# Scilab Textbook Companion for Applied Physics-ii by H. J. Sawant[1]

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# Book Description

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

**Exa** Example (Solved example)

**Eqn** Equation (Particular equation of the above book)

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

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

# Contents

# List of Scilab Codes

# Chapter 1

# Interference of Light

**Scilab code Exa 1.2.1** find the wavelength of light in the visible spectrum

```
//Chapter-1,Example1_2_1 ,pg 1-11

i=45                                          //angle of
   incidence

u=1.2                                                   //
   refractive index of soap film

t=4*10^-5                                               //
   thickness of soap film

r=asind(sind(i)/u)                                        //by
    Snell's law

//for dark band   '2*u*t*cos(r) = n*lam'

wavelength_1=(2*u*t*cosd(r)/1)*10^8
                            //for n=1

wavelength_2=(2*u*t*cosd(r)/2)*10^8
                            //for n=2
```

```
wavelength_3=(2*u*t*cosd(r)/3)*10^8
                                    //for n=3

//visible range of wavelengths is 4000 A.  to  7000
   A.

printf('\n for n=1  wavelength = %.1f A.\n',
   wavelength_1)

printf('\n for n=2  wavelength = %.1f A.\n',
   wavelength_2)

printf('\n for n=3  wavelength = %.2f A.\n',
   wavelength_3)

printf('\n hence, none of the wavelengths from the
   visible region are absent in reflected light ')
```

**Scilab code Exa 1.2.2** find the wavelength of light in the visible spectrum

```
//Chapter-1,Example1_2_2,pg 1-12

u=1.33                                          //
   refractive index of soap film

t=5*10^-5                                       //thickness
    of soap film

//for normal incidence

r=0                                             //angle of
   refraction

//for constructive interference          '2*u*t*cos(r)
```

```
   = (2*n-1)*wavelength/2'

wavelength_1=(2*u*t*cos(r)*2/(2*1-1))*10^8
                    //for  n=1

wavelength_2=(2*u*t*cos(r)*2/(2*2-1))*10^8
                    //for  n=2

wavelength_3=(2*u*t*cos(r)*2/(2*3-1))*10^8
                    //for  n=3

wavelength_4=(2*u*t*cos(r)*2/(2*4-1))*10^8
                    //for  n=4

//visible range of wavelengths is 4000 A.  to  7000
   A.

printf('\n for n=1  wavelength = %.1f A.\n',
   wavelength_1)

printf('\n for n=2  wavelength = %.1f A.\n',
   wavelength_2)

printf('\n for n=3  wavelength = %.1f A.\n',
   wavelength_3)

printf('\n for n=4  wavelength = %.1f A.\n',
   wavelength_4)

printf('\n The wavelength will be reflected is
   wavelength = %.1f A.\n',wavelength_3)
```

**Scilab code Exa 1.2.3** find the order of interference band

```
//Chapter-1,Example1_2_3,pg 1-12
```

```
u=4/3                                    //refractive index of soap film

t=1.5*10^-4                              //thickness of soap film

wavelength=5*10^-5                       //wavelength of light

i=45                                     //angle of incidece

r=asind(sind(i)/u)                       //by Snell's law

n=2*u*t*cosd(r)/wavelength               //for nth dark band

printf("\n the order of an interference band is n = %.0f",n)
```

**Scilab code Exa 1.2.4** find the thickness of soap film

```
//Chapter-1,Example1_2_4,pg 1-13

//for constructive interference   2 u t cos(r) = (2 n -1) wavelength/2

u=1.33

i=45

r=asind(sind(i)/u)                       //by Snell's law
```

```
n=1                                            //for minimum thickness

wavelength=5896*10^-8

t=(2*n-1)*wavelength/(4*u*cosd(r))

printf("\n the minimum thickness of soap film is t = %.7f cm",t)
```

**Scilab code Exa 1.2.5** find the thickness of oil layer

```
//Chapter-1,Example1_2_5,pg 1-14

u=1.3                                          //refractive index of liquid

r=0                                            //angle of refraction for normal incidence

wavelength_1=7000                              //wavelength of light

wavelength_2=5000                              //wavelength of light

//for destructive interference    '2*u*t*cos(r) = (2*n-1)*wavelength/2'

//'n' order for 'wavelength_1' and 'n+1' order for 'wavelength_2'

//as LHS  is same for both the wavelengths, therefore
```

```
//(2*n-1)*7000/2 =(2*(n+1)-1)*5000/2

n=3                                        //number
   of orders

t=((2*n)-1)*wavelength_1/(4*u*cosd(r))

printf('\nThe thickness of oil layer is t = %.2f A.'
   ,t)
```

**Scilab code Exa 1.2.6** find the thickness of film

```
//Chapter-1,Example1_2_6,pg 1-15

n=8

wavelength=5890*10^-8                      //
   wavelength of light

u=1.46                                 //refractive
   index of oil

i=30                        //angle of incidence

r=asind(sind(i)/u)                       //by Snell's
   law

t=n*wavelength/(2*u*cosd(r))

printf("\n the thickness of an oil film is t =%.7f
  cm",t)
```

**Scilab code Exa 1.2.7** find the minimum thickness of film

```
//Chapter-1,Example1_2_7,pg 1-15

u=1.5                                   //refractive
   index of thin film

r1=60                           //angle of refraction

wavelength=5890*10^-8                             //
   wavelength of light

n=1                                     //for minimum
   thickness

t1=n*wavelength/(2*u*cosd(r1))

printf("\n the thickness of an oil film is t =%.7f
   cm",t1)

r2=0                                    //for normal
   incidence

t2=n*wavelength/(2*u*cosd(r2))

printf("\n the thickness of an oil film is t =%.7f
   cm",t2)
```

**Scilab code Exa 1.2.8** find the refractive index of oil

```
//Chapter-1,Example1_2_8,pg 1-16

V=0.2                             //volume of oil

A=10^4                             //area
```

```
t=V/A                              //Thickness of oil film

r=0                                //for normal incidence

n=1                                //for 1st dark band

wavelength=5.5*10^-5               //wavelength of light

u=n*wavelength/(2*t*cosd(r))

printf('\nrefractive index of oil is  u = %.3f',u)
```

**Scilab code Exa 1.2.9** find the wavelength of light in the visible region

```
//Chapter-1,Example1_2_9,pg 1-17

u=1.2                              //refractive index of oil film

t=2*10^-7                          //thickness of oil film

r=60                          //angle of refraction

//for destructive interference   '2*u*t*cos(r) = (2*n-1)*wavelength/2'

wavelength_1=(2*u*t*cosd(r)*2/(2*1-1))*10^10              //for   n=1

```

```
wavelength_2=(2*u*t*cosd(r)*2/(2*2-1))*10^10
                  //for   n=2

wavelength_3=(2*u*t*cosd(r)*2/(2*3-1))*10^10
                  //for   n=3

//visible range of wavelengths is 4000*10^-10 m  to
    7000*10^-10 m

printf('\n for n=1  wavelength = %.f A.\n',
   wavelength_1)

printf('\n for n=2  wavelength = %.f A.\n',
   wavelength_2)

printf('\n for n=3  wavelength = %.f A.\n',
   wavelength_3)

printf('\n The wavelength will be reflected is
   wavelength = %.f A.\n',wavelength_1)
```

**Scilab code Exa 1.3.1** find wavelength of monochromatic light

```
//Chapter-1,Example1_3_1,pg 1-21

N=10
   //no of dark fringes

d=1.2
   //distance between consecutive fringes

B_air=d/N
                                                    //
   fringe width in air

```

```
a=(40/3600)*(%pi/180)
    //angle made by film in radians

wavelength=2*a*B_air
                                                        //as
    fringe width in air is     'B_air = wavelength
    /(2*a)'

printf("\nThe wavelength of monochromatic light is =
    %.8f cm\n",wavelength)
```

**Scilab code Exa 1.3.2** calculate the angle of wedge

```
//Chapter-1,Example1_3_2,pg 1-22

wavelength=5893*10^-8

    //wavelength of light

B=0.1

    //fringe width

u=1.52

    //refractive index of glass wedge

a=(wavelength/(2*u*B))*3600*(180/%pi)
                                                 //as fringe
    spacing is    'B = wavelength/(2*a*u)'

printf("\nThe angle of wedge is  a =%.2f seconds \n"
    ,a)
```

