)/(2*u*cos(r))
```

```
printf("Thickness of the thinnest film is %.7f cm",t
   )
```

Scilab code Exa 1.50 To find the radius of curvature of the plano convex lens

```
//Example 1_50
clc();
clear;
//To find the radius of curvature of the plano
   convex lens
lamda=6000                    //units in angstroam
lamda=6000*10^-8              //units in cm
m=18
Dm=0.65                       //units in cm
n=8
Dn=0.35                       //units in cm
R=(Dm^2-Dn^2)/(4*lamda*(m-n))
printf("Radius of curvature of the plano convex lens
    is %.0f cm",R)
```

Scilab code Exa 1.51 To find the refraactive index of the liquid

```
//Example 1_51
clc();
clear;
//To find the refraactive index of the liquid
D12air=1.45               //units in cm
D12liq=1.25              //units in cm
```

```
u=(D12air)^2/(D12liq)^2
printf("Refractive index of the liquid is %.4f",u)
```

Scilab code Exa 1.52 To find diameter of 25th ring

```
//Example 1_52
clc();
clear;
//To find diameter of 25th ring
dm=0.62       //units in cm
ds=0.3      //units in cm
d25=2*(dm^2-ds^2)+ds^2      //units in cm^2
d25=sqrt(d25)              //units in cm
printf("Diameter of 25th ring is %.3f cm",d25)
```

Scilab code Exa 1.53 To find the radius of the curvature

```
//Example 1_53
clc();
clear;
//To find the radius of the curvature
lamda=5890              //units in angstroam
lamda=5890*10^-8        //units in cm
//diameter of the 15th ring
m=15
Dm=0.590                  //units in cm
//diameter of the 5th ring
n=5
Dn=0.336                  //units in cm
```

```
R=(Dm-Dn)/(4*lamda*(m-n))
printf("the radius of the curvature of the convex
   lens is %.2f cm",R)
```

Scilab code Exa 1.54 To find the wavelength of the light

```
//Example 1_54
clc();
clear;
//To find the wavelength of the light
R=70                    //units in cm
//Diameter of the 10th dark ring
D=0.433                 //units in cm
n=10
lamda=D^2/(4*R*n)             //units in cm
printf("The wavelength of the light is %f cm",lamda)
```

Chapter 2

DIFFRACTION

Scilab code Exa 2.1 To calculate the number of lines

```
//Example 2_1
clc();
clear;
//To calculate the number of lines in one centimeter
    of granting surface
lemda=5*10^-5                          //units in
   centimeters
theta=30                               //units in
   degrees
k=2
e=(k*lemda)/sin(theta*%pi/180)
n=e^-1
printf("no of lines per centimeter is %.0f",n)
//in text book the answer is printed wrong as 1000
   correct answer is 5000
```

Scilab code Exa 2.2 To find the difference in the angles

```
//Example 2_2
clc();
clear;
//To find the difference in the angles of deviation
   in the first and third spectra
lemda=5000*10^-8                    //units in meters
e=1/6000
theta1=asin(lemda/e)*180/%pi          //for first order
theta2=asin((3*lemda)/e)*180/%pi      //for third order
theta=(theta2-theta1)
printf("The difference in the angles of deviation is
    %.1f degrees",theta)
```

Scilab code Exa 2.3 To calculate the minimum number of lines

```
//Example 2_3
clc();
clear;
//To calculate the minimum number of lines
lemda=5890                            //units in angstrom
lemda=5890*10^-8                      //units in centimeters
dlemda=6*10^-8                       //units in centimeters
k=2
width=2.5                            //units in centimeters
n=(lemda/(k*dlemda))/width
printf("no of lines per cm is %.1f",n)
```

Scilab code Exa 2.4 To calculate the total number of lines

```
//Example 2_4
clc();
clear;
//To calculate the total number of lines for the first order
lemda=5890                                  //units in angstrom
lemda=5890*10^-8                            //units in centimeters
dlemda=6*10^-8                              //units in centimeters
k=1
N=lemda/(k*dlemda)
printf("Total no. of lines for the first order is %.0f",N)
//To calculate the total number of lines for the second order
k=2
N=lemda/(k*dlemda)
printf("\nTotal no. of lines for the second order is %.0f",N)
```

Scilab code Exa 2.5 To find the angle of separation

```
//Example 2_5
clc();
clear;
//To find the angle of separation
lemda1=5016*10^-8                                  //units in cm
lemda2=5048*10^-8                                  //units in cm
k=2
```

```
e=2.54/15000                              //units in cm
theta1=asin((2*lemda1)/e)*180/%pi
theta2=asin((2*lemda2)/e)*180/%pi
theta=(theta2-theta1)
theta=theta*100
theta=(theta*101)/60
printf("The angle of separation is %f degrees",theta)
//In text book the answer is printed wrong as 16 Minutes correct answer is 45 minutes
```

Scilab code Exa 3.5 To calculate the wavelength for half wave plate

```
//Example 3_5
clc();
clear;
//To calculate the wavelength for half wave plate
t=0.9*10^-6                    //units in meters
u0=1.658
ue=1.486
lemda=(4*t*(u0-ue))
printf("Thickness of half wave plate is %.10f meters",lemda)
//To calculate the wavelength for half wave plate
lemda=(2*t*(u0-ue))*10^9
printf("\nThickness of half wave plate is %.1f mm",lemda)
```

Scilab code Exa 2.6 To calculate the dispersive power

```
//Example 2_6
clc();
clear;
//To calculate the dispersive power of the granting
    in the third order spectrum
k=3
e=1/4000                          //units in cm
lemda=5000*10^-8                  //units in cm
theta=asin((k*lemda)/e)
dt_dl=k/(e*cos(theta))
printf("Disperssive power of the granting in the
    third order spectrum is %.0f",dt_dl)
```

Scilab code Exa 2.7 To find the highest order of the spectrum

```
//Example 2_7
clc();
clear;
//TO find the highest order of the spectrum
N=5000                              //units in lines/cm
lemda=6000*10^-8                    //units in cm
theta=90                           //units in degrees
k=((1/N)*sin(theta))/lemda
printf("The highest order of the spectrum that can
    be seen is %.0f",k)
```

Scilab code Exa 2.8 To find the wavelength and maximum granting width

```
//Example 2_8
clc();
clear;
//To find wave length and maximum grating
theta1=10 //units in degrees
d=5*10^-9     //units in cm
dtheta=3   //units in degrees
lamda=(sin(theta1*%pi/180)*d)/(cos(theta1*%pi/180)*(dtheta/3600)*(%pi/180))
lamda1=lamda+d
lamda1=lamda1*10^8
d=d*10^8
n=lamda1/(d*2)
k=2
Ne=(n*k*lamda)/(sin(theta1*%pi/180))
printf("wave length is lamda=%.7f meters",lamda)
printf("\nMaximum grating require Ne=%.2f cm",Ne)
```

Scilab code Exa 2.9 To calculate the resolving power in the second order

```
//Example 2_9
clc();
clear;
//To calculate the resolving power and grating element
sintheta1=0.3
sintheta2=0.2
lamda=5000 //units in A
e=(lamda/(sintheta1-sintheta2))*10^-8  //units in cm
width=2.5  //units in cm
n=width/e    //units in cm
resolvingpower=2*n
printf("Grating element is e=%.5f cm\n",e)
```

