

Scilab Textbook Companion for
Applied Physics-ii
by Dr. I. A. Shaikh¹

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

Interference

Scilab code Exa 1.1 Find thickness of film

```
1 //Chapter -1,Example 1_1 ,Page 1-16
2 clc()
3
4 //Given Data:
5 i=45*%pi/180 //angle of incidence
6 u=1.33 //Refractive index of a soap
   film
7 lam=5.896*10^-7 //wavelength of required yellow
   light
8
9 //Calculations:
10 //u=sin i/sin r //Snell's law .So,
11 r=asin(sin(i)/u) //angle of reflection
12
13 //Now, condition for bright fringe is
14 //2ut*cos r=(2n-1)lam/2
15 //Here n=1
16 t=lam/(2*2*u*cos(r)) //minimum thickness of
   film at which light will appear bright yellow
17 printf('Minimum thickness of film at which light
   will appear bright yellow of required wavelength
```

is =%.10f m',t)

Scilab code Exa 1.2 Calculate wavelength

```
1 //Chapter -1,Example 1_2 ,Page 1-16
2 clc()
3
4 //Given Data:
5 theta=40/3600*%pi/180 //angle of wedge in
   radians
6 B=0.12*10^-2 //fringe spacing
7
8 //Calculations:
9 //We know, B=lam/(2*u*theta). Here u=1
10 lam=2*B*theta //wavelength of light used
11 printf('Wavelength of light used is =%.10f m',lam)
```

Scilab code Exa 1.3 Find thickness of film

```
1 //Chapter -1,Example 1_3 ,Page 1-17
2 clc()
3
4 //Given Data:
5 i=30*%pi/180 //angle of incidence
6 u=1.46 //Refractive index of a oil
7 lam=5.890*10^-7 //wavelength of required yellow
   light
8 n=8 //eighth dark band
9
10 //Calculations:
11 //u=sin i/sin r //Snell's law .So,
12 r=asin(sin(i)/u) //angle of reflection
13
```

```

14 //Now, condition for dark fringe is
15 //2ut*cos r=n*lam
16 t=n*lam/(2*u*cos(r)) //thickness of film
17 printf('Thickness of the film is =%.10f m',t)

```

Scilab code Exa 1.4 Find angle of wedge

```

1 //Chapter -1,Example 1_4 ,Page 1-17
2 clc()
3
4 //Given Data:
5
6 B=0.1*10^-2 //fringe spacing
7 lam=5.893*10^-7 //Wavelength of light
8 u=1.52 //Refractive index of
   wedge
9
10 //Calculations:
11 //We know, B=lam/(2*u*theta). Here u=1
12 theta1=lam/(2*u*B) //angle of wedge in
   radians
13 theta=theta1*3600*180/%pi //angle of wedge in
   seconds
14 printf('Angle of wedge is =%.0f seconds of an arc',
   theta)

```

Scilab code Exa 1.5 Find refractive index

```

1 //Chapter -1,Example 1_5 ,Page 1-18
2 clc()
3
4 //Given Data:
5 t=0.2/(100)^2*10^-2 //thickness of film in meter

```

```

6 lam=5.5*10^-7           //wavelength of light in meter
7 r=0                     //normal incidence
8 n=1                     //first band
9
10 //Calculations:
11
12 //Condition for dark fringe is
13 //2ut*cos r =n*lam
14 u=n*lam/(2*t*cos(r))   //Refractive index of a oil
15 printf('Refractive index of a oil is =%.3f ',u)

```

Scilab code Exa 1.6 Calculate thickness

```

1 //Chapter-1,Example 1_6 ,Page 1-18
2 clc()
3
4 //Given Data:
5 lam=5.893*10^-7        //Wavelength of light
6 u=1.42                 //Refractive index of a soap
   film
7 r=0                   //normal incidence
8 n=1                   //first band
9
10 //Calculations:
11
12 //i)
13 //Condition for dark fringe is
14 //2ut*cos r=n*lam
15 t1=n*lam/(2*u*cos(r)) //thickness of film for
   dark black fringe
16 printf('Thickness of the film for dark black fringe
   is =%.10f m \n \n',t1)
17
18 //ii)
19 //Now, condition for bright fringe is

```

```

20 //2ut*cos r=(2n-1)lam/2
21 t2=lam/(2*2*u*cos(r)) //Thickness of film for
    bright fringe
22 printf(' Thickness of film for bright fringe is =%
    .10 f m \n \n',t2)

