

Scilab Textbook Companion for
Engineering Physics
by K. V. Kumar¹

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

INTERFERENCE

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

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

Scilab code Exa 1.2 To calculate the wavelength

```

1 //Example 1_2
2 clc();
3 clear;
4 //To calculate the wavelength
5 //First case to calculate the wavelengths of the
   light source to obtain fringes  $0.46 \times 10^{-2}$  mts
6 lamda1=4200 //units in armstrongs
7 lamda1=lamda1*10-10 //units in mts
8 betaa=0.64*10-2 //units in mts
9 D_d=betaa/lamda1 //units in mts
10 //Second case Distance between slits and screen is
   reduced to half
11 beeta1=0.46*10-2 //units in mts
12 lamdaD_d=beeta1*2 //units in mts
13 lamda=(lamda1*lamdaD_d)/betaa //units in
   mts
14 lamda=lamda*1010 //units in armstrongs
15 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 cent

```

1 //Example 1_3
2 clc;
3 clear;
4 //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
5 //Path difference=(Y*d)/D
6 y=1 //units in mm
7 y=y*10-3 //units in mts
8 D=1 //units in mts
9 d=1 //units in mm

```

```

10 d=d*10^-3           //units in mts
11 pathdifference=(y*d)/D           //units in mts
12 lamda=5893           //units in armstrongs
13 lamda=lamda*10^-10           //units in mts
14 phasedifference=(2*pathdifference)/lamda
           //units in pi radians
15 ratioofintensity=(cos((phasedifference/2)*%pi))^2
16 printf("The ratio of intensity with central maximum
           is %.4f\n",ratioofintensity)
17 pathdifference=lamda/4
18 distance=(pathdifference*D)/d           //units in mts
19 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

```

1 //Example 1_4
2 clc;
3 clear;
4 //To find the ratio of maximum intensity to minimum
           intensity
5 I1=10           //units in watts per square mts
6 I2=25           //units in watts per square mts
7 I1_I2=I1/I2
8 a1_a2=sqrt(I1_I2)
9 Imax_Imin=(a1_a2+1)^2/(a1_a2-1)^2
10 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

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

Scilab code Exa 1.6 To find the distance between the slits

```
1 //Example 1_6
2 clc;
3 clear;
4 //find the distance between the slits
5 lamda=500 //units in nm
6 lamda=500*10^-9
7 D=2 //units in mts
8 f=100
9 d1=5 //units in cm
10 d1=5*10^-2 //units in mts
11 betaa=d1/f //unitd in mts
12 //the distance between the slits
13 d=(lamda*D)/betaa //units in mts
14 d=d*10^3 //units in mm
15 printf("distance between slits is %dmm",d)
```

Scilab code Exa 1.7 To Calculate the fringe width

```
1 //Example 1_7
2 clc;
3 clear;
4 //Calculate the fringe width
5 d=0.2 //units in mm
6 d=0.2*10^-3 //units in mts
7 lamda=550 //units in nm
8 lamda=550*10^-9 //units in mts
9 D=1 //units in mts
10 betaa=(lamda*D)/d //units in mts
11 betaa=betaa*10^3 //units in mm
12 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

```
1 //Example 1_8
2 clc;
3 clear;
4 //To Calculate the Angular position of the 10th
    maximum and first minimum
5 //The distance from centre where 10th maximum is
    obtained by
6 lamda=5460 //units in angstrom
7 lamda=5460*10^-10 //units in mts
8 n=10
```



```

9 d=0.1 //units in mm
10 d=0.1*10^-3 //units in mts
11 D=2 //units in mts
12 x10=(n*lamda*D)/d //units in mts
13 //angular position with respect to center is
14 tantheta=(x10/D) //units in radians
15 z=atan(tantheta)*(180/%pi) //units in degrees
16 printf("Angular position of 10th maximum is theta=%
    .3f degrees",z)
17 x1=(lamda*D)/(2*d) //units n mts
18 printf("\n The distance from centre where 1st
    minimum is obtained is %f metres",x1)
19 tantheta1=(x1/D) //units in radians
20 z1=atan(tantheta1)*(180/%pi) //units in degrees
21 printf("\n Angular position with respect to center
    is theta=%0.3f degrees",z1)

```

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

```

1 //Example 1_9
2 clc();
3 clear;
4 //To Find the least distance of that point from
    central maximum
5 lamda1=650 //units in nm
6 lamda1=650*10^-9 //units in mts
7 lamda2=500 //units in nm
8 lamda2=500*10^-9 //units in mts
9 D=1 //units in mts
10 d=0.5 //units in mm
11 d=0.5*10^-3 //units in mts
12 n_m=lamda2/lamda1
13 printf("This means that 10th bright fringe of 650 nm

```

```

        coincides with 13th fringe of wavelength 500 nm"
    )
14 n=10 //least distance of
    that point from central maximum
15 x=((n*lamda1*D)*10^3)/d
16 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

```

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

```

Scilab code Exa 1.11 To find the refractive index of oil

```

1 //Example 1_11
2 clc();
3 clear;
4 //To find the refractive index of oil

```

```

5 v=0.2          //units in cm
6 area=1        //units in m^2
7 area=area*10^4 //units in cm^2
8 t=v/area      //units in cm
9 n=1
10 lamda=5.5*10^-5 //units in cm
11 r=0          //units in degrees
12 u=(n*lamda)/(2*t*cos(r))
13 printf("Refractive index of oil is u=%0.2f",u)

```

Scilab code Exa 1.12 To calculate the fringe width

```

1 //Example 1-13
2 clc();
3 clear;
4 //To calculate the fringe width
5 dist1=0.005 //units in mm
6 dist2=15    //units in cm
7 alpha=dist1/dist2 //units in radians
8 lamda=6000*10^-9 //units in cm
9 betaa=(lamda)/(2*alpha) //units in
10
11 printf("Fringe width beta=%0.3fcm",betaa)
12
13 //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

```

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

```

Scilab code Exa 1.14 To calculate the distance from the fringe

```

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

```

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

```

1 //Example 1_15
2 clc();
3 clear;

```

```

4 //To find the diameter of the 5th bright ring
5 n=5
6 lemda=5460 //units in angstrom
7 lemda=5460*10^-8 //units in cm
8 u=1.50
9 f=400 //units in cm
10 R=(u-1)*2*f
11 D=sqrt(2*(2*n-1)*lemda*R)
12 printf("The diameter of the 5th fringe %.2f mts",D)