```
printf("Resolving power=%d",resolvingpower)
```

Scilab code Exa 2.10 To calculate the width of the central maxima

```
//Example 2_10
clc();
clear;
//To calculate the width of the central maxima
d=2                              //units in meters
lemda=500*10^-9                //units in meters
a=1.5*10^-3                   //units in meters
x=((2*d*lemda)/a)*10^3
printf("width of central maximum is %.2f mm",x)
```

Scilab code Exa 2.11 To find the slit width

```
//Example 2_11
clc();
clear;
//To find the slit width
d=2                              //units in meters
lemda=500*10^-9                  //units in meters
x=5*10^-3                        //units in meters
a=(d*lemda)/x*10^3
printf("The slit width is %.1f mm",a)
```

Scilab code Exa 2.12 To find the half angular width

```
//Example 2_12
clc();
clear;
//To find the half angular width of the central bright
lemda=6000*10^-10                    //units in meters
a=12*10^-7                           //units in meters
theta=asin(lemda/a)*180/%pi
printf("The half angular width of the central bright is %.0f degrees",theta)
```

Scilab code Exa 2.13 To deduce the missing order of a double slit

```
//Example 2_13
clc();
clear;
//deduce the missing order of a double slit
a=0.16*10^-3  //units in m
b=0.8*10^-3 //units in m
n_p=(a+b)/a
for j=1:3
printf("For p=%d n=%d\n",j,j*n_p);
end
```

Scilab code Exa 2.14 To find the angular separation between two wavelengths

```
//Example 2_14
clc();
clear;
//To find the angular separation between two wave
   lengths
N=6*10^5                              //units in lines per
    meter
m=3
lemda1=500*10^-9                      //units in meters
lemda2=510*10^-9                     //units in meters
theta1=asin(m*N*lemda1)*180/%pi
theta2=asin(m*N*lemda2)*180/%pi
theta=(theta2-theta1)
printf("The angular separation between two wave
   lengths is %.2f degrees",theta)
```

Scilab code Exa 2.15 To find the highest order

```
//Example 2_15
clc();
clear;
//To find the highest order that ca be seen
n=5906*10^2  //units in  line/cm
lamda=600*10^-9  //units in cm
m=1/(n*lamda)
```

```
printf("Maximum order that can be seen is %d",m)
```

Scilab code Exa 2.16 To find the angular separation of the two lines

```
//Example 2_16
clc();
clear;
//To find the angular separation of two lines of
   sodium in the first order spectrum
N=5*10^5                                //units in
   lines per meter
m=1
lemda1=5890*10^-10                     //units in
   meters
lemda2=5896*10^-10                     //units in
   meters
theta1=asin(m*N*lemda1)*180/%pi
theta2=asin(m*N*lemda2)*180/%pi
theta=(theta2-theta1)
printf("The angular separation is %.3f degrees",
   theta)
```

Scilab code Exa 2.17 To find the slit width

```
//Example 2_17
clc();
clear;
//To find the slit width
theta=15                           //units in degrees
```

```
lemda=6500                        //units in angstrom
lemda=6500*10^-8
n=1
a=(n*lemda)/sin(theta*%pi/180)
printf("slit width of white light is %f",a)
```

Scilab code Exa 2.18 To find the wavelength of the light

```
//Example 2_18
clc();
clear;
//To find the wavelength of the light
theta=15                               //units in
   degrees
a=2.5*10^-6                            //units in
   meters
lemda=((a*%pi*sin(theta*%pi/180))/(1.43*%pi))*10^10
printf("The wavelength of light is %.0f angstrom",
   lemda)
```

Scilab code Exa 2.19 To find the wavelength of the spectral line

```
//Example 2_19
clc();
clear;
//To calculate the wavelength of the spectral line
n=2
N=4250                                //units in
   centimeters
```

```
theta=30                              //units in degrees
lemda=(((1/N)*sin(theta*%pi/180))/n)*10^8
printf("The wavelength of the spectral line is %.0f
    angstrom",lemda)
```

Scilab code Exa 2.20 To find the angular separation

```
//Example 2_23
clc();
clear;
//To find the angular separation
lemda=600*10^-9                               //units in
    meters
n=1
a=1*10^-6                                     //units in
    meters
theta=asin((n*lemda)/a)*180/%pi
printf("The angular separation is %.2f degrees",
    theta)
```

Scilab code Exa 2.21 To find how many orders are visible

```
//Example 2_21
clc();
clear;
//To find the no. of orders are visible
N=10520                              //units in
    centimeters
```

```
lemda=5*10^-5                    //units in centimeters
theta=90                         //units in degrees
n=((1/N)*sin(theta*%pi/180))/lemda
printf("number of orders that are visible in granting spectra is %.0f",n)
```

Scilab code Exa 2.22 To calculate the slit width

```
//Example 2_22
clc();
clear;
//To calculate slit width
lemda=6000                              //units in angstrom
x=4.2                                   //units in millimeters
x=4.2*10^-3                             //units in meters
D=60                                    //units in centimeters
D=60*10^-3                              //units in meters
d=((D*lemda)/x)*10^-9
printf("The Slit width of the screen is %f",d)
```

Scilab code Exa 2.23 To calculate the possible order of spectra

```
//Example 2_23
```

```
clc();
clear;
//To calculate the possible order of spectra
N=5.095*10^3                        //units in lines
   per inch
lemda=6000*10^-8                    //units in cm
m=(1/N)/lemda
printf("The possible order of the spectra is %.0f",m
   )
```

Scilab code Exa 2.24 To find the wavelength of the light

```
//Example 2_4_1
clc();
clear;
//To calculate the wavelength of light
D=150                        //units in centimeters
d=0.03                       //units in centimeters
betaa=0.3                    //units in centimeters
lemda=((betaa*d)/D)*10^8
printf("Wavelength of the light is %.0f angstrom",
   lemda)
```

Chapter 3

POLARIZATION

Scilab code Exa 3.1 To calculate the thickness of a half wave plate

```
//Example 3_1
clc();
clear;
//To calculate the thickness of a half wave plate
lemda=500*10^-9                        //units in
   meters
ue=1.553
u0=1.544
t=(lemda/(2*(ue-u0)))*10^3
printf("Thickness of quartz half wave plate is %.4f
   mm",t)
```

Scilab code Exa 3.2 To calculate the thickness of the quarter wave plate

```
//Example 3_2
clc();
clear;
```

```
//To calculate the thickness of the quarter wave
   plate for sodium light
lemda=589*10^-9                          //units in
   meters
ue=1.553
u0=1.544
t=lemda/(4*(ue-u0))
printf("Thickness of quartz half wave plate is %f mm
   ",t)
```

Scilab code Exa 3.3 To calculate the thickness of a quarter wave plate

```
//Example 3_3
clc();
clear;
//To calculate the thickness of a quarter wave plate
    for monochromotic light
lemda=600*10^-9                         //units in
   meters
u0=1.5533
ue=1.5442
t=lemda/(4*(u0-ue))*10^3
printf("The thickness of a quarter wave plate for
   monochromotic light is %.4f mm ",t)
```

Scilab code Exa 3.4 To find the minimum thickness of half wave and quarter wave