```

Scilab code Exa 1.7 Calculate thickness

```

1 //Chapter -1,Example 1_7 ,Page 1-19
2 clc()
3
4 //Given Data:
5 i=30*%pi/180 //angle of incidence
6 u=1.43 //Refractive index of a soap
    film
7 lam=6*10^-7 //wavelength of light
8 n=1 //For minimum thickness
9
10 //Calculations:
11 //u=sin i/sin r //Snell's law .So,
12 r=asin(sin(i)/u) //angle of reflection
13
14 //Now, condition of minima in transmitted system is
15 //2ut*cos r=(2n-1)lam/2
16 t=lam/(2*2*u*cos(r)) //minimum thickness of
    film
17 printf('Minimum thickness of film is =%.9 f m',t)

```

Scilab code Exa 1.8 Calculate thickness

```

1 //Chapter -1,Example 1_8 ,Page 1-19
2 clc()
3

```

```

4 //Given Data:
5 lam=5.893*10^-7 //Wavelength of light
6 theta=1 //assuming value of theta
7
8 //We know, B=lam/(2*u*theta). Here u=1
9 B=lam/(2*theta) //fringe spacing
10 n=20 //interference fringes
11
12 //Calculations:
13 //t=n*B*tan(theta)
14 t=20*B*theta //Thickness of wire
15 printf('Thickness of wire is =%.9f m',t)

```

Scilab code Exa 1.9 Calculate thickness

```

1 //Chapter -1, Example 1_9 , Page 1-20
2 clc()
3
4 //Given Data:
5 u1=1.3 //Refractive index of oil
6 u2=1.5 //Refractive index of glass
7 lam1=7*10^-7 //Wavelength of light
8 lam2=5*10^-7 //Wavelength of light
9
10 //Calculations:
11
12 //for finding value of n, solve:
13 //(2n+1)*lam1/2=(2(n+1)+1)*lam2/2
14 //We get ,n=2
15 n=2
16
17 toil=(2*n+1)*lam1/(2*u1*2) //thickness of oil
    layer
18 printf('Thickness of oil layer is =%.9f m',toil)

```

Scilab code Exa 1.10 Calculate thickness

```
1 //Chapter –1,Example 1_10 ,Page 1–21
2 clc()
3
4 //Given Data:
5 u1=1.2 //Refractive index of drop of
   oil
6 u2=1.33 //Refractive index of water
7 lam=4.8*10^-7 //wavelength of light
8 n=3 //order
9 r=0 //normal incidence ,so r=0
10
11 //Calculations:
12 t=n*lam/(2*u1) //Thickness of oil drop
13 printf('Thickness of oil drop is =%.8f m',t)
```

Scilab code Exa 1.11 Calculate thickness

```
1 //Chapter –1,Example 1_11 ,Page 1–22
2 clc()
3
4 //Given Data:
5 i=asin(4/5) //angle of incidence
6 u=4/3 //Refractive index of a soap
   film
7 lam1=6.1*10^-7 //wavelength of light
8 lam2=6*10^-7 //wavelength of light
9
10 //Calculations:
11 //u=sin i/sin r //Snell 's law .So,
12 r=asin(sin(i)/u) //angle of reflection
```



```

13
14 //Now, condition for dark band is
15 //2ut*cos r=n*lam
16 //for consecutive bands, n=lam2/(lam1-lam2). hence
17
18 t=lam2*lam1/((lam1-lam2)*2*u*sqrt(1-(sin(i)/u)^2))
    //thickness of film
19 printf('Thickness of the film is =%.7f m',t)

```

Scilab code Exa 1.12 Calculate thickness of film

```

1 //Chapter -1,Example 1_12 ,Page 1-40
2 clc()
3
4 //Given Data:
5 n=10 //10th dark ring
6 Dn=0.5*10^-2 //Diameter of ring
7 lam=6*10^-7 //wavelength of light
8
9 //Calculations:
10 //As Dn^2=4*n*R*lam
11 R=Dn^2/(4*n*lam) //Radius of curvature of the
    lens
12 printf('Radius of curvature of the lens is =%.2f m \
    n \n',R)
13
14 t=Dn^2/(8*R) //thickness of air film
15 printf(' Thickness of air film is =%.7f m \n',t)

```

Scilab code Exa 1.13 Calculate angle of wedge

```

1 //Chapter -1,Example 1_13 ,Page 1-41
2 clc()

```

```

3
4 //Given Data:
5
6 B=0.25*10^-2           //fringe spacing
7 lam=5.5*10^-7         //Wavelength of light
8 u=1.4                 //Refractive index of wedge
9
10 //Calculations:
11 //We know, B=lam/(2*u*theta).
12 theta1=lam/(2*u*B)    //angle of wedge in
    radians
13 theta=theta1*3600*180/%pi //angle of wedge in
    seconds
14 printf('Angle of wedge is =%.1f seconds',theta)