**Scilab code Exa 1.3.3** calculate the wavelength of light

```
//Chapter-1,Example1_3_3,pg 1-22

B=0.25
    //fringe width

u=1.4
    //refractive index of film

a=(20/3600)*(%pi/180)                                           //
    angle made by film in radians

wavelength=2*a*B*u
    //as fringe width is     'B = wavelength/(2*a*u)'

printf("\nThe wavelength of monochromatic light is =
    %.8f cm\n",wavelength)
```

---

**Scilab code Exa 1.3.4** find the number of fringes

```
//Chapter-1,Example1_3_4,pg 1-23

wavelength=5.82*10^-5
    //wavelength of a monochromatic light

```

```
u=1.5
    //refractive index of glass

a=(20/3600)*(%pi/180)                                   //
    angle made by glass film in radians

B=wavelength/(2*u*a)
    //The fringe width

N=1/B
    //the number of fringes per cm

printf("\nThe number of fringes per cm = %.f \n",N)
```

**Scilab code Exa 1.3.5** find the diameter of wire

```
//Chapter-1,Example1_3_5,pg 1-24

wavelength=6*10^-5
    //wavelength of light

B=0.1
    //fringe width(as there are 10 fringes)

u=1
    //refractive index of air wedge

a=wavelength/(2*u*B)
```

```
//as fringe spacing is    'B = wavelength/(2*a*u)
'

dist=10
//distance of plane of rectangular pieces from
wire

d=a*dist
//as for small angle 'tan(a) = a = d/dist'

printf("\nThe diameter of wire is  d = %.3f cm\n",d)
```

**Scilab code Exa 1.3.6** find the separation between consecutive bright fringes

```
//Chapter-1,Example1_3_6,pg 1-24

a=10^-4
//as for small angle 'tan(a) = a'

wavelength=5900*10^-10                                   //
wavelength of light in air

u=1
//refractive index of air

B=wavelength/(2*u*a)                                      //The
fringe width

```

```
printf("\nThe fringe width is  B = %.5f m\n",B)
```

**Scilab code Exa 1.4.1** find the ring number

```
//Chapter-1,Example1_4_1,pg 1-32

//let the diameter of nth dark ring be double the diameter of that of 40th ring

//as   Dn^2 = 4*R*n*wavelength

n_1=40     //40 th dark ring

n=4*n_1     //as diameter is double

printf('\nThe ring number is   n= %.f',n)
```

**Scilab code Exa 1.4.2** find radius of curvature and thickness of film

```
//Chapter-1,Example1_4_2,pg 1-32

//For dark rings Dn=sqrt(4*R*n*wavelength)

n=10                       //10th ring

Dn=0.5                     //diameter of 10th ring

wavelength=5*10^-5                   //wavelength of light

```

```
R=Dn^2/(4*n*wavelength)          //radius of curvature

t=Dn^2/(8*R)               //thickness of film

printf('\nThe radius of curvature is  R = %.2f cm\n',R)

printf('\nThe thickness of film is  t = %.5f cm\n',t)

//mistake in textbook
```

**Scilab code Exa 1.4.3** find the radius of curvature

```
//Chapter-1,Example1_4_3,pg 1-33

n_1=5                                         //5th ring

n_2=15                                        //15th ring

p=n_2-n_1                                     //difference between rings

Dn_1=0.336                              //diameter of 5th ring

Dn_2=0.59                               //diameter of 15th ring

wavelength=5890*10^-8                            //wavelength of light

R=(Dn_2^2-Dn_1^2)/(4*p*wavelength)
```

```
//radius of curvature

printf('\nThe radius of curvature is  R = %.2f cm\n',R)
```

**Scilab code Exa 1.4.4** find the wavelength of light

```
//Chapter-1,Example1_4_4,pg 1-33

//as   n1 = nth ring      n2 = (n+8)th ring

p=8                                         //difference between rings

Dn_1=0.42                                   //diameter of 5th ring

Dn_2=0.7                                    //diameter of 15th ring

R=200                                       //radius of curvature

wavelength=(Dn_2^2-Dn_1^2)/(4*p*R)          //wavelength of light

printf('\nThe wavelength of light is  wavelength = %.6f cm\n',wavelength)
```

**Scilab code Exa 1.4.5** find the refractive index of liquid

```
//chapter-1,Example1_4_5,pg 1-34

```

```
Dn_1=0.218                           //Diameter of
   nth ring

Dn_2=0.451                           //Diameter of (
   n+10)th ring

wavelength=5893*10^-8                          //
   wavelength of light

R=90                               //Radius of
   curvature

p=10

u=(4*p*wavelength*R)/(Dn_2^2-Dn_1^2)               //
   Refractive index of liquid

printf('\nRefractive index of liquid is  u = %.3f',u
   )
```

**Scilab code Exa 1.4.6** find the diameter of dark ring

```
//chapter-1,Example1_4_6,pg 1-34

//For nth dark ring        Dn^2 =4*R*n*wavelength

D_5=0.42                  //Diameter of 5th dark
   ring

D_10=sqrt(2*D_5^2)               //as number of ring
    double, the diameter is sqrt(2) times the
   diameter of original ring

printf('\nThe diameter of 10th dark ring is  D10 = %
   .3f cm',D_10)
```

**Scilab code Exa 1.4.7** find the diameter of dark ring

```
//Chapter-1,Example1_4_7,pg 1-35

R=200                                    //radius of curvature

wavelength_1=6000*10^-8                                        //wavelength of light for nth dark ring

wavelength_2=5000*10^-8                                        //wavelength of light for (n+1)th dark ring

//as nth ring due to wavelength_1= 6000*10^-8 cm is coincide with (n+1)th ring  due to wavelength_2=5000*10^-8 cm

//therefore  6*n = 5*(n+1)

n=5

Dn=sqrt(4*R*n*wavelength_1)

printf('\nDiameter of nth dark ring due to wavelength 6000 A. is   Dn = %.4f cm\n',Dn)

//wrong ans in textbook
```

**Scilab code Exa 1.4.8** find the refractive index of liquid

```
//Chapter-1,Example1_4_8,pg 1-35

D_air=2.3                                    //Diameter of bright ring in air

D_liquid=2                                   //Diameter of bright ring in liquid

u=D_air^2/D_liquid^2                         //Refractive index of liquid

printf('\n The refractive index of liquid is  u = %.4f \n',u)
```

**Scilab code Exa 1.4.11** find the diameter of ring

```
//Chapter-1,Example1_4_11,pg 1-37

D_4=0.4                                      //diameter of 4th dark ring

D_12=0.7                                     //diameter of 12th dark ring

const=D_4^2/(4*4)                            //assume (R*wavelength = const)  for 4th dark ring

D_20=sqrt(4*20*const)                        //For 20th dark ring

printf('\nDiameter of 20th dark ring is   D20 = %.3f cm\n',D_20)
```

**Scilab code Exa 1.4.12** calculate the wavelength of light

```
//Chapter-1,Example1_4_12,pg 1-38

n_1=5                                              //5th
    ring

n_2=15                                             //15th
    ring

p=n_2-n_1                                          //
    difference between rings

Dn_1=0.336                                    //diameter of
    5th ring

Dn_2=0.59                                     //diameter of
    15th ring

R=100                                              //
    Radius of curvature

wavelength=(Dn_2^2-Dn_1^2)/(4*p*R)*10^8
                    //wavelength of light

printf('\nwavelength of light is = %.f A.',
    wavelength)
```

**Scilab code Exa 1.7.1** find the thickness of coating

```
//Chapter-1,Example1_7_1,pg 1-42

```

```
wavelength=560
    //wavelength of light in air

u=2.0
    //refractive index of silicon monoxide material

//The wavelength of 'wavelength_1' in a medium of
    refractive index 'u' is

wavelength_1=wavelength/u

t=wavelength_1/4
    //thickness of the film

printf("\nThe thickness of the film is = %.f nm\n",t
    )
```