```
//Example 3_4
```

```
clc();
clear;
//To find the minimum thickness of half wave and
   quarter wave plates
lemda=589.3*10^-9                    //units in
   meters
u0=1.65833
ue=1.48640
t1=lemda/(2*(u0-ue))
printf("thickness of half wave plate is %.7f mm",t1)
t2=lemda/(4*(u0-ue))
printf("\n thickness of quarter wave plate is %.8f
   mm",t2)
printf("\n \n the minimum thickness of wave plate is
   %.7f mm",t1)
```

Scilab code Exa 3.5 To calculate the wavelength for half wave plate

```
//Example 3_5
clc();
clear;
//To calculate the wavelength for half wave plate
t=0.9*10^-6                    //units in meters
u0=1.658
ue=1.486
lemda=(4*t*(u0-ue))
printf("Thickness of half wave plate is %.10f meters
   ",lemda)
//To calculate the wavelength for half wave plate
lemda=(2*t*(u0-ue))*10^9
printf("\nThickness of half wave plate is %.1f mm",
   lemda)
```

Chapter 4

CRYSTAL STRUCTURES

Scilab code Exa 4.1 To calculate the density

```
//Example 4_1
clc();
clear;
//To calculate the density of the germanium
n=8
a=5.62*10^-10                                     //units in
   meters
M=710.59                         //atomic weight of Ge
   units in a.m.u
N=6.02*10^26                    //units in kg/mol
Density=(n*M)/(a^3*N)
printf("Density of the germanium is %.0f kg/m^3",
   Density)
```

Scilab code Exa 4.2 To calculate the lattice constant

```
//Example 4_2
```

```
clc();
clear;
//To calculate the lattice constant
M=55.85                //units in a.m.u
density=7860           //units in kg/m^3
n=2
N=6.02*10^26           //units in kg/mol
a=((n*M)/(density*N))^(1/3)*10^9
printf("Lattice constant is %.2f angstrom",a)
```

Scilab code Exa 4.3 To calculate the lattice constant

```
//Example 4_3
clc();
clear;
//To calculate the lattice constant
M=6.94                         //units in a.m.u
density=530                   //units in kg/m^3
n=2
N=6.02*10^26                 //units in kg/mol
a=((n*M)/(density*N))^(1/3)*10^10
printf("Lattice constant is %.2f angstrom",a)
```

Scilab code Exa 4.4 To calculate the number of atoms

```
//Example 4_4
clc();
clear;
//To calculate the number of atoms per unit cell
```

```
a=2.9*10^-10                          //units in meters
density=7870                         //units in kg/m^3
M=55.85                              //units in kg/m^3
N=6.02*10^26                        //units in kg/mol
n=(a^3*density*N)/M
printf("number of atoms %.0f",n)
```

Scilab code Exa 4.5 To calculate the density

```
//Example 4_5
clc();
clear;
//To calculate the density
n=8
a=5.6*10^-10                              //units in
   meters
M=710.59                                //units in a.m.u
N=6.02*10^26                           //units in kg/mol
Density=(n*M)/(a^3*N)
printf("Density is %.0f kg/m^3",Density)
```

Scilab code Exa 4.6 To calculate the lattice constant

```
//Example 4_6
clc();
clear;
//To calculate the lattice constant
M=55.85                                //units in a.m.u
density=7860                         //units in kg/m^3
```

```
n=2
N=6.02*10^26                          //units in kg/mol
a=(((n*M)/(density*N))^(1/3))*10^9
printf("lattice constant is %.3f angstrom",a)
```

Scilab code Exa 4.7 To calculate the lattice constant

```
//Example 4_7
clc();
clear;
//To calculate the lattice constant
M=6.94                              //units in a.m.u
density=530                         //units in kg/m^3
n=2
N=6.02*10^26                        //units in kg/mol
a=((n*M)/(density*N))^(1/3)*10^10
printf("lattice constant is %.3f angstrom",a)
```

Scilab code Exa 4.8 To calculate the number of atoms

```
//Example 4_8
clc();
clear;
//To calculate the number of atoms per unit cell
a=2.9*10^-10                             //units in meters
M=55.85                                //units in kg/m^3
density=7870                          //units in kg/m^3
N=6.02*10^26                         //units in kg/mol
n=(a^3*density*N)/M
```

```
printf("number of atoms %.0f",n)
```

Scilab code Exa 4.9 To calculate the density

```
//Example 4_9
clc();
clear;
//To calculate the density of copper
r=0.1278*10^-9                    //units in meters
M=63.5                            //units in a.m.u
N=6.02*10^26                      //units in kg/mol
n=4
a=sqrt(8)*r
density=(n*M)/(N*a^3)
printf("density of copper is %.3f kg/m^3",density)
//in text book anser printed wrong as 893.66 correct
    answer is 8933.25
```

Scilab code Exa 4.10 To calculate the percentage of volume change

```
//Example 4_10
clc();
clear;
//To calculate the percentage of volume
r1=1.258                              //units in
    meters
r2=1.292                              //units in meters
v1=((4*r1)/sqrt(3))^3/2
v2=(2*sqrt(2)*1.292)^3/4
```

```
v=(v1-v2)/v2*100
printf("The percentage of volume changed during this
    structural change is %.3f",v)
```

Scilab code Exa 4.11 To find the position of radius of an atom

```
//Example 4_11
clc();
clear;
//To calculate where the radius of the atom is
   present
a=4/sqrt(2)
R=a/2-1
printf("The radius of the atom is at R=%.3fr",R)
```

Scilab code Exa 4.12 To calculate the distance between two adjacent atoms

```
//Example 4_12
clc();
clear;
//To calculate distance betweenadjacent atoms
molwt=23+35.5   //units in grams/mol
avagadro=6.023*10^23   //units in gm/mol
mass=molwt/avagadro   //units in gm
unitvol=2.18    //units in gm/cm^3
noofmol=unitvol/mass    //units in gm/cm^3
total=2*noofmol   //units in gm/cm^3
printf("number of atoms in NaCl is")
disp(total)
```

```
printf("atom/cm^3")
a=(1/total)^(1/3)
a=a*10^8    //units in A
printf("\nradius a=%.2f A",a)
```

Scilab code Exa 4.13 To find the glancing angle

```
//Example 4_13
clc();
clear;
//To calculate the glancing angle for the second
   order diffraction
lemda=0.071*10^-9                                  //units
   in meters
a=0.28*10^-9                                      //units
   in meters
h=1
k=1
l=0
n=2
theta=(asin((n*lemda)/(2*(a/(sqrt(h^2+k^2+l^2))))))
   *180/%pi
printf("The glancing angle for the second order
   diffraction is %.2f degrees",theta)
```

Scilab code Exa 4.14 To determine the space of the reflecting plane and the volume of the unit cell

```
//Example 4_14
```

```
clc();
clear;
//To determine the space of the reflecting plane and
    the volume of the unit cell
lemda=3*10^-10                        //units in
   meters
theta=40                              //units in
   degrees
h=1
k=0
l=0
n=1
d=(n*lemda)/(2*sin(theta*%pi/180))*10^10
printf("The space of the reflecting plane is %.3f
   angstrom",d)
v=(d*sqrt(h^2+k^2+l^2)*10^-10)^3
printf("\n\nThe volume of the unit cell is %.33f m^3
   ",v)
```

Scilab code Exa 4.15 To find the miller indices