```

Scilab code Exa 1.14 Find diameter of ring

```

1 //Chapter -1,Example 1.14 ,Page 1-41
2 clc()
3
4 //Given Data:
5 n=4           //4th dark ring
6 m=12         //m=n+p
7 D4=0.4*10^-2 //Diameter of 4th ring
8 D12=0.7*10^-2 //Diameter of 12th ring
9
10 //Calculations:
11
12 //(Dn+p)^2-Dn^2=4*p*lam*R
13 //Solving , (D12^2-D4^2)/(D20^2-D4^2)
14 //We get above value =1/2. Hence
15 D20=sqrt(2*D12^2-D4^2) //Diameter of 20th ring
16 printf('Diameter of 20th ring is =%.5f m \n',D20)

```

Scilab code Exa 1.15 Calculate refractive index

```
1 //Chapter -1,Example 1_15 ,Page 1-42
2 clc()
3
4 //Given Data:
5 n=6 //6th bright ring
6 D6=0.31*10^-2 //Diameter of 6th ring
7 lam=6*10^-7 //wavelength of light
8 R=1 //Radius of curvature
9
10 //Calculations:
11
12 //Diameter of nth bright ring is
13 //Dn^2=2(2n-1)*lam*R/u. Hence
14 u=2*(2*n-1)*lam*R/(D6)^2 //Refractive index of
    liquid
15 printf('Refractive index of liquid is =%.3f \n',u)
```

Scilab code Exa 1.16 Find difference of squares of diameters of rings

```
1 //Chapter -1,Example 1_16 ,Page 1-42
2 clc()
3
4 //Given Data:
5 lam=6*10^-7 //wavelength of light
6 k=0.125*10^-4 //k=D(n+1)^2-Dn^2.
7 u=1 //Refractive index of medium
    between lens and plate
8 //Calculations:
9
10 //i)
```

```

11 lam1=4.5*10^-7 //new wavelength of light
12 //Difference between squares of diameters of
    successive rings is directly proportional to
    wavelength.So,
13 k1=lam1/lam*k //new Difference between squares of
    diameters of successive rings after changing
    wavelength
14 printf('New Difference between squares of diameters
    of successive rings after changing wavelength is
    =%.8f m^2 \n',k1)
15
16 //ii)
17 u2=1.33 //Refractive index of liquid
    introduced between lens and plate
18 //Difference between squares of diameters of
    successive rings is inversely proportional to
    Refractive index.so,
19 k2=u/u2*k //new Difference between squares of
    diameters of successive rings after changing
    refractive index
20 printf(' New Difference between squares of diameters
    of successive rings after changing refractive
    index is =%.8f m^2 \n',k2)
21
22 //iii)
23 //Difference between squares of diameters of
    successive rings is directly proportional to
    Radius of curvature.So,
24 //after doubling radius of curvature ,
25 k3=2*k //new Difference between squares of
    diameters of successive rings after doubling
    radius of curvature
26 printf(' New Difference between squares of diameters
    of successive rings after doubling radius of
    curvature is =%.8f m^2 \n',k3)

```

Scilab code Exa 1.17 Calculate Refractive index

```
1 //Chapter -1,Example 1_17 ,Page 1-43
2 clc()
3
4 //Given Data:
5 Dn=0.225*10^-2 //Diameter of nth ring
6 Dm=0.45*10^-2 //Diameter of (n+9)th ring
7 lam=6*10^-7 //wavelength of light
8 R=0.9 //Radius of curvature
9 p=9
10
11 // Calculations:
12 //(Dn+p)^2-Dn^2=4*p*lam*R/u
13 u=4*p*lam*R/((Dm)^2-Dn^2) //Refractive index of
    liquid
14 printf('Refractive index of liquid is =%.2f \n',u)
```

Scilab code Exa 1.18 Find diameter of ring

```
1 //Chapter -1,Example 1_18 ,Page 1-44
2 clc()
3
4 //Given Data:
5 D10=0.5*10^-2 //Diameter of 10th ring
6 lam=5.5*10^-7 //wavelength of light
7 u=1.25 //Refractive index of liquid
8
9
10 // Calculations:
11 //As  $D_n^2=4*n*R*lam/u$ 
```

```

12 //Dn^2 is inversely proportional to refractive index
13 D10n=D10/sqrt(u) //new diameter of 10th
    ring after changing medium between lens and plate
14 printf('new diameter of 10th ring after changing
    medium between lens and plate is =%.6f m \n',D10n
    )

```

Scilab code Exa 1.19 Find radius of curvature

```

1 //Chapter -1,Example 1_19 ,Page 1-45
2 clc()
3
4 //Given Data:
5 D5=0.336*10^-2 //Diameter of 5th ring
6 D15=0.59*10^-2 //Diameter of 15th ring
7 lam=5.89*10^-7 //wavelength of light
8 p=10 //n=5,n+p=15
9
10 //Calculations:
11 //((Dn+p)^2-Dn^2=4*p*lam*R/u
12 R=((D15)^2-D5^2)/(4*p*lam) //Radius of curvature
    of the lens
13 printf('Radius of curvature of the lens is =%.3f m \
    n',R)