```

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

```

1 //Example 1-16
2 clc();
3 clear;
4 //To find the wavelength in the visible region
5 u=1.33
6 t=500 //units in angstrom
7 t=500*10^-10 //units in mts
8 n=0 //when n=0
9 lemda1=(4*u*t)/((2*n)+1)
10 printf("when n=0 then lemda1 is %.11f mts",lemda1)
11 n=1 //when n=1
12 lemda2=(4*u*t)/((2*n)+1)
13 printf("\nwhen n=1 then lemda2 is %.11f mts",lemda2)
14 n=2 //when n=1
15 lemda3=(4*u*t)/((2*n)+1)
16 printf("\n when n=2 then lemda3 is %.11f mts",lemda3
)
17 n=3 //when n=1
18 lemda4=(4*u*t)/((2*n)+1)
19 printf("\n when n=3 then lemda4 is %.11f mts",lemda4
)

```

```
20 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

```
1 //Example 1_17
2 clc();
3 clear;
4 //To calculate the order of interference of the dark
    band
5 t=1.5*10^-6 //units in cm
6 lemda=5*10^-7 //units in cm
7 i=60 //units in degree
8 u=1.33
9 r=asin((sin(i*pi/180))/u)*(180/pi) //units in
    degree
10 n=(2*u*t*cos(r*pi/180))/lemda
11 printf("The order of interference of the dark band
    is %.0f",n)
12 //In this question ,the thickness and lemda values
    are given wrong
13 //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

```
1 //Example 1_18
2 clc();
3 clear;
```

```

4 //To calculate the smallest thickness of the plate
5 lemnda=5890 //units in
   angstroam
6 lemnda=5890*10^-10 //units in mts
7 u=1.5
8 n=1
9 r=60 //units in degree
10 t=(n*lemnda)/(2*u*cos(r*pi/180))*10^10
11 printf("Thickness of the glass plate is %.0f
   angstroam",t)

```

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

```

1 //Example 1_19
2 clc();
3 clear;
4 //To find the diameter of 20th ring
5 D4=0.4 //units in cm
6 D12=0.7 //units in cm
7 D20=sqrt(2*(D12^2-D4^2)+D4^2)
8 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

```

1 //Example 1_20
2 clc();
3 clear;
4 //To calculate the refractive index of the liquid

```

```

5 D10=1.40 //units in cm
6 d10=1.27 //units in cm
7 u=D10^2/d10^2
8 printf("Refractive index of the liquid is %.3f",u)

```

Scilab code Exa 1.21 To find the wavelength of light used

```

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

```

Scilab code Exa 1.22 To find the total number of lines

```

1 //Example 1_22
2 clc();
3 clear;
4 //To calculate the number of lines
5 theta=18.233 //units in degrees
6 n=1
7 lamda=6.56*10^-7 //units in meters
8 m=(0.02*sin(theta*pi/180))/(n*lamda)

```



```
9 printf("Number of lines M=%d",m)
```

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

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

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

```
1 //Example 1_24
2 clc();
3 clear;
4 //To calculate the refractive index of the liquid
5 lemda=5.895*10^-7 //units in
   mts
6 D=0.3*10^-2 //units in
   mts
7 R=1 //units in
   mts
```

```

8 n=5
9 u=(4*R*n*lemda)/D^2
10 printf("The reractive index of the liquid is %.2f",u
    )

```

Scilab code Exa 1.25 To find the value of slit width

```

1 //Example 1_25
2 clc();
3 clear;
4 //To find the value of the slit width
5 lemda=6500 //units in
    angstroam
6 theta=30 //units in
    degrees
7 a=lemda/sin(theta*%pi/180)
8 printf("The value of the slit is %.0f angstroam",a)

```

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

```

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

```

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

```
1 //Example 1_27
2 clc();
3 clear;
4 //To find the wavelength in the visible region
5 t=5000 //units in angstrom
6 t=5000*10^-10 //units in mts
7 u=1.33
8 n=0 //let us take n=0
9 lemda=(4*u*t)/(2*n+1)
10 printf("The wavelength in the infrared region is %
    .10f",lemda)
11 n=1 //let us take n=1
12 lemda1=(4*u*t)/(2*n+1)
13 printf("\\n The wavelength in the IR region is %.10f"
    ,lemda1)
14 n=2 //let us take n=2
15 lemda3=(4*u*t)/(2*n+1)
16 printf("\\n The wavelength in the visible region is %
    .10f",lemda3)
17 n=3 //let us take n=3
18 lemda4=(4*u*t)/(2*n+1)
19 printf("\\n The wavelength in the UV region is %.10f"
    ,lemda4)
20 printf("\\n\\n In all wavelengths reflected The
    wavelength in the visible region %.10f",lemda3)
```

Scilab code Exa 1.28 To calculate the order of interference

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

Scilab code Exa 1.29 To calculate the smallest thickness

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

Scilab code Exa 1.30 To calculate the thickness of air film

```
1 //Example 1_30
2 clc();
3 clear;
4 //To calculate the thickness of air film
5 lemda=500 //units in
   nanometers
6 lemda=500*10^-9 //units in meters
7 n=10
8 D=2 //units in
   millimeters
9 D=2*10-3 //units in meters
10 R=D^2/(4*n*lemda) //units in meters
11 t=(D^2/(8*R))*10^6
12 printf("Thickness of air film is %.1f micrometers",t
   )
```

Scilab code Exa 1.31 To find the wavelength of the light

```
1 //Example 1_30
2 clc();
3 clear;
4 //To find the wavelength of the light
5 D5=0.336 //units in
   centimeters
6 D5=0.336*10^-2 //units in meters
```

```

7 D15=0.59 //units in
   centimeters
8 D15=0.59*10^-2 //units in meters
9 m=10
10 R=100 //units in
   centimeters
11 R=100*10^-2 //units in meters
12 lemda=((D15^2-D5^2)/(4*m*R))*10^9
13 printf("Wavelength of the light is %.0f nanometers",
   lemda)

```

Scilab code Exa 1.32 To find the radius of curvature

```

1 //Example 1_32
2 clc();
3 clear;
4 //To find the radius of curvature of the lens
5 lemda=5900 //units in
   angstroam
6 lemda=5900*10^-10 //units in meters
7 D=0.5 //units in
   centimeters
8 D=0.5*10^-2 //units in meters
9 n=10
10 R=D^2/(4*n*lemda)
11 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

```

1 //Example 1_33
2 clc();
3 clear;
4 //To calculate the refractive index of the liquid
5 lemda=5.895*10-7 //units in
    meters
6 D=0.3 //units in
    centimeters
7 D=0.3*10-2 //units in
    meters
8 R=100 //units in
    centimeters
9 R=100*10-2 //units in meters
10 n=5
11 u=(4*R*n*lemda)/D2
12 printf("The refractive index of the liquid is %.3f",
    u)