```
//Example 4_15
clc();
clear;
//To find miller indices
n=1
lamda=0.82*10^-10   //units in meters
theta=75.86 //units in degrees
d=(n*lamda)/(2*sin(theta*%pi/180))
d=d*10^11
printf("obtained d value is d=%dA",d)
printf("\n As rounding of d equal to 3 A that is d=a
    miller indices that are possible are (0,0,1)
```

,(0,1,0),(1,0,0)")

Scilab code Exa 4.16 To find the wavelength and energy of xray beam

```
//Example 4_16
clc();
clear;
//To find the wavelength and energy of X-ray beam
theta=27.5                                    //units in
   degrees
n=1
h=1
k=1
l=1
H=6.625*10^-34                             //planks constant
c=3*10^10                    //velocity of light units
   in meters
a=5.63*10^-10                                //units in meters
lemda=(2*(a/sqrt(h^2+k^2+l^2))*sin(theta*%pi/180))/n
   *10^10
printf("The wavelength of X-Ray beam is %.0f
   angstrom",lemda)
lemda=lemda*10^-10    //units in cm
E=(H*c)/lemda
E=E*10^20  //units in Joules
E=E/(1.6*10^-19)
printf("\n\nThe energy of X-ray beam is ")
disp(E)
printf("eV")
```

Scilab code Exa 4.17 To calculate the lattice parameter of lead

```
//Example 4_17
clc();
clear;
//To find the lattice parameter of Lead
lemda=1.5*10^-10                              //units in
    meters
theta=34                                      //units in
    degrees
n=1
h=2
k=0
l=2
a=(n*lemda)/(2*sin(theta))*sqrt(h^2+k^2+l^2)*10^10
printf("the lattice parameter of the Lead is %.3f
    angstrom",a)
```

Chapter 5

CRYSTAL PLANES AND X RAY DIFFRACTION

Scilab code Exa 5.1 To calculate the number of atoms per meter square of plane

```
//Example 5_1
clc();
clear;
//To calculate the number of atoms per meter square
    of plane
//For (100) Plane
a=2
noofatomspercell=1/4*2*a
noofatomsperunitarea=noofatomspercell/a^2    //units
    in Terms of R
printf("Number of atoms per unit area of 100 plane %
    .2f*R^-2",noofatomsperunitarea)
//For (110) Plane
a=2
noofatomspercell=1/4*2*a
noofatomsperunitarea=noofatomspercell/(sqrt(2)*a^2)
      //units in Terms of R
printf("\nNumber of atoms per unit area of 110 plane
```

```
%.2f*R^-2",noofatomsperunitarea)
//For (111) Plane
a=2
noofatomspercell=1/4*2*a
bc=sqrt(2)*a
ad=(sqrt(3)/2)*sqrt(2)*a
area=0.5*bc*ad
noofatomsperunitarea=noofatomspercell/area    //units in Terms of R
printf("\nNumber of atoms per unit area of 110 plane %.2f*R^-2",noofatomsperunitarea)
```

Scilab code Exa 5.2 To show for a simple cubic lattice

```
//Example 5_2
clc();
clear;
//To show d100:d110:d111=sqrt(6):sqrt(3):sqrt(2)
//For d100
h=1
k=0
l=0
d100=1/sqrt(h^2+k^2+l^2)    //Units in terms of a
//For d110
h=1
k=1
l=0
d110=1/sqrt(h^2+k^2+l^2)    //Units in terms of a
//For d111
h=1
k=1
l=1
d111=1/sqrt(h^2+k^2+l^2)    //Units in terms of a
```

```
printf("d100:d110:d111=%.3f:%.3f:%.3f",d100,d110,d111)
```

Scilab code Exa 5.3 To determine the interplaner spacing

```
//Example 5_3
clc();
clear;
//To determine the interplanar spacing
a=450   //units in nm
h=2
k=2
l=0
d220=a/sqrt(h^2+k^2+l^2)      //units in nm
printf("Inter planar spacing d220=%.1f nm",d220)
//in text book the answer is printed wrong as 15.1 nm The answer is  159 nm
```

Scilab code Exa 5.4 To calculate the interplanar spacing

```
//Example 5_4
clc();
clear;
//To determine the interplanar spacing
r=1.278*10^-10   //units in meters
a=(4*r)/sqrt(2)      //units in meters
h=1
k=1
l=1
```

```
d111=a/sqrt(h^2+k^2+l^2)      //units in meters
printf("Inter planar spacing d111=")
disp(d111)
printf("meters")
```

Scilab code Exa 5.5 To find the lattice parameter of lead

```
//Example 5_5
clc();
clear;
//To find the lattice parameter of lead
theta=30  //units in degrees
n=1
l=1.54*10^-10     //units in meters
d=(n*l)/(2*sin(theta*%pi/180))
h=2
k=2
l=0
a=d*(sqrt(h^2+k^2+l^2)) //units in meters
a=a*10^10       //units in Armstrongs
printf("Lattice parameter is a=%.1f A",a)
//in text book the answer is printed wrong as 4.1A
   The answer is  4.4A nm
```

Scilab code Exa 5.6 To calculate the interplanar spacing of the crystal

```
//Example 5_6
clc();
clear;
```

```
//To calculate the inter planar spacing
//For theta=6.45
theta=6.45  //units in degrees
lamda=0.58    //units in Armstrongs
d_n=lamda/sin(6.45*%pi/180)    //units in Armstrongs
printf("Inter planara spacing at %.2fDegrees is d/n=
    %.3f Armstrongs",theta,d_n)
//For theta=9.15
theta=9.15  //units in degrees
lamda=0.58    //units in Armstrongs
d_n=lamda/sin(9.15*%pi/180)    //units in Armstrongs
printf("\nInter planara spacing at %.2fDegrees is d/
    n=%.3f Armstrongs",theta,d_n)
//For theta=13
theta=13  //units in degrees
lamda=0.58    //units in Armstrongs
d_n=lamda/sin(13*%pi/180)    //units in Armstrongs
printf("\nInter planara spacing at %.2fDegrees is d/
    n=%.3f Armstrongs",theta,d_n)
//In text book the answers are printed wrong as
    2.568A, 1.817A,1.288A the correct answers are
    5.163A,3.647A,2.578A
```

Scilab code Exa 5.7 To find the number of orders of braggs reflections

```
//Example 5_7
clc();
clear;
//To find the order of braggs equation
d=1.181   //units in A
theta=90     //units in degrees
lamda=1.540
n=(2*d*sin(theta*%pi/180))/lamda
```

```

printf("The order of Braggs equation is %d",n)
```

Scilab code Exa 5.8 To find the lattice parameter

```
//Example 5_8
clc();
clear;
//To find lattice parameter
n=1
lamda=0.58 //units in A
theta=9.5  //units in degrees
a=(n*lamda)/(2*sin(theta*%pi/180))
printf("lattice parametera=%.3fA",a)
//In text book answer printed wrong as 3.52A correct
    answer is 1.75A
```

Scilab code Exa 5.9 To calculate the glancing angle

```
//Example 5_9
clc();
clear;
//To calculate the glancing angle
theta1=8.58  //units in degrees
n1=3
lamda1=0.842  //units in A
n2=3
lamda2=0.842  //units in A
```