---

**Scilab code Exa 1.7.2** find the thickness of coating

```
//Chapter-1,Example1_7_2,pg 1-42

wavelength=6000
    //wavelength of light in air

u=1.2
    //refractive index of transparant material

wavelength_1=wavelength/u
    //The wavelength of wavelength_1 in a medium of
```

```
refractive index 'u'

t=wavelength_1/4 //thickness of coating

printf("\nThe thickness of coating to eliminate reflection is t = %.f A.\n",t)
```

# Chapter 2

# Diffraction of Light

**Scilab code Exa 2.2.1** calculate the width of slit

```
//Chapter-2,Example2_2_1,pg 2-10

angle=30                                    //angle of
   incidance

n=1                                                 //first
   minimum

wavelength=6500*10^-8                                 //
   wavelength of light

a=(n*wavelength)/sind(angle)
   //For minimum intensity in single slit

printf('\nvalue of a =%.5f cm\n',a)
```

**Scilab code Exa 2.2.2** calculate the angular separation between first order minima

```
//Chapter-2,Example2_2_2,pg 2-10

a=6*10^-6                                     //width of slit

n=1                                           //for first minimum

wavelength=6000*10^-10                        //wavelength of light

angle=2*asind(n*wavelength/a)                 //angular seperation

printf('\nThe angular seperation between first order minima is angle = %.4f degree\n',angle)
```

**Scilab code Exa 2.2.3** calculate wavelength of light

```
//Chapter-2,Example2_2_3,pg 2-11

n2=2                                          //for second order minima

n3=3                                          //for third order minima

wavelength_3=4000                             //wavelength of light for third order minima

//as second order minima is coincide with third order minima,  n2*wavelength2= n3*wavelength_3

wavelength_2=n3*wavelength_3/n2

```

```
printf("\nwavelength of light for second order
   minima is = %.f A.",wavelength_2)
```

**Scilab code Exa 2.2.4** find half angular width of a principal maximum

```
//Chapter-2,Example2_2_4,pg 2-11

a=0.16*10^-3                                    //width of
     slit

n=1                                           //for first
   minimum

wavelength=5600*10^-10                              //
   wavelength of light

angle=asind(n*wavelength/a)                   //angular
   seperation

printf('\nThe half angular width of a principal
   maximum is angle = %.4f degrees\n',angle)
```

**Scilab code Exa 2.2.5** find half angular width of central maximum

```
//Chapter-2,Example2_2_5,pg 2-11

a=12*10^-7                                      //width of
     slit

n=1                                             //for
    first minimum

```

```
wavelength=6000*10^-10                              //wavelength of light

angle=asind(n*wavelength/a)                         //angular seperation

printf('\nThe half angular width of the central maximum is angle = %.1f degrees\n',angle)
```

**Scilab code Exa 2.2.6** calculate the angle

```
//Chapter-2,Example2_2_6,pg 2-12

a=2*10^-6                                           //width of slit

n=1                                                 //for first minimum

wavelength=6500*10^-10                              //wavelength of light

angle=asind(n*wavelength/a)                         //angular seperation

printf('\nThe half angular width of a principal maximum is  angle =%.2f degrees\n',angle)
```

**Scilab code Exa 2.3.1** calculate the missing orders

```
//Chapter-2,Example2_3_1,pg 2-16

a=0.16                                   //width of slit
```

```
b=0.8                                    //width of slit
n=[1 2 3]                                 //no of minima
m=((a+b)/a).*n
printf('\nthe missing orders are m = ')
disp(m)
```

**Scilab code Exa 2.4.1** find the orders

```
//Chapter-2,Example2_4_1,pg 2-24
wavelength_1=5000
   //wavelength of light
wavelength_2=7000
   //wavelength of light
N=4000
   //number of lines per cm
m_1=1/((wavelength_1*10^-8)*N)
                                          //for wavelength=
   5000 A.
m_2=1/((wavelength_2*10^-8)*N)
                                           //for wavelength=
   7000 A.
printf('\nnumber of orders visible for 7000*10^-10
   meter are %.2f\n',m_2)
```

```
printf('\nnumber of orders visible for 5000*10^-10
    meter are %.1f\n',m_1)
```

**Scilab code Exa 2.4.2** find the number of lines per meter

```
//Chapter-2,Example2_4_2,pg 2-24

//as a mth order of wavelength 5400 A. is
    superimposed on (m+1)th order of wavelength 4050
    A.

angle=30                                    //angle
    of diffraction

wavelength_1=5400                                  //
    for mth order

wavelength_2=4050                                  //
    for (m+1)th order

m=wavelength_2/(wavelength_1-wavelength_2)

N=(sind(angle)/(m*wavelength_1))*10^8
                                 //Number of lines
    per cm

printf('\nNumber of lines per cm N = %.2f',N)
```

**Scilab code Exa 2.4.3** calculate the wavelength of spectral line

```
//Chapter-2,Example2_4_3,pg 2-25

```

```
//as 3rd order line of wavelength lam is coincide
   with 4th order wavelength 4992 A.

m_1=3
   //3rd order

m_2=4
   //for 4th order

wavelength_2=4992
                                            //for 4th
   order

wavelength_1=m_2*wavelength_2/m_1

printf('\nwavelength of light is  = %.0f A.',
   wavelength_1)
```

**Scilab code Exa 2.4.4** find the angle of diffraction

```
//Chapter-2,Example2_4_4,pg 2-25

wavelength=6328*10^-10                                  //
   wavelength of light

m1=1                                              //for
   first order

m2=2                                              //for
   second order

N= 6000*10^2                                      //Number
   of lines per unit length
```

```
angle_1=asind(N*m1*wavelength)

angle_2=asind(N*m2*wavelength)

printf('\nangle of diaffraction for 1st order minima
    is  ang1 = %.2f degrees',angle_1)

printf('\nangle of diaffraction for 2nd order minima
    is  ang2 = %.2f degrees',angle_2)
```

**Scilab code Exa 2.4.5** calculate the number of lines per meter

```
//Chapter-2,Example2_4_5,pg 2-26

m=2                                    //ofr second
    order principal maximum

wavelength=5*10^-5                          //
    wavelength of light

angle=30                                  //ang of
    diaffraction

N=sind(angle)/(m*wavelength)

printf('\nNumber of lines per cm is  N = %.f',N)
```

**Scilab code Exa 2.4.6** find the longest wavelength

```
//Chapter-2,Example2_4_6,pg 2-26

```

```
m=3                                          //third
   order

angle=90                                     //for normal
    incidence

N=7000                                       //Number of
   lines per meter

wavelength=(sind(angle)/(m*N))*10^8

printf('\nThe longest wavelength is lam = %.0f A. ',
   wavelength)
```

**Scilab code Exa 2.4.7** calculate the total number of lines

```
//Chapter-2,Example2_4_7,pg 2-27

m=1                                              //first
   ordr spectrum

wavelength=6560*10^-8                            //
   wavelength of light

angle=16.2                                      //angle
   of diffraction

N=2*sind(angle)/(m*wavelength)

printf('\nNumber of lines per 2 cm  is  N = %.0f',N)
```

**Scilab code Exa 2.4.8** calculate total number of lines

```
//Chapter-2,Example2_4_8,pg 2-27


m=1                                                       //first ordr spectrum

wavelength=6.56*10^-5                                     //wavelength of light

angle=18.23333333                                         //angle of diffraction

N=2*sind(angle)/(m*wavelength)

printf('\nNumber of lines per 2 cm  is  N = %.2f',N)
```

**Scilab code Exa 2.4.9** calculate the highest order spectrum

```
//Chapter-2,Example2_4_9,pg 2-27

N=5000                                                    //Number of lines per meter

wavelength=6*10^-5                                        //wavelength of light

m_max=1/(N*wavelength)

printf('\nThe highest order spectrum is  m = %.0f ',m_max)
```

**Scilab code Exa 2.4.10** find the order of absent spectra

```
//Chapter-2,Example2_4_10,pg 2-28

N=5000*10^2                                          //
   Number of lines per meter

wavelength=6000*10^-10
                                        //wavelength of
   light

m_max=1/(N*wavelength)

//for absent spectra

n=[1 2 3]

m=3*n                                                //as b
    = 2a          and m = ((a+b)/a)*n

printf('\n The order of absent spectra is m = %.0f '
   ,m_max)
```