```

Scilab code Exa 1.20 Find radius of curvature

```

1 //Chapter -1,Example 1_20 ,Page 1-45
2 clc()
3
4 //Given Data:
5 n=10 //10th dark ring

```

```

6 D10=0.6*10^-2 //Diameter of ring
7 lam=6*10^-7 //wavelength of light
8 u=4/3 //Refractive index of water
9
10
11 // Calculations :
12 //As  $Dn^2=4*n*R*lam/u$ 
13 R=D10^2*u/(4*n*lam) //Radius of curvature of the
    lens
14 printf('Radius of curvature of the lens is =%.1f m \
    n',R)

```

Scilab code Exa 1.20.1 Find wavelength

```

1 //Chapter -1,Example 1_20_1 ,Page 1-52
2 clc()
3
4 //Given Data:
5 i=45*%pi/180 //angle of incidence
6 u=1.2 //Refractive index of a film
7 t=4*10^-7 //thickness of film
8
9 //Calculations:
10 //u=sin i/sin r //Snell's law .So,
11 r=asin(sin(i)/u) //angle of reflection
12
13 //Now, condition for dark fringe is
14 //2ut*cos r=n*lam
15 lam1=2*u*t*cos(r)/1 //n=1
16 printf('For n=1 wavelength is =%.10f m \n',lam1)
17 printf(' This is in the visible spectrum and it will
    remain absent.\n \n')
18
19 lam2=2*u*t*cos(r)/2 //n=2
20 printf(' For n=2 wavelength is =%.10f m \n',lam2)

```

```
21 printf(' This is not in the visible spectrum \n \n')
```

Scilab code Exa 1.20.2 Find thickness of medium

```
1 //Chapter -1,Example 1_20_2 ,Page 1-53
2 clc()
3
4 //Given Data:
5 r=45*%pi/180 //angle of refraction
6 u=1.45 //Refractive index of a medium
7 lam=5.5*10^-7 //wavelength of required yellow
  light
8 n=1
9
10 //Calculations:
11
12 //Now, condition for dark fringe is
13 //2ut*cos r=n*lam
14 t=n*lam/(2*u*cos(r)) //thickness of thin medium
15 printf('Thickness of the thin medium is =%.10f m',t)
```

Scilab code Exa 1.21 Find wavelength

```
1 //Chapter -1,Example 1_21 ,Page 1-45
2 clc()
3
4 //Given Data:
5 u=1.33 //Refractive index of a soap
  film
6 r=0 //normal incidence
7 t=5*10^-7 //thickness of film
8
9 //Calculations:
```



```

10
11 //Now, condition for maxima is
12 //2ut*cos r=(2n-1)lam/2
13 lam1=4*u*t*cos(r)/(2*1-1) //n=1
14 printf('For n=1 wavelength is =%.10f m \n',lam1)
15 lam2=4*u*t*cos(r)/(2*2-1) //n=2
16 printf(' For n=2 wavelength is =%.10f m \n',lam2)
17 lam3=4*u*t*cos(r)/(2*3-1) //n=3
18 printf(' For n=3 wavelength is =%.10f m \n',lam3)
19 lam4=4*u*t*cos(r)/(2*4-1) //n=4
20 printf(' For n=4 wavelength is =%.10f m \n \n',lam4)
21
22 printf(' Out of these wavelengths wavelength for n=3
    lies in the visible spectrum. \n \n')
23 printf(' Hence, wavelength for n=3 is the most
    reflected wavelength.')

```

Scilab code Exa 1.22 Calculate thickness

```

1 //Chapter -1,Example 1.22 ,Page 1-46
2 clc()
3
4 //Given Data:
5 u=1.5 //Refractive index of a oil
6 lam=5.88*10^-7 //wavelength of required yellow
    light
7 n=1 //for smallest thickness
8 r=60*%pi/180 //angle of reflection
9
10 //Calculations:
11
12 //Now, condition for dark fringe is
13 //2ut*cos r=n*lam
14 t=n*lam/(2*u*cos(r)) //thickness of film
15 printf('Thickness of the film is =%.10f m',t)

```

Scilab code Exa 1.23 Calculate wavelength

```
1 //Chapter -1,Example 1_23 ,Page 1-46
2 clc()
3
4 //Given Data:
5 theta=20/3600*%pi/180 //angle of wedge in
   radians
6 B=0.25*10^-2 //fringe spacing
7 u=1.4 //Refractive index of film
8
9 //Calculations:
10 //We know, B=lam/(2*u*theta).
11 lam=2*B*theta*u //wavelength of light
12 printf('Wavelength of light is =%.10f m',lam)
```

