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 5
    th 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 = %.4
    f \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)
```