**Scilab code Exa 2.4.11** calculate total number of lines

```
//Chapter-2,Example2_4_11,pg 2-28

m=1

   //first ordr spectrum

```

```
wavelength=5790*10^-10                                        //wavelength of light

angle=19.994                                                  //angle of diffraction

N=2.54*sind(angle)/(m*wavelength*100)

printf('\nNumber of lines per 2.54 cm  is  N = %.0f lines',N)
```

**Scilab code Exa 2.6.1** find angular separation and number of lines per meter

```
//Chapter-2,Example2_6_1,pg 2-31

wavelength_1=5893*10^-10                                      //wavelength of light

wavelength_2=5896*10^-10                                      //wavelength of light

m=2                                                           //for second order

N1=3000*10^2/0.5                                              //Number of lines per meter

angle_1=asind(m*wavelength_1*N1)                              //for wavelength_1

angle_2=asind(m*wavelength_2*N1)
```

```
                              //for wavelength_2

angle_sep=angle_2-angle_1

printf('\nangular seperation is %.4f degrees \n',
    angle_sep)

d_wavelength=3*10^-10

N=wavelength_1/(m*d_wavelength)

printf('\n The number of lines per meter is  N = %.0
    f\n ',N)
```

**Scilab code Exa 2.6.2** find the smallest wavelength interval

```
//Chapter-2,Example2_6_2,pg 2-32

wavelength=481                                    //
    wavelength of light

m=3                                               //for
    third order

N=620*5.05                                        //
    number of lines per meter

d_wavelength=wavelength/(m*N)

printf('\n The smallest wavelength interval is
    d_wavelength = %.4f nm\n',d_wavelength)
```

**Scilab code Exa 2.6.3** find the width of grating

```
//Chapter-2,Example2_6_3,pg 2-33

wavelength=5890*10^-10                                          //wavelength
   of light

d_wavelength=6*10^-10

m=2
   //for second order

N=wavelength/(d_wavelength*m)

W=N/500                                                          //
   as there are 500 lines/cm

printf('\n The width of grating is W = %.3f cm',W)
```

**Scilab code Exa 2.6.4** find the resolving power of diffraction

```
//Chapter-2,Example2_6_4,pg 2-33

N=3*5000                                                         //
   number of lines

n_l=5000*10^2                                                    //
   number of lines per meter

wavelength=5890*10^-10                                      //wavelength of
   light

m_max=1/(n_l*wavelength)

R_P_max=(m_max)*N
```

```

printf('\n The maximum R.P. = %.0f ',R_P_max)
```

**Scilab code Exa 2.6.5** calculate number of lines and the grating element

```
//Chapter-2,Example2_6_5,pg 2-34

wavelength=5890*10^-10                          //wavelength of light

d_wavelength=6*10^-10

m=2    //for second order

N=wavelength/(d_wavelength*m)

W=3                          //width of grating

width=W/N

printf('\nNumber of lines is  N = %.0f \n',N)

printf('\n The grating element(width of line) is  a+b =%.7f cm',width)
```

**Scilab code Exa 2.6.6** find the resolving power

```
//Chapter-2,Example2_6_6,pg 2-34

```

```
m=2                                              //for second
   order

N=40000                                          //Number of
   lines

RP=m*N

printf('\n The resolving power is  R.P. = %.0f',RP)
```

# Chapter 3

# Fibre Optics

**Scilab code Exa 3.3.1** find refractive index of cladding

```
//Chapter-3,Example3_3_1,pg 3-6

NA=0.5                    //Numerical aperture

n1=1.54                   //refractive index of core

n2=sqrt(n1^2-NA^2)        //Numerical aperture is 'NA^2 = n1^2 - n2^2'

printf("\nThe refractive index of cladding is  n2 = %.3f\n",n2)
```

---

**Scilab code Exa 3.3.2** find refractive index of core and acceptance angle

```
//Chapter-3,Example3_3_2,pg 3-6

NA=0.2
   //Numerical aperture

n2=1.59                                                  //
   refractive index of cladding

n1=sqrt(n2^2-NA^2)
                                         //Numerical
   aperture is 'NA^2 = n1^2 - n2^2'

printf("\nThe refractive index of core is n1 = %.1f\
   n",n1)

n0=1.33                                                  //
   refractive index of medium

angle_0=asind(NA/n0)
   //For medium numerical aperture is 'NA=n0*sin(
   angle_0)'

printf("\nThe acceptance angle is angle_0 = %.2f
   Degree\n",angle_0)
```

**Scilab code Exa 3.3.3** find the numerical aperture and acceptance angle

```
//Chapter-3,Example3_3_3,pg 3-6

n1=1.49
   //refractive index f core
```

```
n2=1.44                                          //refractive index of cladding

NA=sqrt(n1^2 - n2^2)                                       //Numerical aperture is 'NA^2 = n1^2 - n2^2'

printf("\nThe Numerical aperture is N.A. = %.5f\n",NA)

angle_0=asind(NA)                   //for air numerical aperture is 'NA=sin(angle_0)'

printf("\nThe acceptance angle is angle_0 = %.1f Degree\n",angle_0)
```

**Scilab code Exa 3.3.4** find the critical angle and angle of acceptance cone

```
//Chapter-3,Example3_3_4,pg 3-7

n1=1.6                                           //refractive index f core

n2=1.3                                           //refractive index of cladding

angle_c=asind(n2/n1)                   //Critical angle

printf("\nThe critical angle is angle_c = %.2f Degree\n",angle_c)
```

```
angle_0=asind(sqrt(n1^2-n2^2))                    //for air numerical aperture is 'NA=sin(angle_0)'

angle_cone=2*angle_0

printf("\nThe acceptance angle cone = %.3f Degree\n",angle_cone)

//mistake in textbook
```

**Scilab code Exa 3.3.5** the refractive index of cladding

```
//Chapter-3,Example3_3_5,pg 3-7

angle_0=30                                                          //acceptance angle

n1=1.4                                                              //refractive index of core

n2=sqrt(n1^2-sind(angle_0)^2)                      //Numerical aperture is 'NA^2 = n1^2 - n2^2' also numerical aperture is 'NA=sin(angle_0)'

printf("\nThe refractive index of cladding is  n2 = %.4f\n",n2)
```

**Scilab code Exa 3.3.6** calculate the fractional index change

```
//Chapter-3,Example3_3_6,pg 3-8

n1=1.563
    //refractive index f core

n2=1.498
    //refractive index of cladding

delta=(n1-n2)/n1                                    //
    fractional index change

printf("\nThe fractional index change is  Delta = %
    .4f \n",delta)
```

**Scilab code Exa 3.3.7** calculate the maximum refractive index of cladding

```
//Chapter-3,Example3_3_7,pg 3-8

//as total internal reflection takes place for light
     travlling within 5 degree of the fibre axis

angle_c=90-5
    //critical angle

n1=1.50
    //refractive index of core

n2=n1*sind(angle_c)

printf("\nThe maximum refractive index of cladding
```

```
is  n2 = %.4f\n",n2)
```

**Scilab code Exa 3.3.8** calculate the acceptance angle

```
//Chapter-3,Example3_3_8,pg 3-8

//In air

angle_0_air=30                                  //acceptance angle of an optical fibre

NA=sind(angle_0_air)                            //Numerical aperture is 'NA^2 = n1^2 - n2^2'  also numerical aperture is 'NA=sin(angle)'

n0=1.33                                         //refractive index of medium

angle_0=asind(NA/n0)                            //For medium numerical aperture is 'NA=n0*sin(angle_0)'

printf("\nThe acceptance angle in medium is angle_0 = %.2f Degree\n",angle_0)
```

**Scilab code Exa 3.4.1** calculate normalized frequency and number of modes

```
//Chapter-3,Example3_4_1,pg 3-10

```

```
d=29*10^-6
    //diameter of core of step index fibre

wavelength=1.3*10^-6
    //wavelength of light

n1=1.52
    //refractive index of core

n2=1.5189
    //refractive index of cladding

V=%pi*d*sqrt(n1^2-n2^2)/wavelength                          //Normalized
    frequency of the fibre

printf("\nThe normalised frequency of fibre is  V =
    %.3f\n",V)

N=V^2/2
    //The number of modes

printf("\nThe number of modes = %.f\n",N)
```