```

Scilab code Exa 1.34 To calculate index of the liquid

```

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

```

Scilab code Exa 1.35 To calculate the intensity ratio

```
1 //Example 1_35
2 clc();
3 clear;
4 //To calculate the intensity ratio of the bright and
   dark fringes
5 I1=1
6 I2=25
7 A1=sqrt(I1)
8 A2=sqrt(I2)
9 Imax=(A1+A2)^2
10 Imin=(A2-A1)^2
11 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

```
1 //Example 1_36
2 clc();
3 clear;
4 //To find the order which will be visible at this
   point
5 lemnda1=6000 //units in
   angstroam
6 lemnda1=6000*10^-8 //units in cm
7 lemnda2=4500 //units in
   angstroam
```



```

8 lemدا2=4500*10^-8 //units in cm
9 n1=21
10 n2=(n1*lemدا1)/lemدا2
11 printf("The order is %.0f",n2)

```

Scilab code Exa 1.37 To find the separation between the slits

```

1 //Example 1_37
2 clc();
3 clear;
4 //To find the separation between the slits
5 lemدا=5100 //units in angstroam
6 lemدا=5100*10^-8 //units in cm
7 D=200 //units in cm
8 betaa=0.01 //units in mts
9 betaa=0.01*10^-3 //units in cm
10 d=(lemدا*D)/betaa*10^-3
11 printf("The separation between the slits is %.2f mts
",d)

```

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

```

1 //Example 1_38
2 clc();
3 clear;
4 //To calculate the thickness of the mica sheet
5 d=0.1 //units in cm
6 D=50 //units in cm
7 u=1.58

```

```

8 x=0.2 //units in cm
9 t=(x*d)/(D*(u-1))
10 printf("The thickness of the mica sheet is %.6f cm",
t)

```

Scilab code Exa 1.39 To calculate the fringe width

```

1 //Example 1_39
2 clc();
3 clear;
4 //To calculate the fringe width
5 lemnda=5000 //units in angstrom
6 lemnda=5000*10^-8 //units in cm
7 d=0.05 //units in cm
8 D=50 //units in cm
9 betaa=(lemnda*D)/d
10 printf("Fringe width is %.2f cm",betaa)

```

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

```

1 //Example 1_40
2 clc();
3 clear;
4 //To calculate the wavelength of source of light
5 betaa=0.30 //units in cm
6 d=0.04 //units in cm
7 D=180 //units in cm
8 lemnda=((betaa*d)/D)*10^8

```

```

9 printf("The wavelength of source of light is %.0f
    angstrom", lemدا)
10 //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

```

1 //Example 1_41
2 clc();
3 clear;
4 //To calculate the wavelength of monochromatic light
5 betaa=0.4 //units in mm
6 betaa=0.4*10^-1 //units in cm
7 d=0.1 //units in cm
8 D=80 //units in cm
9 lemدا=(d*betaa)/D*10^8
10 printf("The wavelength of monochromatic light is %.0
    f angstrom", lemدا)

```

Scilab code Exa 1.42 To find the fringe width

```

1 //Example 1_42
2 clc();
3 clear;
4 //To find the fringe width
5 lemدا=5000 //units in angstrom
6 lemدا=5000*10^-8 //units in cm
7 d=0.05 //units in cm
8 D=50 //units in cm

```

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

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

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

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

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

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

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

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

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

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

```
1 //Example 1_47
2 clc();
3 clear;
4 //To find the thickness of the glass plate
5 lemda=5000 //units in angstrom
6 lemda=5000*10^-8 //units in cm
7 s_beta=6
8 u=1.5
9 t=((s_beta)*lemda)/(u-1)
10 printf("The thickness of the glass plate is %.4f cm",
    ,t)
```

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

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

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

```
1 //Example 1_49
2 clc();
3 clear;
4 //To find the thickness of the thinnest film
5 u=1.33
6 lemnda=6000 //units in angstroam
7 lemnda=6000*10^-8 //units in cm
8 i=0 //units in degrees
9 r=0 //units in degrees
10 n=1
11 t=(n*lemnda)/(2*u*cos(r))
12 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

```
1 //Example 1_50
2 clc();
3 clear;
4 //To find the radius of curvature of the plano
    convex lens
5 lamda=6000 //units in angstroam
6 lamda=6000*10^-8 //units in cm
7 m=18
8 Dm=0.65 //units in cm
9 n=8
```

```

10 Dn=0.35 //units in cm
11 R=(Dm^2-Dn^2)/(4*lamda*(m-n))
12 printf("Radius of curvature of the plano convex lens
    is %.0f cm",R)

```

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

```

1 //Example 1_51
2 clc();
3 clear;
4 //To find the refractive index of the liquid
5 D12air=1.45 //units in cm
6 D12liq=1.25 //units in cm
7 u=(D12air)^2/(D12liq)^2
8 printf("Refractive index of the liquid is %.4f",u)

```

Scilab code Exa 1.52 To find diameter of 25th ring

```

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

```

Scilab code Exa 1.53 To find the radius of the curvature

```
1 //Example 1_53
2 clc();
3 clear;
4 //To find the radius of the curvature
5 lamda=5890 //units in angstrom
6 lamda=5890*10^-8 //units in cm
7 //diameter of the 15th ring
8 m=15
9 Dm=0.590 //units in cm
10 //diameter of the 5th ring
11 n=5
12 Dn=0.336 //units in cm
13 R=(Dm-Dn)/(4*lamda*(m-n))
14 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

```
1 //Example 1_54
2 clc();
3 clear;
4 //To find the wavelength of the light
5 R=70 //units in cm
6 //Diameter of the 10th dark ring
7 D=0.433 //units in cm
8 n=10
```

```
9 lamda=D^2/(4*R*n) //units in cm
10 printf("The wavelength of the light is %f cm",lamda)
```

Chapter 2

DIFFRACTION

Scilab code Exa 2.1 To calculate the number of lines

```
1 //Example 2_1
2 clc();
3 clear;
4 //To calculate the number of lines in one centimeter
   of grating surface
5 lemda=5*10^-5 //units in
   centimeters
6 theta=30 //units in
   degrees
7 k=2
8 e=(k*lemda)/sin(theta*%pi/180)
9 n=e^-1
10 printf("no of lines per centimeter is %.0f",n)
11 //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

```

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

```

Scilab code Exa 2.3 To calculate the minimum number of lines

```

1 //Example 2_3
2 clc();
3 clear;
4 //To calculate the minimum number of lines
5 lemnda=5890           //units in angstrom
6 lemnda=5890*10^-8    //units in centimeters
7 dlemnda=6*10^-8     //units in centimeters
8 k=2
9 width=2.5           //units in centimeters
10 n=(lemnda/(k*dlemnda))/width
11 printf("no of lines per cm is %.1f",n)

```

Scilab code Exa 2.4 To calculate the total number of lines