Scilab code Exa 1.24 Find order of ring

```
1 //Chapter -1,Example 1_24 ,Page 1-47
2 clc()
3
4 //Given Data:
5 //Dn=2*D40
6
7 //Calculations:
8 //As Dn^2=4*n*R*lam/u and Dn^2=4*D40^2
9 //i.e. 4*n*R*lam/u=4*4*40*R*lam/u .hence ,
10 n=4*40 //order of the required ring
11 printf('Order of the dark ring which will have
   double the diameter of that of 40th ring is =%.0f
   ',n)
```

Scilab code Exa 1.25 Calculate diameter of ring

```
1 //Chapter -1,Example 1_25 ,Page 1-47
2 clc()
3
4 //Given Data:
5 lam1=6*10^-7 //wavelength of light
6 lam2=4.5*10^-7 //wavelength of light
7 R=0.9 //Radius of curvature
8
9 //Calculations:
10 //As  $Dn^2=4*n*R*lam$ .
11 // $Dn^2=D(n+1)^2$  for different wavelengths.we get ,
12  $n=lam2/(lam1-lam2)$  //nth dark ring due to lam1
   which coincides with (n+1)th dark ring due lam2
13 D3=sqrt(4*n*R*lam1) //diameter of 3rd dark ring
   for lam1
14 printf('Diameter of 3rd dark ring for lam1 is =%.5f
   m \n',D3)
```

Scilab code Exa 1.26 Calculate order of band

```
1 //Chapter -1,Example 1_26 ,Page 1-48
2 clc()
3
4 //Given Data:
5 i=45*%pi/180 //angle of incidence
6 u=4/3 //Refractive index of soap film
7 lam=5*10^-7 //wavelength of light
8 t=1.5*10^-6 //thickness of film
9
10 //Calculations:
```

```

11 //u=sin i/sin r      //Snell's law .So,
12 r=asin(sin(i)/u)    //angle of reflection
13
14 //Now, condition for dark band is
15 //2ut*cos r=n*lam
16 n=2*u*t*cos(r)/lam  //order of band
17 printf('order of dark band is =%.1f \n',n)

```

Scilab code Exa 1.27 Find radius of curvature

```

1 //Chapter -1,Example 1_27 ,Page 1-49
2 clc()
3
4 //Given Data:
5 D5=0.336*10^-2      //Diameter of 5th ring
6 D15=0.59*10^-2     //Diameter of 15th ring
7 lam=5.89*10^-7     //wavelength of light
8 p=10                //n=5,n+p=15
9
10 //Calculations:
11 //(Dn+p)^2-Dn^2=4*p*lam*R/u
12 R=((D15)^2-D5^2)/(4*p*lam) //Radius of curvature
    of the lens
13 printf('Radius of curvature of the lens is =%.4f m \
    n',R)

```

Scilab code Exa 1.29 Prove separation between consecutive rings reduces as serial number of rings

```

1 //Chapter -1,Example 1_29 ,Page 1-50
2 clc()
3
4 //As  $D_n^2=4*n*R*lam$  .

```

```

5 //thus, Dn is directly proportional to sqaure root
  of n
6 D5=sqrt(5) //D5 is directly proportional to
  sqaure root of 5
7 D4=sqrt(4) //D4 is directly proportional to
  sqaure root of 4
8 k1=D5-D4
9 printf('Separation between D5 and D4 is directly
  proportional to =%.3f \n',k1)
10
11 D80=sqrt(80) //D80 is directly proportional to
  sqaure root of 80
12 D79=sqrt(79) //D79 is directly proportional to
  sqaure root of 79
13 k2=D80-D79
14 printf(' Separation between D80 and D79 is directly
  proportional to =%.3f \n \n',k2)
15
16 printf(' Thus, (D80-D79) < (D5-D4).\n Hence proved.'
  )

```

Scilab code Exa 1.30 Calculate wavelength

```

1 //Chapter -1,Example 1_30 ,Page 1-51
2 clc()
3
4 //Given Data:
5 D5=0.336*10^-2 //Diameter of 5th ring
6 D15=0.59*10^-2 //Diameter of 15th ring
7 p=10 //n=5,n+p=15
8 R=1 //Radius of curvature
9
10 // Calculations:
11 // (Dn+p)^2-Dn^2=4*p*lam*R/u
12 lam=((D15)^2-D5^2)/(4*p*R) //Wavelength of light

```

```
13 printf('Wavelength of light is =%.10f m',lam)
```

Scilab code Exa 1.31 Obtain expression for thickness of film

```
1 //Chapter -1,Example 1_31 ,Page 1-51
2 clc()
3
4
5 //Condition for bright band is
6 //2ut*cos r = (2n-1)*lam1
7
8 //for consecutive bands , 2n=(lam1+lam2)/(lam1-lam2) .
9 //thus , 2ut*cos r = lam2*lam1/(lam1-lam2)
10
11 //And, thicknessof film
12 //t= lam2*lam1/((2*u*cosr)(lam1-lam2))
13 printf('Hence expression for thickness of film is
    obtained.')
```