```
sintheta3=(sin(theta1*%pi/180)*n1*lamda1)/(n2*lamda2
    )
theta3=asin(sintheta3)*180/%pi*3
printf("The Glancing angle is Theta3=%.2f degrees",
    theta3)
```

Scilab code Exa 5.10 To determine the interplaner spacing and miller indices

```
//Example 5_10
clc();
clear;
//To determine interplanar spacing andmiller indices
n=1
lamda=1.54    //Units in A
theta=20.3    //units in degrees
d=(n*lamda)/(2*sin(theta*%pi/180)) //units in A
printf("Interplanar spacing d=%d A\n",d)
a=3.16
hkl=a/d
hkl2=hkl^2
printf("In order to get h^2+k^2+l^2=%d as l=0 then h
    =1 and k=1",hkl2)
```

Scilab code Exa 5.11 To find the wavenength and energy

```
//Example 5_11
clc();
clear;
```

```
//To find the wavenength and energy
n=4
a=107.87    //units in amu
N=10500
row=6.052*10^26
a=((n*a)/(N*row))^(1/3)*10^10  //units in A
h=1
k=1
l=1
d=a/sqrt(h^2+k^2+l^2)   //units in A
theta=19.      //units in degrees
lamda=2*d*sin(theta*%pi/180)     //units in A
printf("Wavelength is lamda=%.2fA",lamda)
lamda=lamda*10^-10   //units in meters

h=6.625*10^-34  //Plancks constant
c=3*10^8      //units in meter/sec
energy=(h*c)/(lamda*1.6*10^-19)   //units in eV
printf("\n energy is =%d eV",energy)
```

Scilab code Exa 5.12 To calculate the wavelength ansd maximum order of diffraction

```
//Example 5_12
clc();
clear;
//To calculate the wavelength ansd maximum order of
   diffraction
n=1
d=0.282*10^-9      //units in meters
theta=8.583    //units in degrees
lamda=((2*d*sin(theta*%pi/180))/n)*10^9   //units in
   nm
```

```
printf("wavelength is lamda=%.3f nm",lamda)
//When theta=90 degrees
lama=lamda*10^9    //units in meters
n=(2*d)/lamda*10^9
printf("\nMaximum order of diffraction is n=%d",n)
```

Scilab code Exa 5.13 To find maximum possible order difraction

```
//Example 5_13
clc();
clear;
//To find the Maximum possible diffraction order
lamda=1.5                    //units in A.U
d=1.6                      //units in A.U
n=(2*d)/lamda
printf("Maximum possible diffraction order = %.0f",n
   )
```

Scilab code Exa 5.14 To calculate the inter atomic spacing

```
//Example 5_14
clc();
clear;
//To clculate the inter frame spacing
lamda=1.5418*10^-10   //units in mts
theta=30    //units in degrees
d=lamda/(2*sin(theta*%pi/180))
d=d*10^10    //units in A
h=1
```

```
k=1
l=1
a=d*sqrt(h^2+k^2+l^2)
printf("The inter frame spacing is a=%.2f A",a)
```

Scilab code Exa 5.15 To find the glancing angle

```
//Example 5_15
clc();
clear;
//To find the glancing angle for the second order
   diffraction
d100=0.28                  //units in nm
n=2
lamda=0.071               //units in nm
d110=d100/sqrt(2)
theta=asin(( n*lamda)/(2*d110))*180/%pi
printf("The glancing angle is %d degrees",theta)
```

Scilab code Exa 5.16 To calculate the distance

```
//Example 5_16
clc();
clear;
//To calculate the distane between (110) planes
a=0.38                  //units in nm
h=1
k=1
l=0
```

```
d=a/sqrt(h^2+k^2+l^2)
printf("Distance between (110) planes d = %.2f nm",d
   )
```

Scilab code Exa 5.17 To compare the density of lattice point

```
//Example 5_17
clc();
clear;
//To compare  the density of lattice points
//For (110) plane
area=sqrt(2)   //units in a
areacontains=(1/4)*4
density=1/area        //units in a
//(111) plane
areaa=1/sqrt(2)      //interms of a
eo=sqrt(3)/sqrt(2)
area1=eo/sqrt(2)
density=(3*(1/6))/(area1)
printf("The ratio of density of planes is %.3f:%.3f"
   ,sqrt(2),sqrt(3))
```

Scilab code Exa 5.18 To calculate the glancing angle

```
//Example 5_18
clc();
clear;
//To calculate the glancing angle
h=1
```

```
k=1
l=0
lamda=0.065*10^-9    //units in m
n=2
a=0.26*10^-9    //units in nm
sintheta=(n*lamda*sqrt(h^2+k^2+k^2))/(2*a)
theta=asin(sintheta)*180/%pi    //units in degrees
printf("Theta=%.2f degrees",theta)
//the answer in the textbook is given wrong as theta =20.7 degrees but the right answer is 25.66 degrees
```

Scilab code Exa 5.19 To calculate the cube edge of the unit cell

```
//Example 5_19
clc();
clear;
//To compute the cube edge of unit cell
n=1
lamda=1.54*10^-10    //units in meters
theta=19.2    //units in degrees
d=(n*lamda)/(2*sin(theta*%pi/180))
h=1
k=1
l=1
a=d*sqrt(h^2+k^2+k^2)*10^10    //units in A
printf("Cube edge of unit cell a=%.2f A",a)
```

Scilab code Exa 5.20 To calculate the cube edge of the unit cell

```
//Example 5_20
clc();
clear;
//To compute the cube edge of unit cell
n=1
lamda=1.54*10^-10  //units in m
theta=19.2   //units in degrees
d=(n*lamda)/(2*sin(theta*%pi/180))
h=1
k=1
l=1
a=d*sqrt(h^2+k^2+k^2)
printf("Cube edge of unit cell a=")
disp(a)
printf("meters")
```

Scilab code Exa 5.21 To find the intercepts along the y and z axis

```
//Example 5_21
clc();
clear;
//To find intercepts along x and y axis
oa_ob=3/2
oa_oc=1/2
b=0.184   //units in nm
ob=(1/oa_ob)*b
c=0.197   //units in nm
oc=(1/oa_oc)*c
printf("OB=%.3f nm",ob)
printf("\nOC=%.3f nm",oc)
```

Scilab code Exa 5.22 To calculate the inter planner distance

```
//Example 5_22
clc();
clear;
//To calculate the interplanar spacing distance
h=1
k=2
l=3
a=0.82    //units in nm
b=0.94     //units in nm
c=0.75     //units in nm
d=((h/a)^2+(k/b)^2+(l/c)^2)^-0.5    //units in nm
printf("Interplanar spacing d=%.3f nm",d)
```

Scilab code Exa 5.23 To find the interplanner spacing

```
//Example 5_23
clc();
clear;
//To find the interplanar spacing
n=2
lamda=0.12    //units in nm
theta=28  //units in degrees
d=(n*lamda)/(2*sin(theta*%pi/180))
printf("Interplanar spacong d=%.2f nm",d)
```

Scilab code Exa 5.24 To find the interplanner spacing and lemda