```

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

```

Scilab code Exa 2.5 To find the angle of separation

```

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

```

```

8 e=2.54/15000                                //units in
      cm
9 theta1=asin((2*lemda1)/e)*180/%pi
10 theta2=asin((2*lemda2)/e)*180/%pi
11 theta=(theta2-theta1)
12 theta=theta*100
13 theta=(theta*101)/60
14 printf("The angle of separation is %f degrees",theta
      )
15 //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

```

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

```

Scilab code Exa 2.6 To calculate the dispersive power

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

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

```
1 //Example 2_7
2 clc();
3 clear;
4 //TO find the highest order of the spectrum
5 N=5000 //units in lines/cm
6 lemda=6000*10^-8 //units in cm
7 theta=90 //units in degrees
8 k=((1/N)*sin(theta))/lemda
9 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 grating width

```

1 //Example 2_8
2 clc();
3 clear;
4 //To find wave length and maximum grating
5 theta1=10 //units in degrees
6 d=5*10^-9 //units in cm
7 dtheta=3 //units in degrees
8 lamda=(sin(theta1*pi/180)*d)/(cos(theta1*pi/180)*(
    dtheta/3600)*(pi/180))
9 lamda1=lamda+d
10 lamda1=lamda1*10^8
11 d=d*10^8
12 n=lamda1/(d*2)
13 k=2
14 Ne=(n*k*lamda)/(sin(theta1*pi/180))
15 printf("wave length is lamda=%0.7f meters",lamda)
16 printf("\nMaximum grating require Ne=%0.2f cm",Ne)

```

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

```

1 //Example 2_9
2 clc();
3 clear;
4 //To calculate the resolving power and grating
  element
5 sintheta1=0.3
6 sintheta2=0.2
7 lamda=5000 //units in A
8 e=(lamda/(sintheta1-sintheta2))*10^-8 //units in cm
9 width=2.5 //units in cm
10 n=width/e //units in cm
11 resolvingpower=2*n
12 printf("Grating element is e=%0.5f cm\n",e)

```



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

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

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

Scilab code Exa 2.11 To find the slit width

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

Scilab code Exa 2.12 To find the half angular width

```
1 //Example 2_12
2 clc();
3 clear;
4 //To find the half angular width of the central
  bright
5 lemnda=6000*10^-10 //units in
  meters
6 a=12*10^-7 //units in meters
7 theta=asin(lemnda/a)*180/%pi
8 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

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

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

```
1 //Example 2_14
2 clc();
3 clear;
4 //To find the angular separation between two wave
  lengths
5 N=6*10^5 //units in lines per
  meter
6 m=3
7 lemnda1=500*10^-9 //units in meters
8 lemnda2=510*10^-9 //units in meters
9 theta1=asin(m*N*lemnda1)*180/%pi
10 theta2=asin(m*N*lemnda2)*180/%pi
11 theta=(theta2-theta1)
12 printf("The angular separation between two wave
  lengths is %.2f degrees",theta)
```

Scilab code Exa 2.15 To find the highest order

```
1 //Example 2_15
2 clc();
3 clear;
4 //To find the highest order that ca be seen
5 n=5906*10^2 //units in line/cm
6 lamda=600*10^-9 //units in cm
7 m=1/(n*lamda)
8 printf("Maximum order that can be seen is %d",m)
```

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

```
1 //Example 2_16
2 clc();
3 clear;
4 //To find the angular separation of two lines of
   sodium in the first order spectrum
5 N=5*10^5 //units in
   lines per meter
6 m=1
7 lemnda1=5890*10^-10 //units in
   meters
8 lemnda2=5896*10^-10 //units in
   meters
9 theta1=asin(m*N*lemnda1)*180/%pi
10 theta2=asin(m*N*lemnda2)*180/%pi
11 theta=(theta2-theta1)
12 printf("The angular separation is %.3f degrees",
   theta)
```

Scilab code Exa 2.17 To find the slit width

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

```

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

```

Scilab code Exa 2.18 To find the wavelength of the light

```

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

```

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

```

1 //Example 2_19
2 clc();
3 clear;
4 //To calculate the wavelength of the spectral line
5 n=2
6 N=4250 //units in
   centimeters

```

```

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

```

Scilab code Exa 2.20 To find the angular separation

```

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

```

Scilab code Exa 2.21 To find how many orders are visible

```

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

```

```

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

```

Scilab code Exa 2.22 To calculate the slit width

```

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

```

Scilab code Exa 2.23 To calculate the possible order of spectra

```

1 //Example 2_23

```

```

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

```

Scilab code Exa 2.24 To find the wavelength of the light

```

1  //Example 2_4_1
2  clc();
3  clear;
4  //To calculate the wavelength of light
5  D=150                 //units in centimeters
6  d=0.03               //units in centimeters
7  betaa=0.3           //units in centimeters
8  lemnda=((betaa*d)/D)*10^8
9  printf("Wavelength of the light is %.0f angstrom",
   lemnda)

```

Chapter 3

POLARIZATION

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

```
1 //Example 3_1
2 clc();
3 clear;
4 //To calculate the thickness of a half wave plate
5 lemnda=500*10^-9 //units in
   meters
6 ue=1.553
7 u0=1.544
8 t=(lemnda/(2*(ue-u0)))*10^3
9 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

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

```

4 //To calculate the thickness of the quarter wave
  plate for sodium light
5 lemnda=589*10^-9 //units in
  meters
6 ue=1.553
7 u0=1.544
8 t=lemnda/(4*(ue-u0))
9 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

```

1 //Example 3_3
2 clc();
3 clear;
4 //To calculate the thickness of a quarter wave plate
  for monochromotic light
5 lemnda=600*10^-9 //units in
  meters
6 u0=1.5533
7 ue=1.5442
8 t=lemnda/(4*(u0-ue))*10^3
9 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

```

1 //Example 3_4
2 clc();

```

```

3 clear;
4 //To find the minimum thickness of half wave and
   quarter wave plates
5 lemda=589.3*10^-9           //units in
   meters
6 u0=1.65833
7 ue=1.48640
8 t1=lemda/(2*(u0-ue))
9 printf("thickness of half wave plate is %.7f mm",t1)
10 t2=lemda/(4*(u0-ue))
11 printf("\n thickness of quarter wave plate is %.8f
   mm",t2)
12 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

```

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

```

Chapter 4

CRYSTAL STRUCTURES

Scilab code Exa 4.1 To calculate the density

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

Scilab code Exa 4.2 To calculate the lattice constant

```
1 //Example 4_2
```

```

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