Chapter 2

Diffraction of light

Scilab code Exa 2.1 Find longest wavelength

```
1 //Chapter -2,Example 2_1 ,Page 2-30
2 clc()
3
4 //Given Data:
5 m=4 //order
6 N=1/5000*10^-2 //N=(a+b) grating element
7
8 //Calculations:
9
10 //We know, (a+b)*sin(theta)=m*lam
11 //for longest wavelength, sin(theta)=1
12 lam=N/m //longest wavelength
13 printf('The longest wavelength is =%.10f m',lam)
```

Scilab code Exa 2.2 Calculate width of slit

```
1 //Chapter -2,Example 2_2 ,Page 2-30
2 clc()
```

```

3
4 //Given Data:
5 m=1 //order
6 lam=6.5*10^-7 //Wavelength of red light
7 theta=30*%pi/180 //angle of diffraction
8
9 //Calculations:
10
11 //We know, a*sin(theta)=m*lam
12 a=m*lam/sin(theta) //width of slit
13 printf('width of slit is = %.7f m',a)

```

Scilab code Exa 2.3 Calculate angular position of first minima

```

1 //Chapter -2,Example 2_3 ,Page 2-31
2 clc()
3
4 //Given Data:
5 m=1 //order
6 lam=4*10^-7 //Wavelength of light
7 a=10^-6 //width of slit
8
9 //Calculations:
10
11 //We know, a*sin(theta)=m*lam
12 theta=asin(m*lam/a)*180/%pi //angular position in
    first minima
13 printf('angular position in first minima is = %.2f
    degrees ',theta)

```

Scilab code Exa 2.4 Find angular breadth

```

1 //Chapter -2,Example 2_4 ,Page 2-31

```



```

2  clc()
3
4  //Given Data:
5  m=1                      //order
6  lam1=4*10^-7             //Wavelength of light
7  lam2=7*10^-7            //Wavelength of light
8  n=1/6000*10^-2          //n=(a+b) grating element
9
10 //Calculations:
11
12 //We know, (a+b)*sin(theta)=m*lam
13 theta1=asin(m*lam1/n)*180/%pi    //angle of
    diffraction
14 theta2=asin(m*lam2/n)*180/%pi    //angle of
    diffraction
15 d=theta2-theta1              //angular breadth
    of first order visible spectrum
16 printf('angular breadth of first order visible
    spectrum is = %.2f degrees ',d)

```

Scilab code Exa 2.5 Calculate total number of lines on grating

```

1  //Chapter -2,Example 2_5 ,Page 2-31
2  clc()
3
4  //Given Data:
5  m=1                      //order
6  lam=6.56*10^-7          //Wavelength of red light
7  theta=18.25*%pi/180     //angle of diffraction
8  W=2*10^-2               //width of grating
9
10 //Calculations:
11
12 //We know, (a+b)*sin(theta)=m*lam
13 N=sin(theta)/(m*lam)     //N-number of lines per m, N

```

```

    =1/(a+b)
14 Tn=N*W //Total number of lines on
    grating
15 printf('Total number of lines on grating is = %.0f ',
    ,Tn)

```

Scilab code Exa 2.7 Show that spectra either overlap or are isolated

```

1 //Chapter -2,Example 2_7 ,Page 2-33
2 clc()
3
4 //Given Data:
5 GE=2.54/15000*10^-2 //GE=(a+b) grating element
6 lam1=4*10^-7 //Wavelength of light
7 lam2=7*10^-7 //Wavelength of light
8
9 //Calculations:
10
11 //We know, (a+b)*sin(theta)=m*lam
12 theta11=asin(1*lam1/GE)*180/%pi //angular
    position of first minima for lam1
13 theta12=asin(2*lam1/GE)*180/%pi //angular
    position of second minima for lam1
14 theta13=asin(3*lam1/GE)*180/%pi //angular
    position of third minima for lam1
15
16 theta21=asin(1*lam2/GE)*180/%pi //angular
    position of first minima for lam2
17 theta22=asin(2*lam2/GE)*180/%pi //angular
    position of second minima for lam2
18 theta23=asin(3*lam2/GE)*180/%pi //angular
    position of third minima for lam2
19
20 printf('Thus the angular position for lam1 and lam2
    are as follows: \n \n ')

```

```

21 printf('First order: %.0f degrees ',theta11)
22 printf(' %.0f degrees --Isolated \n',theta21)
23
24 printf(' Second order: %.0f degrees ',theta12)
25 printf(' %.0f degrees --Overlap \n',theta22)
26
27 printf(' Third order: %.0f degrees ',theta13)
28 printf(' %.0f degrees --Overlap \n',theta23)