```
//Example 5_24
clc();
clear;
//To find the interplanar spacing and lamda
n1=3
lamda=97    //units in pm
theta1=23    //units in degrees
theta2=60   //units in degrees
lamda1=(n1*lamda*sin(theta1*%pi/180))/(sin(theta2*%pi/180))   //units in pm
d=(n1*lamda)/(2*sin(theta2*%pi/180))
printf("lamda=%d pm",lamda1)
printf("\n d=%d pm",d)
```

Scilab code Exa 5.25 To find the wavelength

```
//Example 5_25
clc();
clear;
//To find the wavelength at which planes give rise to maximum intensity
d=275   //units in pm
theta=45    //units in degrees
lamda=(2*d*sin(theta*%pi/180))    //units in pm
n=3
printf("\nFor n=3 lamda=%.2f",lamda/n)
```

```
n=4
printf("\nFor n=4 lamda=%.2f",lamda/n)
printf("\nLamda lies beyond the range of wavelengths
    of polychromatic source")
```

Scilab code Exa 5.26 To calculate the bragg angle and the wavelength

```
//Example 5_26
clc();
clear;
//To calculate the braggs angle and Wavelength
theta2=87   //units in degrees
theta=theta2/2      //units in degrees
h=1
k=1
l=1
a=0.2    //units in nm
d=a/sqrt(h^2+k^2+l^2)   //units in nm
lamda=2*d*sin(theta*%pi/180)  //units in nm
printf("lamda=%.3f nm",lamda)
```

Scilab code Exa 5.27 To identify the unite cell and to determine its dimensions

```
//Example 5_27
clc();
clear;
//To identify unit cell and determine its dimensions
```

```
printf("We have the relation sin^(theta)=((lamda/(2*a))^2*(h^2+k^2+l^2))=(j*((lamda/(2*a))^2)")
printf("\n This can be used to Estimate the cell parameters and Indexing")
```

Scilab code Exa 5.28 To calculate the effective temprature

```
//Example 5_28
clc();
clear;
//To calculate the effective temprature
theta=28.5    //units in degrees
d=0.203    //units in nm
lamda=(2*d*sin(theta*%pi/180))*10^-9   //units in nano meters
h=6.626*10^-34
m=1.67*10^-27
k=1.38*10^-23
t=h^2/(3*m*k*lamda^2)
printf("The effective tempratures is T=%d K",t)
```

Scilab code Exa 5.29 To calculate the braggs angle

```
//Example 5_29
clc();
clear;
//To calculate the Braggs angle
h=6.624*10^-34
m=9.1*10^-31        //units in Kgs
```

```
e=1.6*10^-19    //units in eV
vo=80    //units in nm
lamda=(h/sqrt(2*m*e*vo))*10^9     //units in m
h=1
k=1
l=1
lp=0.35    //units in nm
d111=lp/sqrt(h^2+k^2+l^2)       //units in nm
theta=asin(lamda/(2*d111))*(180/%pi)
printf("Braggs angle is %.2f Degrees",theta)
```

Scilab code Exa 5.30 To explain the difference between the samples

```
//Example 5_30
clc();
clear;
//To give an explanation for the differences between
    samples
lamda=0.152   //units in nm
h=1
k=1
l=1
theta1=21    //units in degrees
theta2=383    //units in degrees
d111a=lamda/(2*sin(theta1*%pi/180))     //units in nm
d111b=lamda/(2*sin(theta2*%pi/180))   //units in nm
alpha1=d111a*sqrt(h^2+k^2+l^2)   //units in nm
alpha2=d111b*sqrt(h^2+k^2+l^2)   //units in nm
printf("For sample A Alpha=%.3f nm",alpha1)
printf("\nFor sample B Alpha=%.3f nm",alpha2)
//In text book answers are printed wrong as 0.363nm
   and 0.361nm correct answers are 0.3 nm and 0.275
   nm
```

Scilab code Exa 5.31 To find the lattice parameter and the atomic diameter

```
//Example 5_31
clc();
clear;
//To find the lattice parameter and atomic diameter
lamda=0.171   //units in nm
theta1=30    //units in degrees
theta2=35.283    //units in degrees
d100=lamda/(2*sin(theta1*%pi/180))
d200=lamda/(2*sin(theta2*%pi/180))
h=1
k=1
l=0
alpha1=d100*sqrt(h^2+k^2+l^2)
alpha2=d200*sqrt(h^2+k^2+l^2)
printf("As alpha1 != alpha2 that is %.3f!=%.3f \
   tMetal is not bee",alpha1,alpha2)
a=0.296   //units in nm
diam=a/(sqrt(h^2+k^2+l^2))
printf("\nAtomic diameter is a=%.2f nm",diam)
```

Scilab code Exa 5.32 To find the braggs reflection

```
//Example 5_32
clc();
```

```
clear;
//To find the plane which gives reflection
D=0.228  //units in nm
lamda=0.154  //units in nm
hkl=((2*D)/((lamda/2)*sqrt(3)))^2
printf("Tha maximum value that is possible for h^2+k^2+l^2=%.2f so (h,k,l) values are (2,2,2)",hkl)
//In text book answer printed wrong as 13.98 correct answer is 11.69
```

Scilab code Exa 5.33 To calculate the wavelength and maximum order of diffraction

```
//Example 5_33
clc();
clear;
//To calculate the wavelength and maximum order of diffraction
d=0.282*10^-9                          //units in meters
theta=8.583                          //units in degrees
lamda=2*d*(sin(theta*%pi/180))
lamda1=lamda*10^10    //units in A
theta=90  //units in degrees
n=(2*(d)*sin(theta*%pi/180))/lamda
printf("wave length lamda=%.3fA",lamda1)
printf("\nMaximum order of diffraction n=%d",round(n))
```

Scilab code Exa 5.34 To find the angle at which it occurs

```
//Example 5_34
clc();
clear;
//To find the angle at which it occurs
n=3
lemda=0.79*10^-10                              //units in
   meters
d=3.04*10^-10                                 //units in
   meters
theta=asin((n*lemda)/(2*d))*180/%pi
printf("The angle at which it occurs is %.3f degrees
   ",theta)
```

Chapter 6

LASER

Scilab code Exa 6.1 To calculate the relative population

```
//Example 6_1
clc();
clear;
//To calculate the relative population
h=6.626*10^-34
v=4.32*10^14
kb=1.38*10^-23
t=300
k=(h*v)/(kb*t)
n1_n2=%e^k
printf("Relative population N1/N2=")
disp(n1_n2)
```

Scilab code Exa 6.2 To find how many photons emitted and power density

```
//Example 6_2
clc();
```

```
clear;
//To find how many photons emitted and power density
v=3*10^8
lamda=632.8*10^-9
fre=v/lamda
outpow=2.3*10^-3
n=1
h=6.626*10^-34
N=(outpow*n)/(h*fre)
printf("Number of photons emitted is")
disp(N)
printf("photons/second\n")
spotarea=1*10^-6
density=outpow/spotarea
printf("Power density is %d kW/met^2",density)
```

Scilab code Exa 6.3 To calculate the wavelength of emission from GaAs

```
//Example 6_3
clc();
clear;
//To calculate the wavelength of emission from GaAs
Eg=1.44*1.6*10^-19
h=6.626*10^-34
c=3*10^8
lamda=(h*c)/Eg
printf("Wavelength = %.10f",lamda)
```

Scilab code Exa 6.4 To find the band gap