```

Scilab code Exa 4.3 To calculate the lattice constant

```

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

```

Scilab code Exa 4.4 To calculate the number of atoms

```

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

```

```

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

```

Scilab code Exa 4.5 To calculate the density

```

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

```

Scilab code Exa 4.6 To calculate the lattice constant

```

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

```

```

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

```

Scilab code Exa 4.7 To calculate the lattice constant

```

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

```

Scilab code Exa 4.8 To calculate the number of atoms

```

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

```



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

Scilab code Exa 4.9 To calculate the density

```
1 //Example 4_9
2 clc();
3 clear;
4 //To calculate the density of copper
5 r=0.1278*10^-9 //units in meters
6 M=63.5 //units in a.m.u
7 N=6.02*10^26 //units in kg/mol
8 n=4
9 a=sqrt(8)*r
10 density=(n*M)/(N*a^3)
11 printf("density of copper is %.3f kg/m^3",density)
12 //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

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

```
9 v=(v1-v2)/v2*100
10 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

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

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

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

```

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

```

Scilab code Exa 4.13 To find the glancing angle

```

1 //Example 4_13
2 clc();
3 clear;
4 //To calculate the glancing angle for the second
  order diffraction
5 lemnda=0.071*10^-9 //units
  in meters
6 a=0.28*10^-9 //units
  in meters
7 h=1
8 k=1
9 l=0
10 n=2
11 theta=(asin((n*lemnda)/(2*(a/(sqrt(h^2+k^2+l^2))))))
  *180/%pi
12 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

```

1 //Example 4_14
2 clc();

```

```

3 clear;
4 //To determine the space of the reflecting plane and
   the volume of the unit cell
5 lemnda=3*10^-10 //units in
   meters
6 theta=40 //units in
   degrees
7 h=1
8 k=0
9 l=0
10 n=1
11 d=(n*lemnda)/(2*sin(theta*%pi/180))*10^10
12 printf("The space of the reflecting plane is %.3f
   angstrom",d)
13 v=(d*sqrt(h^2+k^2+l^2)*10^-10)^3
14 printf("\n\nThe volume of the unit cell is %.33f m^3
   ",v)

```

Scilab code Exa 4.15 To find the miller indices

```

1 //Example 4_15
2 clc();
3 clear;
4 //To find miller indices
5 n=1
6 lamda=0.82*10^-10 //units in meters
7 theta=75.86 //units in degrees
8 d=(n*lamda)/(2*sin(theta*%pi/180))
9 d=d*10^11
10 printf("obtained d value is d=%dA",d)
11 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

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

Scilab code Exa 4.17 To calculate the lattice parameter of lead

```
1 //Example 4_17
2 clc();
3 clear;
4 //To find the lattice parameter of Lead
5 lemnda=1.5*10^-10 //units in
   meters
6 theta=34 //units in
   degrees
7 n=1
8 h=2
9 k=0
10 l=2
11 a=(n*lemnda)/(2*sin(theta))*sqrt(h^2+k^2+l^2)*10^10
12 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

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

```

15 //For (111) Plane
16 a=2
17 noofatomspercell=1/4*2*a
18 bc=sqrt(2)*a
19 ad=(sqrt(3)/2)*sqrt(2)*a
20 area=0.5*bc*ad
21 noofatomsperunitarea=noofatomspercell/area //units
    in Terms of R
22 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

```

1 //Example 5_2
2 clc();
3 clear;
4 //To show d100:d110:d111=sqrt(6):sqrt(3):sqrt(2)
5 //For d100
6 h=1
7 k=0
8 l=0
9 d100=1/sqrt(h^2+k^2+l^2) //Units in terms of a
10 //For d110
11 h=1
12 k=1
13 l=0
14 d110=1/sqrt(h^2+k^2+l^2) //Units in terms of a
15 //For d111
16 h=1
17 k=1
18 l=1
19 d111=1/sqrt(h^2+k^2+l^2) //Units in terms of a
20 printf("d100:d110:d111=%.3f:%.3f:%.3f",d100,d110,

```


d111)

Scilab code Exa 5.3 To determine the interplaner spacing

```
1 //Example 5_3
2 clc();
3 clear;
4 //To determine the interplanar spacing
5 a=450 //units in nm
6 h=2
7 k=2
8 l=0
9 d220=a/sqrt(h^2+k^2+l^2) //units in nm
10 printf("Inter planar spacing d220=%0.1f nm",d220)
11 //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

```
1 //Example 5_4
2 clc();
3 clear;
4 //To determine the interplanar spacing
5 r=1.278*10^-10 //units in meters
6 a=(4*r)/sqrt(2) //units in meters
7 h=1
8 k=1
9 l=1
10 d111=a/sqrt(h^2+k^2+l^2) //units in meters
```

```
11 printf("Inter planar spacing d111=")
12 disp(d111)
13 printf("meters")
```

Scilab code Exa 5.5 To find the lattice parameter of lead

```
1 //Example 5_5
2 clc();
3 clear;
4 //To find the lattice parameter of lead
5 theta=30 //units in degrees
6 n=1
7 l=1.54*10^-10 //units in meters
8 d=(n*l)/(2*sin(theta*pi/180))
9 h=2
10 k=2
11 l=0
12 a=d*(sqrt(h^2+k^2+l^2)) //units in meters
13 a=a*10^10 //units in Armstrongs
14 printf("Lattice parameter is a=%0.1f A",a)
15 //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

```
1 //Example 5_6
2 clc();
3 clear;
4 //To calculate the inter planar spacing
```

```

5 //For theta=6.45
6 theta=6.45 //units in degrees
7 lamda=0.58 //units in Armstrongs
8 d_n=lamda/sin(6.45*%pi/180) //units in Armstrongs
9 printf("Inter planara spacing at %.2fDegrees is d/n=
    %.3f Armstrongs",theta,d_n)
10 //For theta=9.15
11 theta=9.15 //units in degrees
12 lamda=0.58 //units in Armstrongs
13 d_n=lamda/sin(9.15*%pi/180) //units in Armstrongs
14 printf("\nInter planara spacing at %.2fDegrees is d/
    n=%.3f Armstrongs",theta,d_n)
15 //For theta=13
16 theta=13 //units in degrees
17 lamda=0.58 //units in Armstrongs
18 d_n=lamda/sin(13*%pi/180) //units in Armstrongs
19 printf("\nInter planara spacing at %.2fDegrees is d/
    n=%.3f Armstrongs",theta,d_n)
20 //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