```

Scilab code Exa 2.8 Calculate separation between central maxima and first minima

```

1 //Chapter -2,Example 2_8 ,Page 2-34
2 clc()
3
4 //Given Data:
5 lam=5.893*10^-7 //Wavelength of light
6 d=0.01*10^-2 //width of slit (a=d)
7 f=1 //distance between screen and
   slit
8
9 //Calculations:
10 x=f*lam/d //separation between central
   maxima and first minima
11 printf('Separation between central maxima and first
   minima is = %.6f m \n',x)

```

Scilab code Exa 2.9 Find angular width

```

1 //Chapter -2,Example 2_9 ,Page 2-34
2 clc()
3
4 //Given Data:

```

```

5 m=1                                //order
6 lam=6*10^-7                        //Wavelength of light
7 a=12*10^-7                          //width of slit
8
9 //Calculations:
10
11 //We know, a*sin(theta)=m*lam
12 theta=asin(m*lam/a)*180/%pi        //angular position in
    first minima
13 printf('Half angular width of first maxima is = %.0f
    degrees ',theta)

```

Scilab code Exa 2.10 Calculate total angular width

```

1 //Chapter -2,Example 2_10 ,Page 2-34
2 clc()
3
4 //Given Data:
5 lam=6*10^-7                        //Wavelength of light
6 a=0.02*10^-2                      //width of slit (a=d)
7 f=2                                //distance between screen and
    slit
8
9 //Calculations:
10
11 //We know, a*sin(theta)=m*lam, here m=1
12 theta=asin(lam/a)*180*60/%pi      //angular position
    in first minima (1 degree=60 minutes)
13 printf('Total angular width is = %.2f minutes \n \n',
    ,2*theta)
14
15 x=f*lam/a                          //separation between central
    maxima and first minima
16 printf(' Linear width is = %.6f m \n',2*x)

```

Scilab code Exa 2.11 Find wavelength

```
1 //Chapter -2,Example 2_11 ,Page 2-35
2 clc()
3
4 //Given Data:
5 a=0.14*10^-3 //width of slit
6 n=2 //order
7 y=1.6*10^-2 //separation between second
   dark band and central bright band
8 D=2 //distance between screen and
   slit
9
10 //Calculations:
11
12 theta=y/D //from diagram
13
14 //We know, a*sin(theta)=n*lam
15 //here sin(theta)=theta
16 lam=a*theta/n //wavelength of light
17 printf('wavelength of light is = %.10f m \n',lam)
```

Scilab code Exa 2.13 Find angles of maxima

```
1 //Chapter -2,Example 2_13 ,Page 2-36
2 clc()
3
4 //Given Data:
5 lam=6.328*10^-7 //Wavelength of light
6 N=1/6000*10^-2 //N=(a+b) grating element
7
8 //Calculations:
```

```

9
10 //We know,  $N \cdot \sin(\theta) = m \cdot \lambda$ 
11 theta1=asin(1*lam/N)*180/%pi //angular position
    in first order maxima,m=1
12 printf('Angular position in first order maxima is =
    %.2f degrees \n \n',theta1)
13
14 theta2=asin(2*lam/N)*180/%pi //angular position
    in second order maxima,m=2
15 printf(' Angular position in second order maxima is
    = %.2f degrees \n',theta2)

```

Scilab code Exa 2.14 Calculate grating element

```

1 //Chapter –2,Example 2_14 ,Page 2–37
2 clc()
3
4 //Given Data:
5 lam1=6*10^-7 //wavelength of yellow light
6 lam2=4.8*10^-7 //wavelength of blue light
7 theta=asin(3/4) //angle of diffraction
8
9 //Calculations:
10
11 //for consecutive bands,  $n \cdot \lambda_1 = (n+1) \cdot \lambda_2$ . thus,
12 n=lam2/(lam1-lam2) //order
13
14 //We know,  $(a+b) \cdot \sin(\theta) = m \cdot \lambda$ 
15 N=n*lam1/sin(theta) //N=(a+b) grating element
16 printf('Grating element (a+b) is = %.8f m \n',N)

```

Scilab code Exa 2.15.1 Compute wavelength

```

1 //Chapter -2,Example 2_15_1 ,Page 2-54
2 clc()
3
4 //Given Data:
5 a=0.2*10^-3 //width of slit
6 n=1 //order
7 y=0.5*10^-2 //separation between first
   minima and central bright band
8 D=2 //distance between screen and
   slit
9
10 //Calculations:
11
12 theta=y/D //from diagram
13
14 //We know, a*sin(theta)=n*lam
15 //here sin(theta)=theta
16 lam=a*theta/n //wavelength of light
17 printf('wavelength of light is = %.10 f m \n',lam)