```
//Example 6_4
clc();
clear;
//To find the band gap
lamda=1.55  //units in eV
eg=1.24/lamda   //units in eV
printf("Band gap is Eg=%.1feV",eg)
```

Scilab code Exa 6.5 To find the relative population of the states in Ruby laser

```
//Example 6_5
clc();
clear;
//To find the relative population of the states in Ruby laser
h=6.626*10^-34
v=3*10^8  //units in met/sec
kb=1.381*10^-23  //units in J/L
t=300   //units in K
n_no=exp((h*v)/(kb*t))
printf("The relative population of two states is N/N0=")
disp(n_no)
//In textb book answer is printed wrong as 8*10^31 correct answer is 1.000048
```

Scilab code Exa 6.6 To calculate the ratio of stimulated emission rate to spontaneous emission

```
//Example 6_6
clc();
clear;
//To calculate the ratio of stimulated emission rate
    to spontaneous emission
c=3*10^8  //units in met/sec
lamda=0.5*10^-9
v=(c/lamda)*10^-3   //units in hz
h=6.626*10^-34  //units in J S
kb=1.381*10^-23  //units in J/K
t=1000
b21_a21=1/(exp((h*v)/(kb*t))-1)
printf("The ratio of Simulated emission to
   spontaneous emission B21/A21=")
disp(b21_a21)
```

Chapter 7

FIBER OPTICS

Scilab code Exa 7.1 To calculate Critical angle numerical apperture and acceptance angle

```
//Example 7_1
clc();
clear;
//To calculate Critical angle numerical apperture
   and acceptance angle
n1=1.5
n2=1.47
phi=asin(n2/n1)*180/%pi    //units in degrees
NA=sqrt(n1^2-n2^2)
accetangle=asin(NA)*180/%pi    //units in degrees
printf("Critical angle=%.1f degrees",phi)
printf("\n Numerical apperture=%.2f",NA)
printf("\nAcceptance angle=%.1f Degrees",accetangle)
```

Scilab code Exa 7.2 To estimate the numerical aperture

```
//Example 7_2
clc();
clear;
//To estimate the numerical aperture
n1=1.46
delta=0.05
NA=n1*sqrt(2*delta)
printf("The numerical aperture is %.2f",NA)
```

Scilab code Exa 7.3 To compare the acceptance angle

```
//Example 7_3
clc();
clear;
//To compare the acceptance angle
NA=0.3
thetaa=asin(NA)*180/%pi  //units in degrees
theta1=asin(NA/sin(45*%pi/180))*180/%pi  //units in degrees
printf("for meridional rays theta=%.2f degrees",thetaa)
printf("\n for skew rays theta=%.2f degrees",theta1)
```

Scilab code Exa 7.4 To calculate the numerical aperture and acceptance angle

```
//Example 7_4
clc();
clear;
```

```
//To calculate the numerical aperture and acceptance
    angle
n1=1.53
delta=0.0196
NA=n1*sqrt(2*delta)
printf("The numerical aperture is %.3f",NA)
theta=asin(NA)*180/%pi
printf("\nThe acceptance angle is %.2f degrees",
   theta)
```

Scilab code Exa 7.5 To calculate the number of reflections and total distance

```
//Example 7_5
clc();
clear;
//To calculate number of reflections per meter  and
   total distance covered
n1=1.5
n2=1.49
phi=asin(n2/n1)*180/%pi    //units in degrees
a=25    //units in micro meters
leng=2*a*tan(phi*%pi/180)    //units inmicro meters
totalnum=10^6/leng
printf("Total number of reflections is %d\n",
   totalnum)
l=1  //units in meters
distance=l*(sin(phi*%pi/180))
printf("Total distance covered is %.4f Meters",
   distance)
//in text book answer printed wrong as 1.006mcorrect
    answer is 0.9933meters
```

Scilab code Exa 7.6 To calculate the signal attenuation and overall signal attenuation

```
//Example 7_6
clc();
clear;
//To calculate the signal attenuation and overall
   signal attenuation
l=10
pi=100
p0=2
signalatten=(10/l)*log10(pi/p0)     // units in dB
   Km^-1
printf("Signal attenuation per unit length=%.1f dB
   Km^-1",signalatten)
overall=signalatten*10    //units in dB
printf("\nover all Signal attenuation=%d dB",round(
   overall))
```

Scilab code Exa 7.7 To calculate the dispersion

```
//Example 7_7
clc();
clear;
//To calculate the dispersion and bandwidth length
   product
L=10                           //units in Km
n=1.55
```

```
delta=0.026
C=3*10^5                    //units in meter per second
T=(L*n*delta)/C*10^9
printf("The total dispersion is %.1f ns",T)
l=1/(2*T*10^-9)*10
printf("\nThe bandwidth length product is %.2f HZ-Km",l)
//in text book answer is wrong as 7044*10^5 correct answer is 3722084.37
```

Scilab code Exa 7.8 To calculate the numerical aperture

```
//Example 7_8
clc();
clear;
//To calculate the numerical aperture
n1=1.55
n2=1.50
NA=sqrt(n1^2-n2^2)
printf("The numerical aperture is %.3f",NA)
```

Scilab code Exa 7.9 To calculate the angle of acceptance

```
//Example 7_9
clc();
clear;
//To calculate the angle of acceptance of a optical fiber
```

```
n1=1.563
n2=1.498
theta=asin(sqrt(n1^2-n2^2))*180/%pi
printf("The angle of acceptance is %.2f degrees",
   theta)
```

Scilab code Exa 7.10 To calculate the refractive index of material

```
//Example 7_10
clc();
clear;
//To calculate the refractive index of the material
   of the core
NA=0.39
delta=0.05
n1=NA/sqrt(2*delta)
printf("The refractive index of the material of the
   core is %.4f",n1)
```

Scilab code Exa 7.11 To calculate the fractional index change

```
//Example 7_11
clc();
clear;
//To calculate the fractional index for an optical
   fiber
n1=1.563
n2=1.498
delta=(n1-n2)/n1
```

```
printf("The fractioal index of an optical fiber is %
   .4f",delta)
```

Scilab code Exa 7.12 To calculate the numerical aperture and acceptance angle

```
//Example 7_12
clc();
clear;
//To calculate the numerical aperature and
   acceptance angle
n1=1.48
n2=1.45
NA=sqrt(n1^2-n2^2)
printf("The numerical aperature is %.4f",NA)
theta=asin(NA)*180/%pi
printf("\nThe acceptance angle is %.2f degrees",
   theta)
```

Scilab code Exa 7.13 To calculate the refractive index of material

```
//Example 7_13
clc();
clear;
//To calculate the refractive index of the core
NA=0.39
delta=0.05
n1=NA/sqrt(2*delta)
```

```
printf("The refractive index of the core is %.3f",n1
  )
```

Scilab code Exa 7.14 To calculate the fractional index change

```
//Example 7_14
clc();
clear;
//To calculate the fractional index
n1=1.563
n2=1.498
delta=(n1-n2)/n1
printf("The fractional index is %.4f",delta)
```

Scilab code Exa 7.15 To calculate the numerical aperture

```
//Example 7_15
clc();
clear;
//To calculate the numerical aperture
n1=1.55
n2=1.50
n0=1
NA=sqrt(n1^2-n2^2)/n0
printf("The numerical aperture is %.2f",NA)
```

Scilab code Exa 7.16 To calculate the angle of acceptance