**Scilab code Exa 3.4.2** calculate the maximum radius for fibre

```
//Chapter-3,Example3_4_2,pg 3-10

//For single mode fibre ,  V < 2.405

```

```
V=2.405
    //normalized frequency of fibre

n1=1.47
    //refractive index of core

n2=1.46
    //refractive index of cladding

wavelength=1.3
    //wavelength

d=V*wavelength/(%pi*sqrt(n1^2-n2^2))
                                    //diameter of
    core

r=(d/2)

printf("\nThe maximum radius for fibre = %.3f um\n",
    r)
```

---

**Scilab code Exa 3.4.3** find various parameters of fibre

```
//Chapter-3,Example3_4_3,pg 3-11

wavelength=1*10^-6
    //wavelength of light

r=50*10^-6
```

```
//radius of core

delta=0.055  //relative refractive index of fibre

n1=1.48  //refractive index of core

n2=n1*(1-delta)  //as    'delta= (n1-n2)/n1'

printf("\nThe refractive index of cladding  n2 = %.4f \n",n2)

NA=sqrt(n1^2-n2^2)  //numerical aperture

printf("\nThe numerical aperture N.A. = %.3f \n",NA)

angle_0=asind(NA)  // as   N.A.=sin(angle_0)

printf("\nThe acceptance angle is  angle_0 = %.2f Degree\n",angle_0)

d=2*r

V=%pi*d*NA/wavelength  //Normalized frequency of the fibre

printf("\nThe normalised frequency of fibre is  V = %.2f\n",V)
```

```
N=V^2/2
    //The number of modes

printf("\nThe number of modes  = %.f \n",N)
```

**Scilab code Exa 3.4.4** calculate various parameters of fibre

```
//Chapter-3,Example3_4_4,pg 3-12

wavelength=1*10^-6
    //wavelength of light

d=6*10^-6
    //diameter of core

n1=1.45
    //refractive index of core

n2=1.448
    //refractive index of cladding

angle_c=asind(n2/n1)                                    //
    critical angle is    'sin(angle_c) = n2/n1'

printf("\nThe critical angle is  angle_c = %.f
    Degree\n",angle_c)

NA=sqrt(n1^2-n2^2)
```

```

angle_0=asind(NA)                                    //acceptance angle is    'sin(angle_0) = NA = sqrt(n1^2-n2^2)'

printf("\nThe acceptance angle is  angle_0 =  %.3f Degree\n",angle_0)

N=%pi^2*d^2*NA^2/(2*wavelength^2)                    //the number of modes propogating through fibre

printf("\nthe number of modes propogating through fibre is  N = %.f\n",N)
```

**Scilab code Exa 3.4.5** calculate the number of modes

```
//Chapter-3,Example3_4_5,pg 3-12

wavelength=1*10^-6                                   //wavelength of light

r=50*10^-6                                           //radius of core

n1=1.50                                              //refractive index of core

n2=1.48                                              //refractive index of cladding
```

```
NA=sqrt(n1^2-n2^2)    //numerical aperture

d=2*r    //diameter of core

N=%pi^2*d^2*NA^2/(2*wavelength^2)    //the number of modes propogating through fibre

printf("\nthe number of modes propogating through fibre is  N = %.f\n",N)
```

**Scilab code Exa 3.4.6** calculate various parameters of fibre

```
//Chapter-3,Example3_4_6 ,pg 3-13

wavelength=1.4*10^-6    //wavelength of light

d=40*10^-6    //diameter of core

n1=1.55    //refractive index of core

n2=1.50    //refractive index of cladding
```

```
NA=sqrt(n1^2-n2^2)
    //numerical aperture

printf("\nThe numerical aperture N.A. = %.4f \n",NA)

delta=(n1-n2)/n1
    //Fractional index change

printf("\nThe fractional index change Delta = %.5f\n
    ",delta)

V=%pi*d*NA/wavelength
    //Normalized frequency of the fibre

printf("\nthe V-number is  V = %.2f  \n",V)
```

**Scilab code Exa 3.6.1** calculate the fibre attenuation

```
//Chapter-3,Example3_6_1,pg 3-17

Pin=1
    //Input power in mW

Pout=0.3
    //output power in mW

Pl=(-10)*log10(Pout/Pin)                          //Power loss
    or attenuation
```

```

L=0.1
    //Length of cable in km

a=Pl/L
    //fibre attenuation

printf("\nThe fibre attenuation is a = %.2f dB/km\n"
    ,a)
```

**Scilab code Exa 3.6.2** calculate the output power

```
//Chapter-3,Example3_6_2,pg 3-18

L=3
    //length of fibre in km

a=1.5
    //Loss specification in dB/km

Pin=9.0
    //input power in uW

Pl=a*L
    //Power loss

Pout=Pin*10^(-Pl/10)
                                                        //as
    Power loss or attenuation is    Pl=(-10)*log10(
```

```
Pout/Pin)

printf("\nThe output power Pout = %.3f uW\n",Pout)
```

**Scilab code Exa 3.6.3** calculate the fractional initial intensity

```
//Chapter-3,Example3_6_3,pg 3-18

a=2.2

//ratio= Pout/Pin

//For a length of L=2 km

Pl1=a*2

ratio_1=10^(-Pl1/10)                                       //as Power loss or attenuation is  Pl=(-10)*log10(Pout/Pin)

printf("\nThe fractional initial intensity after 2 km is %.3f \n",ratio_1)

//For a length of L=6 km

Pl2=a*6

ratio_2=10^(-Pl2/10)                                       //as Power loss or attenuation is  Pl=(-10)*log10(Pout/Pin)

printf("\nThe fractional initial intensity after 6 km is %.3f \n",ratio_2)
```

**Scilab code Exa 3.6.4** find the loss specification in cable

```
//Chapter-3,Example3_6_4,pg 3-19

Pin=8.6
    //Input power in mW

Pout=7.5
    //output power in mW

Pl=(-10)*log10(Pout/Pin)                                    //Power loss
    or attenuation

L=0.5
    //Length of cable in km

a=Pl/L
    //Loss secification

printf("\nThe loss specification in cable is  a = %
    .3f dB/km\n",a)
```

# Chapter 4

# Lasers

**Scilab code Exa 4.6.1** find the number of emitted photons

```
//Chapter-4,Example4_6_1,pg 4-7

P=3.147*10^-3                                    //output
   power

t=60                                             //time

wavelength=632.8*10^-9                                 //
   wavelength of He-Ne laser

h=6.63*10^-34                                    //Plancks
    constant

c=3*10^8                                         //
   velocity of light in air

N=P*t*wavelength/(h*c)                                 //
   No. of photons emitted

printf("\nNo. of photons emitted each minute\n")

```

```
disp(N)
```

**Scilab code Exa 4.6.2** find the ratio of population of two energy levels

```
//Chapter-4,Example4_6_2,pg 4-7

wavelength=694.3*10^-9                                      //
   wavelength of He-Ne laser

h=6.63*10^-34                                       //Plancks
    constant

c=3*10^8                                            //
   velocity of light in air

k=1.38*10^-23                                       //
   Boltzmann constant

T=300                                               //ambient
    temperature in kelvin

ratio=%e^-(h*c/(wavelength*k*T))                            //
   ratio of population of two energy level in laser

printf("\nRatio of population of two energy level in
    laser N2/N1 is\n")

disp(ratio)
```

**Scilab code Exa 4.6.3** calculate the wavelength of photons

```
//Chapter-4,Example4_6_3,pg 4-8

```

```
P=100*10^3                                            //
   avrage power per pulse

t=20*10^-9                                            //
   time duration

h=6.63*10^-34                                         //
   Plancks constant

c=3*10^8                                              //
   velocity of light in air

N=6.981*10^15                                         //
   No. of photons per pulse

wavelength=N*h*c/(P*t)*10^10

printf("\nWavelength of photons = %.f A.\n",
   wavelength)
```