```

1 //Example 5_7
2 clc();
3 clear;
4 //To find the order of braggs equation
5 d=1.181 //units in A
6 theta=90 //units in degrees
7 lamda=1.540
8 n=(2*d*sin(theta*%pi/180))/lamda
9

```

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

Scilab code Exa 5.8 To find the lattice parameter

```
1 //Example 5_8
2 clc();
3 clear;
4 //To find lattice parameter
5 n=1
6 lamda=0.58 //units in A
7 theta=9.5 //units in degrees
8 a=(n*lamda)/(2*sin(theta*pi/180))
9 printf("lattice parametera=%0.3fA",a)
10 //In text book answer printed wrong as 3.52A correct
    answer is 1.75A
```

Scilab code Exa 5.9 To calculate the glancing angle

```
1 //Example 5_9
2 clc();
3 clear;
4 //To calculate the glancing angle
5 theta1=8.58 //units in degrees
6 n1=3
7 lamda1=0.842 //units in A
8 n2=3
9 lamda2=0.842 //units in A
10 sintheta3=(sin(theta1*pi/180)*n1*lamda1)/(n2*lamda2
    )
```

```

11 theta3=asin(sintheta3)*180/%pi*3
12 printf("The Glancing angle is Theta3=%.2f degrees",
    theta3)

```

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

```

1 //Example 5_10
2 clc();
3 clear;
4 //To determine interplanar spacing andmiller indices
5 n=1
6 lamda=1.54 //Units in A
7 theta=20.3 //units in degrees
8 d=(n*lamda)/(2*sin(theta*pi/180)) //units in A
9 printf("Interplanar spacing d=%d A\n",d)
10 a=3.16
11 hkl=a/d
12 hkl2=hkl^2
13 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

```

1 //Example 5_11
2 clc();
3 clear;
4 //To find the wavenength and energy
5 n=4
6 a=107.87 //units in amu

```

```

7 N=10500
8 row=6.052*10^26
9 a=((n*a)/(N*row))^(1/3)*10^10 //units in A
10 h=1
11 k=1
12 l=1
13 d=a/sqrt(h^2+k^2+l^2) //units in A
14 theta=19. //units in degrees
15 lamda=2*d*sin(theta*pi/180) //units in A
16 printf("Wavelength is lamda=%0.2fA",lamda)
17 lamda=lamda*10^-10 //units in meters
18
19 h=6.625*10^-34 //Plancks constant
20 c=3*10^8 //units in meter/sec
21 energy=(h*c)/(lamda*1.6*10^-19) //units in eV
22 printf("\n energy is =%0d eV",energy)

```

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

```

1 //Example 5_12
2 clc();
3 clear;
4 //To calculate the wavelength and maximum order of
  diffraction
5 n=1
6 d=0.282*10^-9 //units in meters
7 theta=8.583 //units in degrees
8 lamda=((2*d*sin(theta*pi/180))/n)*10^9 //units in
  nm
9 printf("wavelength is lamda=%0.3f nm",lamda)
10 //When theta=90 degrees
11 lama=lamda*10^9 //units in meters
12 n=(2*d)/lamda*10^9

```

```
13 printf("\\nMaximum order of diffraction is n=%d",n)
```

Scilab code Exa 5.13 To find maximum possible order diffraction

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

Scilab code Exa 5.14 To calculate the inter atomic spacing

```
1 //Example 5_14
2 clc();
3 clear;
4 //To calculate the inter frame spacing
5 lamda=1.5418*10^-10 //units in mts
6 theta=30 //units in degrees
7 d=lamda/(2*sin(theta*%pi/180))
8 d=d*10^10 //units in A
9 h=1
10 k=1
11 l=1
12 a=d*sqrt(h^2+k^2+l^2)
13 printf("The inter frame spacing is a=%.2f A",a)
```

Scilab code Exa 5.15 To find the glancing angle

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

Scilab code Exa 5.16 To calculate the distance

```
1 //Example 5_16
2 clc();
3 clear;
4 //To calculate the distane between (110) planes
5 a=0.38 //units in mm
6 h=1
7 k=1
8 l=0
9 d=a/sqrt(h^2+k^2+l^2)
10 printf("Distance between (110) planes d = %.2f nm",d
  )
```

Scilab code Exa 5.17 To compare the density of lattice point

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

Scilab code Exa 5.18 To calculate the glancing angle

```
1 //Example 5_18
2 clc();
3 clear;
4 //To calculate the glancing angle
5 h=1
6 k=1
7 l=0
8 lamda=0.065*10^-9 //units in m
```

```

9 n=2
10 a=0.26*10^-9 //units in nm
11 sintheta=(n*lamda*sqrt(h^2+k^2+k^2))/(2*a)
12 theta=asin(sintheta)*180/%pi //units in degrees
13 printf("Theta=%0.2f degrees",theta)
14 //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

```

1 //Example 5_19
2 clc();
3 clear;
4 //To compute the cube edge of unit cell
5 n=1
6 lamda=1.54*10^-10 //units in meters
7 theta=19.2 //units in degrees
8 d=(n*lamda)/(2*sin(theta*%pi/180))
9 h=1
10 k=1
11 l=1
12 a=d*sqrt(h^2+k^2+k^2)*10^10 //units in A
13 printf("Cube edge of unit cell a=%0.2f A",a)

```

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

```

1 //Example 5_20
2 clc();

```

```

3 clear;
4 //To compute the cube edge of unit cell
5 n=1
6 lamda=1.54*10^-10 //units in m
7 theta=19.2 //units in degrees
8 d=(n*lamda)/(2*sin(theta*pi/180))
9 h=1
10 k=1
11 l=1
12 a=d*sqrt(h^2+k^2+l^2)
13 printf("Cube edge of unit cell a=")
14 disp(a)
15 printf(" meters")

```

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

```

1 //Example 5_21
2 clc();
3 clear;
4 //To find intercepts along x and y axis
5 oa_ob=3/2
6 oa_oc=1/2
7 b=0.184 //units in nm
8 ob=(1/oa_ob)*b
9 c=0.197 //units in nm
10 oc=(1/oa_oc)*c
11 printf("OB=%0.3 f nm", ob)
12 printf("\nOC=%0.3 f nm", oc)

```

Scilab code Exa 5.22 To calculate the inter planner distance

```
1 //Example 5_22
2 clc();
3 clear;
4 //To calculate the interplanar spacing distance
5 h=1
6 k=2
7 l=3
8 a=0.82 //units in nm
9 b=0.94 //units in nm
10 c=0.75 //units in nm
11 d=((h/a)^2+(k/b)^2+(l/c)^2)^-0.5 //units in nm
12 printf("Interplanar spacing d=%0.3f nm",d)
```

Scilab code Exa 5.23 To find the interplanner spacing