```
//Example 7_16
clc();
clear;
//To calculate the angle of acceptance
n1=1.563
n2=1.498
theta=asin(sqrt(n1^2-n2^2))*180/%pi
printf("The acceptance angle is %.2f degrees",theta
    )
```

Scilab code Exa 7.17 To calculate the critical angle

```
//Example 7_17
clc();
clear;
//To calculate the critical angle
n1=1.53
n2=1.42
theta=asin(n2/n1)*180/%pi
printf("The critical angle is %.2f degrees",theta)
```

Scilab code Exa 7.18 To determine the numerical aperture and acceptance angle

```
//Example 7_18
clc();
clear;
//To find the numerical aperature and acceptance
   angle
n1=1.6
n2=1.4
n0=1.33
NA=sqrt(n1^2-n2^2)/n0
printf("The numerical aperature is %.3f",NA)
theta=asin(NA)*180/%pi
printf("\nThe acceptance angle is %.2f degrees",
   theta)
```

Scilab code Exa 7.19 To calculate the fractional index change

```
//Example 7_19
clc();
clear;
//To calculate the fractional index
n1=1.5
n2=1.3
delta=(n1-n2)/n1
printf("The fractional index is %.3f",delta)
```

Scilab code Exa 7.20 To calculate the angle of refraction at the interface

```
//Example 7_20
clc();
clear;
//To calculate the angle of refraction theta1 at the interface
n1=1.55
n2=1.6
theta2=60                          //units in degrees
theta1=asin((n1*sin(theta2*%pi/180))/n2)*180/%pi
printf("The angle of refraction is %.2f degrees",theta1)
```

Scilab code Exa 7.21 To calculate refractive index of core

```
//Example 7_21
clc();
clear;
//To calculate the refractive index of core
delta=0.14
n2=1.3
n1=n2/(1-delta)
printf("The refractive index of core is %.2f",n1)
```

Scilab code Exa 7.22 To calculate the numerical aperture

```
//Example 7_22
clc();
clear;
//To calculate the numerical aperature
```

```
theta=26.80                       //units in degrees
NA=sin(theta*%pi/180)
printf("The numerical aperature is %.4f",NA)
```

Chapter 8

NON DESTRUCTIVE TESTING USING ULTRASONICS

Scilab code Exa 8.1 To calculate the depth of the ocean

```
//Example 8_1
clc();
clear;
//To calculate the depth of the ocean
v=1500                              //units in meter per
    second
t=1.33                              //units in seconds
D=(v*t)/2
printf("The depth of the ocean is %.2f meters",D)
```

Scilab code Exa 8.2 To calculate the fundamental frequency of crystal

```
//Example 8_2
clc();
clear;
//To calculate the fundamental frequency of crystal
t=0.002                                    //units in meters
v=5750                                    //units in meter per
    second
f=v/(2*t)
printf("The fundamental frequency of crystal is %.0f
    Hz",f)
//the answer in the textbook is given wrong as
   1.44*10^-6 but the correct answer is 1437500 Hz
```

Scilab code Exa 8.3 To calculate the depth of sea and the wavelength of pulse

```
//Example 8_3
clc();
clear;
//To calculate the depth of the sea and the
   wavelength of pulse
v=1700                                       //units in meter
   per second
f=0.07*10^6                                 //units in Hz
t=0.65                                      //units in seconds
l=(v*t)/2
printf("The depth of the sea is %.2f meters",l)
lemda=v/f
printf("\n\nThe wavelength of pulse is %.3f meters",
   lemda)
```

Scilab code Exa 8.4 To find the sound level

```
//Example 8_4
clc();
clear;
//To find the sound level in decibles
I0=10^-12                                          //units in w/
   m^2
I=5*10^-8                                          //units in w/m
   ^2
Id=10*log10(I/I0)
printf("The intensity in decibles is %.2f dB",Id)
```

Scilab code Exa 8.5 To find the noise level

```
//Example 8_5
clc();
clear;
//To find the noise level when four drills are
   working
I=90                              //units in decibel
In=10*log10(4)+I
printf("new intensity level=%.2f dB",In)
```

Scilab code Exa 8.6 To calculate the intensity level

```
//Example 8_6
clc();
clear;
//To calculate the intensity level
I=8*10^-5                    //units in walt per meter square
I0=10^-12                    //units in decibels
In=10*log10(I/I0)
printf("Intensity level=%.3f dB",In)
```

Scilab code Exa 8.7 To calculate the fundamental frequency of crystal

```
//Example 8_7
clc();
clear;
//To calculate the fundamental frequency of crystal
t=0.002                      //units in meters
V=5750                       //units in meter per second
v=V/(2*t)*10^-6
printf("The fundamental frequency of crystal %.4f MHz",v)
```

Scilab code Exa 8.8 To calculate the fundamental frequency

```
//Example 8_8
clc();
```

```
clear;
//To calculate fundamental frequency of piezo electric crystal
l=3*10^-3                              //units in meters
Y=8*10^10                             //units in N/m^2
d=2.5*10^3                           //units in kg/m^3
v=(1/(2*l))*sqrt(Y/d)
printf("Frequency=%d Hz",v)
```

Scilab code Exa 8.9 To calculate the natural frequency

```
//Example 8_9
clc();
clear;
//To calculate the natural frequency of ultrasonic waves
l=5.5*10^-3                                //units in meters
Y=8*10^10                                //units in N/m^2
d=2.65*10^3                              //units in kg/m^3
v=(1/(2*l))*sqrt(Y/d)
printf("The natural frequency of ultrasonic waves is %.0f",v)
//In textbook answer printed wrong as 499 correct answer is 499493
```

Scilab code Exa 8.10 To calculate the natural frequency

```
//Example 8_10
clc();
```

```
clear;
//To calculate the frequency of pure iron rod
l=40*10^-3                          //units in meter
d=7.25*10^3                         //units in kg/m
   ^3
Y=115*10^9                         //units in N/m^3
v=(1/(2*l))*sqrt(Y/d)
printf("Natural frequency v=%.3f Hz",v)
```

Scilab code Exa 8.11 To calculate the capacitance

```
//Example 8_11
clc();
clear;
//To calculate the capacitance
v=10^6                             //units in Hz
L=1                               //units in henry
C=1/(4*%pi^2*v^2*L)
C=C*10^12    //units in PF
printf("Capacitance C=%.3f PF",C)
```

Scilab code Exa 8.12 To find the fundamental frequency

```
//Example 8_12
clc();
clear;
//To find the fundamental frequency
l=3*10^-3                                //units in
   meters
```

```
d=3.5*10^3                                          //units in kg/m
    ^3
Y=8*10^10                                           //units in N/m^2
v=1/(2*l)*sqrt(Y/d)
v=v*10^-6    //units in Hz
printf("Fundamental Frequency v=%.3f Hz",v)
```

Scilab code Exa 8.13 To calculate the fundamental frequency

```
//Example 8_13
clc();
clear;
//To calculate the fundamental frequency
l=0.001          //units in mts
y=7.9*10^10        //units in N/mts^2
d=2650            //units in N/mts^2
v=sqrt(y/d)   //units in m/sec
toe=0.001   //units in m
V=v/(2*toe)    //units in Hz
printf("Fundamental frequency=%.2fHz",V)
```