# Chapter 5

# Quantum Mechanics

**Scilab code Exa 5.3.1** calculate de Broglie wavelength and velocity and time

```
//Chapter-5,Example5_3_1,pg 5-5

h=6.63*10^-34                                   //Plancks constant

m=10^-2                                         //mass of an moving object

v1=1                                            //velocity of that object

wavelength_1=h/(m*v1)

printf("\nThe de Broglie Wavelength is\n")

disp(wavelength_1)

printf("meter\n")

wavelength_2=10^-10
```

```
//new de Broglie wavelength

v2=h/(m*wavelength_2)   //new velocity of an object

printf("\nThe new velocity of an object is\n")

disp(v2)

printf("meter/sec\n")

d=10^-3   //Distance travelled with speed v2

t=(d/v2)/(365*24*60*60)   //time required to travel distance

printf("\nTime required to travel distance is\n")

disp(t)

printf("years\n")

//mistake in textbook
```

**Scilab code Exa 5.3.2** calculate the velocity

```
//Chapter-5,Example5_3_2,pg 5-6

h=6.63*10^-34   //Plancks constant

```

```
m=9.1*10^-31                                         //mass of an electron

wavelength=10^-10                                    //de Broglie wavelength of an electron

v=h/(m*wavelength)                                   //velocity of an electron

printf("\nThe velocity of an electron is  v = %.1f m/s\n",v)
```

**Scilab code Exa 5.3.3** calculate kinetic energy of an electron

```
//Chapter-5,Example5_3_3,pg 5-6

h=6.63*10^-34                                        //Plancks constant

m=9.1*10^-31                                         //mass of an electron

wavelength=5000*10^-10                               //de Broglie wavelength of an electron

e=1.6*10^-19                                         //charge on electron

E=h^2/(2*m*wavelength^2*e)                           //Kinetic energy of an electron

printf("\nKinetic energy of an electron is  E = %.9f eV\n",E)
```

**Scilab code Exa 5.3.4** find the wavelength of a beam of neutron

```
//Chapter-5,Example5_3_4,pg 5-7

E=0.025                                         //
    energy of neutron

h=6.63*10^-34                                   //
    Plancks constant

m=1.676*10^-27                                  //mass
    of a neutron

e=1.6*10^-19                                    //
    charge on electron

wavelength=h/sqrt(2*m*E*e)
    //The Wavelength of a beam of neutron

printf("\nThe Wavelength of a beam of neutron is\n")

disp(wavelength)

printf("meter\n")
```

**Scilab code Exa 5.3.5** find the de Broglie wavelength of an electron

```
//Chapter-5,Example5_3_5,pg 5-7

E=120                                           //
    kinetic energy of an electron

```

```
h=6.63*10^-34                                    //Plancks constant
m=9.1*10^-31                                     //mass of an electron
e=1.6*10^-19                                     //charge on electron
wavelength=h/sqrt(2*m*E*e)      //The de Broglie Wavelength of an electron
printf("\nThe de Broglie Wavelength of an electron is\n")
disp(wavelength)
printf("meter\n")
```

---

**Scilab code Exa 5.3.6** calculate the velocity and kinetic energy of neutron

```
//Chapter-5,Example5_3_6,pg 5-7
h=6.63*10^-34                                    //Plancks constant
m=1.67*10^-27                                   //mass of a neutron
e=1.6*10^-19                                     //charge on electron
wavelength=10^-10            //The de Broglie Wavelength of a neutron
```

```
v=h/(m*wavelength)
    //velocity of a neutron

printf("\nThe velocity of a neutron is  v= %.f m/s\n
    ",v)

E=h^2/(2*m*wavelength^2*e)
    //Kinetic energy of a neutron

printf("\nKinetic energy of a neutron is  E= %.5f eV
    \n",E)
```

---

**Scilab code Exa 5.3.7** find the de Broglie wavelength

```
//Chapter-5,Example5_3_7,pg 5-8

//(1)
V=182                                               //
    Potential difference

wavelength_1=12.27*10^-10/sqrt(V)
                              //The de Broglie wavelength of
     an electron accelerated through a potential diff
    . of 'V'


printf("\nThe de Broglie wavelength of an electron
    accelerated through a potential diff. of V is\n")

disp(wavelength_1)

printf("meter\n")

//(2)
h=6.63*10^-34                                       //
```

```
Plancks constant

m=1

v=1

wavelength_2=h/(m*v)

printf("\nThe de Broglie wavelength of an object is\n")

disp(wavelength_2)

printf("meter\n")
```

**Scilab code Exa 5.3.8** find the momentum and energy of an electron

```
//Chapter-5,Example5_3_8,pg 5-9

h=6.63*10^-34                                    //Plancks constant

m=9.1*10^-31                                     //mass of an electron

e=1.6*10^-19                                     //charge on electron

wavelength=10^-14         //The de Broglie wavelength of an electron

p=h/wavelength         //as the de Broglie wavelength of an electron is (lam=h/p)

```

```
printf("\nThe momentum of an electron is\n")

disp(p)

printf("kg-meter/sec\n")

E=p^2/(2*m*e)*10^-6  //energy corresponds to momentum

printf("\nenergy of an electron is  E = %.2f MeV\n",E)
```

**Scilab code Exa 5.3.9** find the parameters for an electron wave

```
//Chapter-5,Example5_3_9,pg 5-10

V=3000                                          //Potential difference

wavelength=12.27/sqrt(V)                        //The de Broglie wavelength of an electron accelerated through a potential diff. of 'V'

printf("\nThe de Broglie wavelength of an electron accelerated through a potential diff. of V is %.3f A.\n",wavelength)

h=6.63*10^-34                                   //Plancks constant

p=h/(wavelength*10^-10)                         //as the de Broglie wavelength of an electron is (wavelength=h/p)

```

```
printf("\nThe momentum of an electron is\n")

disp(p)

printf("kg-meter/sec\n")

wave_no=1/(wavelength*10^-10)                                    //wave
    number

printf("\nThe wave number = %.f/m\n",wave_no)

d=2.04                                                           //
    distance between planes

n=1                                                              //
    For first ordet reflection

angle=asind(n*wavelength/(2*d))                                  //
    By Bragg's law '2dsin(angle)=n*wavelength'

printf("\nThe Bragg angle = %.3f Degree\n",angle)
```

**Scilab code Exa 5.3.10** calculate the de Broglie wavelength and momentum of an electron

```
//Chapter-5,Example5_3_10,pg 5-11

V=10*10^3                                                        //
    Potential difference

wavelength=12.27/sqrt(V)                                         // de
    Broglie wavelength of an eThelectron accelerated
    through a potential difference of 'V'

```

```
printf("\nThe de Broglie wavelength of an electron accelerated through a potential difference of V is = %.4f A.\n",wavelength)

h=6.63*10^-34                                   //Plancks constant

p=h/(wavelength*10^-10)                         //The momentum of an electron

printf("\nThe momentum of an electron\n")

disp(p)

printf("kg-meter/sec\n")
```

**Scilab code Exa 5.3.11** calculate the ratio of de Broglie wavelengths

```
//Chapter-5,Example5_3_11,pg 5-11

//a proton and alpha particle are accelerated by the same potential difference

m_p=1.67*10^-27                                 //mass of proton

m_a=4*m_p                                       //mass of alpha particle (assume mass of alpha particle to be 4 times the mass of proton)

e=1.6*10^-19                                    //
```

```
    charge of proton

e_a=2*e                                                  //charge of an alpha particle

h=6.63*10^-34                                            //plancks constant

wavelength_p=h/sqrt(2*m_p*e)                             //wavelength of proton

wavelength_a=h/sqrt(2*m_a*e_a)                           //wavelength of an alpha particle

ratio=wavelength_p/wavelength_a                          //ratio of the de Broglie wavelengths associated with proton and alpha particle

printf("\nthe ratio of wavelengths associated with proton and alpha particle = %.3f\n",ratio)
```

**Scilab code Exa 5.3.12** calculate the velocity and de Broglie wavelength of an alpha particle

```
//Chapter-5,Example5_3_12,pg 5-12

h=6.63*10^-34                                            //Plancks constant

```

```
m=6.68*10^-27
    //mass of alpha particle

E=1.6*10^-16
    //energy asociated with alpha particle

wavelength=h/sqrt(2*m*E)

printf("\nThe de Broglie wavelength of an alpha
    particle\n")

disp(wavelength)

printf("meter\n")

v=h/(m*wavelength)
    //velocity of an alpha particle

printf("\nThe velocity of an alpha particle  v = %.2
    f m/s\n",v)
```