```
1 //Example 5_23
2 clc();
3 clear;
4 //To find the interplanar spacing
5 n=2
6 lamda=0.12 //units in nm
7 theta=28 //units in degrees
8 d=(n*lamda)/(2*sin(theta*pi/180))
9 printf("Interplanar spacong d=%0.2f nm",d)
```

Scilab code Exa 5.24 To find the interplanner spacing and lemnda

```

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

```

Scilab code Exa 5.25 To find the wavelength

```

1 //Example 5_25
2 clc();
3 clear;
4 //To find the wavelength at which planes give rise
    to maximum intensity
5 d=275 //units in pm
6 theta=45 //units in degrees
7 lamda=(2*d*sin(theta*pi/180)) //units in pm
8 n=3
9 printf("\nFor n=3 lamda=%.2 f",lamda/n)
10 n=4
11 printf("\nFor n=4 lamda=%.2 f",lamda/n)
12 printf("\nLamda lies beyond the range of wavelengths
    of polychromatic source")

```

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

```
1 //Example 5_26
2 clc();
3 clear;
4 //To calculate the braggs angle and Wavelength
5 theta2=87 //units in degrees
6 theta=theta2/2 //units in degrees
7 h=1
8 k=1
9 l=1
10 a=0.2 //units in nm
11 d=a/sqrt(h^2+k^2+l^2) //units in nm
12 lamda=2*d*sin(theta*%pi/180) //units in nm
13 printf("lamda=%0.3 f nm", lamda)
```

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

```
1 //Example 5_27
2 clc();
3 clear;
4 //To identify unit cell and determine its dimensions
5 printf("We have the relation  $\sin^2(\theta) = ((\lambda / (2 * a))^2 * (h^2 + k^2 + l^2)) = (j * ((\lambda / (2 * a))^2))$ ")
6 printf("\n This can be used to Estimate the cell parameters and Indexing")
```

Scilab code Exa 5.28 To calculate the effective temperature

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

Scilab code Exa 5.29 To calculate the braggs angle

```
1 //Example 5_29
2 clc();
3 clear;
4 //To calculate the Braggs angle
5 h=6.624*10^-34
6 m=9.1*10^-31 //units in Kgs
7 e=1.6*10^-19 //units in eV
8 vo=80 //units in nm
9 lamda=(h/sqrt(2*m*e*vo))*10^9 //units in m
10 h=1
```

```

11 k=1
12 l=1
13 lp=0.35 //units in nm
14 d111=lp/sqrt(h^2+k^2+l^2) //units in nm
15 theta=asin(lamda/(2*d111))*(180/%pi)
16 printf("Braggs angle is %.2f Degrees",theta)

```

Scilab code Exa 5.30 To explain the difference between the samples

```

1 //Example 5_30
2 clc();
3 clear;
4 //To give an explanation for the differences between
   samples
5 lamda=0.152 //units in nm
6 h=1
7 k=1
8 l=1
9 theta1=21 //units in degrees
10 theta2=383 //units in degrees
11 d111a=lamda/(2*sin(theta1*%pi/180)) //units in nm
12 d111b=lamda/(2*sin(theta2*%pi/180)) //units in nm
13 alpha1=d111a*sqrt(h^2+k^2+l^2) //units in nm
14 alpha2=d111b*sqrt(h^2+k^2+l^2) //units in nm
15 printf("For sample A Alpha=%.3f nm",alpha1)
16 printf("\nFor sample B Alpha=%.3f nm",alpha2)
17 //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

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

Scilab code Exa 5.32 To find the bragg's reflection

```
1 //Example 5_32
2 clc();
3 clear;
4 //To find the plane which gives reflection
```

```

5 D=0.228 //units in nm
6 lamda=0.154 //units in nm
7 hkl=((2*D)/((lamda/2)*sqrt(3)))^2
8 printf("The maximum value that is possible for h^2+k
^2+l^2=%0.2f so (h,k,l) values are (2,2,2)",hkl)
9 //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

```

1 //Example 5_33
2 clc();
3 clear;
4 //To calculate the wavelength and maximum order of
diffraction
5 d=0.282*10^-9 //units in meters
6 theta=8.583 //units in degrees
7 lamda=2*d*(sin(theta*%pi/180))
8 lamda1=lamda*10^10 //units in A
9 theta=90 //units in degrees
10 n=(2*(d)*sin(theta*%pi/180))/lamda
11 printf("wave length lamda=%0.3fA",lamda1)
12 printf("\nMaximum order of diffraction n=%d",round(n
))

```

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

```

1 //Example 5_34
2 clc();

```

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

Chapter 6

LASER

Scilab code Exa 6.1 To calculate the relative population

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

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

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

```

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

```

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

```

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

```

Scilab code Exa 6.4 To find the band gap

```

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

```

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

```

1 //Example 6_5
2 clc();
3 clear;
4 //To find the relative population of the states in
  Ruby laser
5 h=6.626*10^-34
6 v=3*10^8 //units in met/sec
7 kb=1.381*10^-23 //units in J/L
8 t=300 //units in K
9 n_no=exp((h*v)/(kb*t))
10 printf("The relative population of two states is N/
  N0=")
11 disp(n_no)
12 //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 spontane

```

1 //Example 6_6

```

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

Chapter 7

FIBER OPTICS

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

```
1 //Example 7_1
2 clc();
3 clear;
4 //To calculate Critical angle numerical apperture
   and acceptance angle
5 n1=1.5
6 n2=1.47
7 phi=asin(n2/n1)*180/%pi //units in degrees
8 NA=sqrt(n1^2-n2^2)
9 acetangle=asin(NA)*180/%pi //units in degrees
10 printf("Critical angle=%0.1f degrees",phi)
11 printf("\n Numerical apperture=%0.2 f",NA)
12 printf("\nAcceptance angle=%0.1f Degrees",acetangle)
```

Scilab code Exa 7.2 To estimate the numerical aperture


```

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

```

Scilab code Exa 7.3 To compare the acceptance angle

```

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

```

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

```

1 //Example 7_4
2 clc();
3 clear;

```

```

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

```

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

```

1 //Example 7_5
2 clc();
3 clear;
4 //To calculate number of reflections per meter and
  total distance covered
5 n1=1.5
6 n2=1.49
7 phi=asin(n2/n1)*180/%pi //units in degrees
8 a=25 //units in micro meters
9 leng=2*a*tan(phi*%pi/180) //units inmicro meters
10 totalnum=10^6/leng
11 printf("Total number of reflections is %d\n",
  totalnum)
12 l=1 //units in meters
13 distance=l*(sin(phi*%pi/180))
14 printf("Total distance covered is %.4f Meters",
  distance)
15 //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 attenua

```
1 //Example 7_6
2 clc();
3 clear;
4 //To calculate the signal attenuation and overall
  signal attenuation
5 l=10
6 pi=100
7 p0=2
8 signalatten=(10/l)*log10(pi/p0)      // units in dB
  Km-1
9 printf("Signal attenuation per unit length=%0.1f dB
  Km-1",signalatten)
10 overall=signalatten*10      //units in dB
11 printf("\nover all Signal attenuation=%0d dB",round(
  overall))
```

Scilab code Exa 7.7 To calculate the dispersion

```
1 //Example 7_7
2 clc();
3 clear;
4 //To calculate the dispersion and bandwidth length
  product
5 L=10      //units in Km
6 n=1.55
7 delta=0.026
```

```

8 C=3*10^5 //units in meter per
   second
9 T=(L*n*delta)/C*10^9
10 printf("The total dispersion is %.1f ns",T)
11 l=1/(2*T*10^-9)*10
12 printf("\nThe bandwidth length product is %.2f HZ-Km
   ",l)
13 //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

```

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

```

Scilab code Exa 7.9 To calculate the angle of acceptance

```

1 //Example 7_9
2 clc();
3 clear;
4 //To calculate the angle of acceptance of a optical
   fiber
5 n1=1.563

```

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

Scilab code Exa 7.10 To calculate the refractive index of material

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

Scilab code Exa 7.11 To calculate the fractional index change

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

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

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

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

Scilab code Exa 7.13 To calculate the refractive index of material

```
1 //Example 7_13  
2 clc();  
3 clear;  
4 //To calculate the refractive index of the core  
5 NA=0.39  
6 delta=0.05  
7 n1=NA/sqrt(2*delta)  
8 printf("The refractive index of the core is %.3f",n1  
   )
```

Scilab code Exa 7.14 To calculate the fractional index change

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

Scilab code Exa 7.15 To calculate the numerical aperture

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

Scilab code Exa 7.16 To calculate the angle of acceptance

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

Scilab code Exa 7.17 To calculate the critical angle

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

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

```
1 //Example 7_18
2 clc();
3 clear;
```



```

4 //To find the numerical aperature and acceptance
   angle
5 n1=1.6
6 n2=1.4
7 n0=1.33
8 NA=sqrt(n1^2-n2^2)/n0
9 printf("The numerical aperature is %.3f",NA)
10 theta=asin(NA)*180/%pi
11 printf("\nThe acceptance angle is %.2f degrees",
   theta)

```

Scilab code Exa 7.19 To calculate the fractional index change

```

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

```

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

```

1 //Example 7_20
2 clc();
3 clear;
4 //To calculate the angle of refraction thetal at the
   interface

```

```

5 n1=1.55
6 n2=1.6
7 theta2=60 //units in degrees
8 theta1=asin((n1*sin(theta2*pi/180))/n2)*180/pi
9 printf("The angle of refraction is %.2f degrees",
        theta1)

```

Scilab code Exa 7.21 To calculate refractive index of core

```

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

```

Scilab code Exa 7.22 To calculate the numerical aperture

```

1 //Example 7_22
2 clc();
3 clear;
4 //To calculate the numerical aperture
5 theta=26.80 //units in degrees
6 NA=sin(theta*pi/180)
7 printf("The numerical aperture is %.4f",NA)

```

Chapter 8

NON DESTRUCTIVE TESTING USING ULTRASONICS

Scilab code Exa 8.1 To calculate the depth of the ocean

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

Scilab code Exa 8.2 To calculate the fundamental frequency of crystal

```

1 //Example 8_2
2 clc();
3 clear;
4 //To calculate the fundamental frequency of crystal
5 t=0.002 //units in meters
6 v=5750 //units in meter per
    second
7 f=v/(2*t)
8 printf("The fundamental frequency of crystal is %.0f
    Hz",f)
9 //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

```

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

```

Scilab code Exa 8.4 To find the sound level

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

Scilab code Exa 8.5 To find the noise level

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

Scilab code Exa 8.6 To calculate the intensity level

```
1 //Example 8_6
2 clc();
3 clear;
4 //To calculate the intensity level
5 I=8*10^-5 //units in walt per
    meter square
6 I0=10^-12 //units in decibels
7 In=10*log10(I/I0)
8 printf("Intensity level=%0.3f dB",In)
```

Scilab code Exa 8.7 To calculate the fundamental frequency of crystal

```
1 //Example 8_7
2 clc();
3 clear;
4 //To calculate the fundamental frequency of crystal
5 t=0.002 //units in meters
6 V=5750 //units in meter per
    second
7 v=V/(2*t)*10^-6
8 printf("The fundamental frequency of crystal %0.4f
    MHz",v)
```

Scilab code Exa 8.8 To calculate the fundamental frequency

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

```

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

```

Scilab code Exa 8.9 To calculate the natural frequency

```

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

```

Scilab code Exa 8.10 To calculate the natural frequency

```

1 //Example 8_10
2 clc();

```



```

3 clear;
4 //To calculate the frequency of pure iron rod
5 l=40*10^-3 //units in meter
6 d=7.25*10^3 //units in kg/m
   ^3
7 Y=115*10^9 //units in N/m^3
8 v=(1/(2*l))*sqrt(Y/d)
9 printf(" Natural frequency v=%0.3 f Hz",v)

```

Scilab code Exa 8.11 To calculate the capacitance

```

1 //Example 8_11
2 clc();
3 clear;
4 //To calculate the capacitance
5 v=10^6 //units in Hz
6 L=1 //units in henry
7 C=1/(4*pi^2*v^2*L)
8 C=C*10^12 //units in PF
9 printf(" Capacitance C=%0.3 f PF",C)

```

Scilab code Exa 8.12 To find the fundamental frequency

```

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

```

```

6 d=3.5*10^3 //units in kg/m
   ^3
7 Y=8*10^10 //units in N/m^2
8 v=1/(2*1)*sqrt(Y/d)
9 v=v*10^-6 //units in Hz
10 printf("Fundamental Frequency v=%0.3 f Hz",v)

```

Scilab code Exa 8.13 To calculate the fundamental frequency

```

1 //Example 8_13
2 clc();
3 clear;
4 //To calculate the fundamental frequency
5 l=0.001 //units in mts
6 y=7.9*10^10 //units in N/mts^2
7 d=2650 //units in N/mts^2
8 v=sqrt(y/d) //units in m/sec
9 toe=0.001 //units in m
10 V=v/(2*toe) //units in Hz
11 printf("Fundamental frequency=%0.2 fHz",V)

```