**Scilab code Exa 5.3.13** find the de Broglie wavelengths of photon and electron

```
//Chapter-5,Example5_3_13,pg 5-12

h=6.63*10^-34
    //Plancks constant

c=3*10^8
```

```
//velocity of light in air

E=1.6*10^-19 //energy of photon

wavelength_ph=h*c/E //The energy of photon is E=h*c/lamph

printf("\nThe de Broglie wavelength of a photon\n")

disp(wavelength_ph)

printf("meter\n")

m=9.1*10^-31 //mass of an electron

wavelength_e=h/sqrt(2*m*E)


printf("\nThe de Broglie wavelength of an electron\n")

disp(wavelength_e)

printf("meter\n")
```

**Scilab code Exa 5.3.14** find the de Broglie wavelength of an electron

```
//Chapter-5,Example5_3_14,pg 5-13

h=6.63*10^-34
```

```
//Plancks constant

m_0=9.1*10^-31
//rest mass of electron

c=3*10^8
//velocity of light in air

E=m_0*c^2
//kinetic energy associated with

wavelength=h/sqrt(2*m_0*E)                    //The
   de broglie wavelength of an electron

printf("\nThe de Broglie wavelength of an electron\n
   ")

disp(wavelength)

printf("meter\n")
```

**Scilab code Exa 5.7.1** find the accuracy in position of an electron

```
//Chapter-5,Example5_7_1,pg 5-26

unc=1*10^-4                    //as
   uncertainty is 0.01%

m=9.1*10^-31
```

```
                                              //mass of
    an electron

h=6.63*10^-34
                                              //Plancks
    constant

v=400
                                                     //
    speed of an electron

delta_v=unc*v
                                                     //
    error in measurement of speed

delta_x=h/(4*%pi*m*delta_v)
                                         //By
    Heisenberg's uncertainty priciple

printf("\nThe accuracy in position of an electron
    Delta_x = %.5f m\n",delta_x)
```

**Scilab code Exa 5.7.2** calculate the percentage of uncertainty

```
//Chapter-5,Example5_7_2,pg 5-27

delta_x=10*10^-9
                                                     //
    position is located within this distance

h=6.63*10^-34
                                                     //
    plancks constant

delta_px=h/(4*%pi*delta_x)
```

```
//By Heisenberg's uncertainty priciple

E=1.6*10^-16 //Energy associated with an electron

m=9.1*10^-31 //mass of an electron

p=sqrt(2*m*E) //momentum of an electron

percentage=delta_px*100/p //percentage uncertainty in momentum

printf("\npercentage uncertainty in momentum of an electron = %.4f \n",percentage)
```

**Scilab code Exa 5.7.3** find the accuracy in position of an electron

```
//Chapter-5,Example5_7_3,pg 5-27


uncertainty=1*10^-4 //as uncertainty is 0.01%

m=9.1*10^-31 //mass of an electron

```

```
h=6.63*10^-34 //Plancks constant

v=4*10^5 //speed of an electron

delta_v=uncertainty*v //error in measurement of speed

delta_x=h/(4*%pi*m*delta_v) //By Heisenberg's uncertainty priciple

printf("\nThe accuracy in position of an electron Delta_x = %.8f m\n",delta_x)
```

**Scilab code Exa 5.7.4** find the accuracy in position of an electron

```
//Chapter-5,Example5_7_4,pg 5-27

uncertainty=1*10^-2 //as uncertainty is 1%

m=9.1*10^-31 //mass of an electron

h=6.63*10^-34 //Plancks constant

```

```
v=1.88*10^6                                           //speed
    of an electron

delta_v=uncertainty*v                                    //
    error in measurement of speed

delta_x=h/(4*%pi*m*delta_v)                          //By
    Heisenberg's uncertainty priciple

printf("\nThe accuracy in position of an electron
    Delta_x =\n")

disp(delta_x)

printf("meter\n")
```

**Scilab code Exa 5.7.5** calculate the minimum time spent by the electrons

```
//Chapter-5,Example5_7_5,pg 5-28

//By Heisenberg's uncertainty principle

//(delta_E*delta_t)>=h/(4*%pi)

//therefore     (h*c*delta_wavelength*delta_t/
    wavelength^2) >= h/(4*%pi)

wavelength=4*10^-7
    //wavelength of spectral line

c=3*10^8
```

```
    //velocity of light in air

delta_wavelength=8*10^-15
    //width of spectral line

delta_t=wavelength^2/(4*%pi*c*delta_wavelength)

printf("\nThe minimum time required by the electrons
    in upper energy state  Delta_t = \n")

disp(delta_t)

printf("sec\n")
```

**Scilab code Exa 5.7.6** calculate the uncertainty in energy

```
//Chapter-5,Example5_7_6,pg 5-29

h=6.63*10^-34
    //Plancks constant

e=1.6*10^-19
    //charge of an electron

delta_t=1.4*10^-10
    //time spent in excited state

delta_E=h/(4*%pi*delta_t*e)
    //By Heisenberg's uncertainty principle (delta_E*
```

```
delta_t)>= h/(4*%pi)

printf("\nThe uncertainty in energy of Iradium in
   the excited state  Delta_E = %.8f eV\n",delta_E)
```

**Scilab code Exa 5.7.7** find the time spent by an atom in excited state

```
//Chapter-5,Example5_7_7,pg 5-29

//By Heisenberg's uncertainty principle

//(delta_E*delta_t)>=h/(4*%pi)

//therefore      (h*c*delta_wavelength*delta_t/
   wavelength^2) >= h/(4*%pi)

wavelength=546*10^-9

   //wavelength of spectral line

c=3*10^8

   //velocity of light in air

delta_wavelength=10^-14

   //width of spectral line

delta_t=wavelength^2/(4*%pi*c*delta_wavelength)

printf("\nThe time spent by an atom in the excited
   state \n")

disp(delta_t)

```

```
printf("sec\n")
```

**Scilab code Exa 5.15.1** find the energy of an electron for different states

```
//Chapter-5,Example5_15_1,pg 5-41

//En=(n^2*h^2)/(8*m*e*L^2)                    n=1,2,3,....

e=1.6*10^-19                    //charge of an electron

h=6.63*10^-34                    //Plancks constant

m=9.1*10^-31                    //mass of an electron

L=2*10^-10                    //width

E1=h^2/(8*m*e*L^2)                    //For ground state n=1

printf("\nThe energy of an electron in ground state E1 = %.2f eV\n",E1)

E2=4*E1                    //For first excited state n=2

```

```
printf("\nThe energy of an electron in ground state
    E2 = %.2f eV\n",E2)

E3=9*E1
    //For second excited state n=3

printf("\nThe energy of an electron in ground state
    E3 = %.2f eV\n",E3)
```

**Scilab code Exa 5.15.2** find the ground state energy of an electron

```
//Chapter-5,Example5_15_2,pg 5-42

//En=(n^2*h^2)/(8*m*e*L^2)              n=1,2,3,....

//as width 'L' gets double ,the ground state energy
    becomes one-fourth

E=5.6*10^-3
    //Ground state energy of an electron

E_new=E/4
    //width is doubled

printf("\nThe new energy of an electron in ground
    state E = %.4f\n",E_new)
```

**Scilab code Exa 5.15.3** calculate the probability of finding the particle

```
//Chapter-5,Example5_15_3,pg 5_42
```

```
//for box of width a , the normalised eigen
   functions are

//    'sci = sqrt(2/a)*sin(n*%pi*x/a)'

//    'sci_c = sqrt(2/a)*sin(n*%pi*x/a)'        complex
    conjugate

//for first excitation

n=2

//probability of finding the particle is      P =
   integral a/4 to 3a/4 of  sci * sci_c

//as 'a' is constant width
//assume
a=1

function y=f(x),y= (2/a)*(sin(n*%pi*x/a))^2,
                         // y = sci * sci_c
endfunction

P=intg(a/4,3*a/4,f)

printf('\nThe probability of finding the particle is
     P = %.1f',P)
```

**Scilab code Exa 5.15.4** find the probability of finding the particle

```
//Chapter-5,Example5_15_4,pg 5_43

//probability of finding the particle is       P =
   integral x1 to x2 of  sci * sci_c
```

```
//interval is (0,1/2)

x1=0

x2=1/2

//sci= x*sqrt(3)

//complex conjugate is  sci_c = x*sqtr(3)

function y=f(x),y=(x*sqrt(3))^2, // y = sci * sci_c
endfunction

P=intg(x1,x2,f)

printf('\nThe probability of finding the particle is P = %.3f',P)
```

**Scilab code Exa 5.15.5** find the lowest energy states

```
//Chapter-5,Example5_15_5,pg 5-44

//for an electron

e=1.6*10^-19                                    // electron charge

m_e=9.1*10^-31                                  //mass of an electron

L=10^-9                                         //width of well

```

```
h=6.63*10^-34                                   //Plank's constant

//the energy level are given by   En = n^2 *h^2/(8*m*L^2)

Ee1=(1^2)*(h^2)/(8*m_e*e*(L^2))                 //for   n = 1

Ee2=(2^2)*(h^2)/(8*m_e*e*(L^2))                 //for   n = 2

Ee3=(3^2)*(h^2)/(8*m_e*e*(L^2))                 //for   n = 3

printf('\n  FOR AN ELECTRON')
printf('\n  the lowest three energy states are obtained ')
printf('\n  for n = 1   Ee1 = %.4f eV',Ee1)
printf('\n  for n = 2   Ee2 = %.4f eV',Ee2)
printf('\n  for n = 3   Ee3 = %.4f eV',Ee3)


//for the grain of dust

m=10^-9                                         //mass of grain of dust

l=10^-4                                         //width of  well

E1=(1^2)*(h^2)/(8*m*e*(l^2))                    //for   n = 1

E2=(2^2)*(h^2)/(8*m*e*(l^2))                    //for   n = 2

E3=(3^2)*(h^2)/(8*m*e*(l^2))
```

```
                                    //for    n = 3

printf('\n\n  FOR THE GRAIN OF DUST ')
printf('\n  the lowest three energy states are
   obtained ')
printf('\n  for n = 1    E1 = ')
disp(E1)
printf('  eV')
printf('\n  for n = 2    E2 = ')
disp(E2)
printf('  eV')
printf('\n  for n = 3    E3 = ')
disp(E3)
printf('  eV')
```

**Scilab code Exa 5.15.6** calculate the width of the well

```
//Chapter-5,Example5_15_6,pg 1-45

E=38

   //potential energy

e=1.6*10^-19

   //charge of an electron

h=6.63*10^-34

   //Plancks constant

m=9.1*10^-31

   //mass of an electron

```

```
//the lowest energy of an electron for n=1 is     E=h
   ^2/(8*m*e*L^2)

L=sqrt(h^2/(8*m*e*E))                                //
   width of the well

printf("\nThe width of the well is  L =\n")

disp(L)

printf("meter\n")
```

**Scilab code Exa 5.15.7** calculate the energy and wavelength of the emitted photon

```
//Chapter-5,Example5_15_7,pg 1-45

e=1.6*10^-19
   //charge of an electron

h=6.63*10^-34
   //Plancks constant

m=9.1*10^-31
   //mass of an electron

c=3*10^8
   //speed of light in air

//The energy eigen values are given by    E=(h^2*n
```

```
^2)/(8*m*e*L^2)

L=5*10^-10                    //width of potential well

//as electron makes a transittion from its n=2 to n=1 energy level

E1=(1*h^2)/(8*m*e*L^2)                    //for n=1

E2=(4*h^2)/(8*m*e*L^2)                    //for n=2

E=E2-E1                    //The energy of emitted photon

printf("\nThe energy of emitted photon is  E2-E1 = %.2f eV\n",E)

//The energy of photon in terms of wavelength is (h*c)/lam

wavelength=(h*c)/(E*e)

printf("\nThe wavelength of emitted photon is = %.9f m\n",wavelength)
```

# Chapter 6

# Motion of Charged Particle in Electric and Magnetic Fields

**Scilab code Exa 6.1.1** calculate radius of revolution and distance covered

```
//Chapter-6,Example6_1_1,pg 6-6

m=9.1*10^-31                                    //
   mass of an electron in kg

v=2.5*10^6                                      //
   velocity of an electron

B=0.94*10^-4                                    //
   strength of uniform magnetic field

e=1.6*10^-19                                    //
   charge of an electron

angle=30
   //angle between velocity vector and field
   direction

r=m*v*sind(angle)/(B*e)*10^3              //radius
```

```
of revolution

printf("\nradius of revolution  r = %.2f mm \n",r)

l=5*v*cosd(angle)*2*%pi*m/(B*e)          // distance coverd in five revolutions

printf("distance coverd in five revolutions  5l =%.3f m",l)
```

**Scilab code Exa 6.1.2** calculate radius and pitch

```
//Chapter-6,Example6_1_2,pg 6-7

m=9.1*10^-31                 // mass of an electron in kg

v=3*10^7                     // velocity of an electron

B=0.23                       // strength of uniform magnetic field

e=1.6*10^-19                 // charge of an electron

angle=45                     // angle between velocity vector and field direction

r=m*v*sind(angle)/(B*e)*10^3           //radius of revolution

printf("\nradius of revolution  r = %.3f mm\n",r)

l=v*cosd(angle)*2*%pi*m/(B*e)*10^3     //pitch
```

```
f helical path

printf("pitch of helical path  l = %.1f mm\n",l)
```

**Scilab code Exa 6.1.3** find the input voltage

```
//Chapter-6,Example6_1_3,pg 6-7

y=1.5                                    //deflection in the beam

d=0.42                                   //distance between two plates

D=28                                     //distance of screen from center of plates

l=1.8                                    //length of plates

Va=1.6*10^3                              //anode voltage

V=2*y*d*Va/(D*l)

Vin=V/6                                  //as amplifier gain is 60

printf("\napplied voltage is  Vin = %.2f V\n",Vin)
```

**Scilab code Exa 6.5.1** calculate phase change

```
//Chapter-6,Example6_5_1,pg 6-16
```

```
dA=0.8                                  //minor axis

dB=2                                    //major axis

phase_shift=asind(dA/dB)                //phase calculation

printf("\n phase shift = %.2f Degrees\n",phase_shift)
```

# Chapter 7

# Superconductivity

**Scilab code Exa 7.3.1** calculate critical temperature of element

```
//Chapter-7,Example7_3_1,pg 7-6

Ho=2*10^5                                       //critical field at absolute zero

Hc=1*10^5                                       //critical field at given temperature

T=8                                             //temperature

Tc=T/sqrt(1-(Hc/Ho))

printf("\ncritical temperature of the element Tc = %.2f Kelvin",Tc)
```

---

**Scilab code Exa 7.3.2** find the critical field

```
//Chapter-7,Example7_3_2,pg 7-7

Bo=3.06*10^-2                                        //
    critical field at absolute zero

Tc=3.7                                               //
    critical temperature

T=2                                                  //
    temperature

Bc=Bo*(1-(T/Tc)^2)

printf("\ncritical field of wire  Bc = %.5f T",Bc)
```

**Scilab code Exa 7.3.3** calculate the critical current

```
//Chapter-7,Example7_3_3,pg 7-7

Ho=6.5*10^4                                          //
    critical field at absolute zero

Tc=7.18                                              //
    critical temperature

T=4.2                                                //
    temperature

r=0.5*10^-3                                          //
    radius of lead wire

Hc=Ho*(1-(T/Tc)^2)

Ic=2*%pi*r*Hc

```

```
printf("\ncritical current for wire  Ic = %.2f
    Amperes\n",Ic)
```

**Scilab code Exa 7.3.4** calculate the isotopic mass

```
//Chapter-7,Example7_3_4,pg 7-8

Tc1=4.185                                    //critical
    temperature 1

Tc2=4.133                                    //critical
    temperature 2

M1=199.5                                     //isotopic mass
     of a metal at temperature T1

a=0.5

M2=(Tc1*sqrt(M1)/Tc2)^2

printf("\nisotopic mass is M2 = %.2f",M2)
```