```

Scilab code Exa 2.15.2 Find number of lines per cm

```

1 //Chapter -2,Example 2_15_2 ,Page 2-55
2 clc()
3
4 //Given Data:
5 lam1=5.4*10^-7 //Wavelength of light
6 lam2=4.05*10^-7 //Wavelength of light
7 theta=30*%pi/180 //angle of diffraction
8
9 //Calculations:
10 //We know, (a+b)*sin(theta)=n*lam
11 //n*lam1=(n+1)*lam2, we get
12 n=3
13 N=sin(theta)/(n*lam1)*10^-2 //Number of lines

```

```

    per m= 1/(a+b)*10-2
14 printf('Number of lines per cm is = %.0f \n',N)

```

Scilab code Exa 2.15.4 Check whether lines are resolved or not

```

1 //Chapter -2,Example 2_15_4 ,Page 2-56
2 clc()
3
4 //Given Data:
5 GE=1/6000*10-2 //GE=(a+b) grating
    element
6 lam1=5.893*10-7 //Wavelength of light
7 lam2=5.896*10-7 //Wavelength of light
8 m=2 //order
9
10 //Calculations:
11 theta1=asin(m*lam1/GE)*180/%pi //angular
    position in first minima
12 theta2=asin(m*lam2/GE)*180/%pi //angular
    position in second minima
13
14 as=(theta2-theta1) //Angular separation
    in minutes
15 printf('Angular separation is = %.3f degrees \n \n',
    as)
16
17 dlam=lam2-lam1 //difference in
    wavelength
18 lam=(lam2+lam1)/2 //Mean wavelength
19
20 //We know that R.P.=lam/dlam=m*N
21 N=lam/dlam/m //Number of lines on
    grating for first order
22 printf(' Number of lines on grating for first order
    is = %.0f \n \n',N)

```



```

23 printf(' But, number of lines per cm on grating is
        6000. \n Which is greater than number of lines
        per cm needed for resolution. \n')
24 printf(' Hence, both lines will be well resolved in
        2nd order. ')

```

Scilab code Exa 2.17 Calculate wavelength and deduce missing order

```

1 //Chapter -2,Example 2_17,Pad 2-39
2 clc()
3
4 //Given Data:
5 d=0.04*10^-2 //Separation between slits
6 D=1.7 //distance between screen and
        slit
7 B=0.25*10^-2 //Fringe spacing
8
9 //Calculations:
10 //We know, B=D*lam/d
11 lam=B*d/D //Wavelength of light
12 printf('Wavelength of light is = %.10f m \n \n',lam)
13
14 //The condition for missing order is ,
15 //(a+b)/a = m/n
16 b=0.04*10^-2 //Separation in slits
17 a=0.08*10^-3 //Slit width
18 n=(a+b)/a //missing orders for m=1,2,3
19
20 n1=1*n
21 n2=2*n
22 n3=3*n
23 printf(' Missing orders are = %.0f ',n1)
24 printf(' , %.0f ',n2)
25 printf(' , %.0f ',n3)

```

Scilab code Exa 2.18 Find maximum order visible

```
1 //Chapter -2,Example 2_18 ,Page 2-39
2 clc()
3
4 //Given Data:
5 N=2.54/2620*10^-2 //N=(a+b) grating element
6 lam=5*10^-7 //Wavelength of red light
7
8 //Calculations:
9
10 //We know, (a+b)*sin(theta)=n*lam
11 //maximum value of sin(theta)=1
12 n=N/lam //Maximum number of orders
    visible
13 printf('Maximum number of orders visible is = %.0f ',
    ,n)
```

Scilab code Exa 2.19 Find number of orders visible

```
1 //Chapter -2,Example 2_19 ,Page 2-40
2 clc()
3
4 //Given Data:
5 N=1/4000*10^-2 //N=(a+b) grating element
6 lam1=5*10^-7 //Wavelength of light
7 lam2=7.5*10^-7 //Wavelength of light
8
9 //Calculations:
10
11 //We know, (a+b)*sin(theta)=n*lam
12 //maximum value of sin(theta)=1
```

```

13 n1=N/lam1           //Maximum number of orders
    visible
14 n2=N/lam2           //Maximum number of orders
    visible
15 printf('The observed number of orders range between
    = %.0f ',n2)
16 printf('to %.0f ',n1)

```

Scilab code Exa 2.20 Find wavelength that coincides

```

1 //Chapter -2,Example 2_20 ,Page 2-40
2 clc()
3
4 //Given Data:
5 n=5           //order
6 lam=6*10^-7   //Wavelength of light
7
8 //Calculations:
9 //We know, a*sin(theta)=n*lam
10 //n*lam=n1*lam1
11 lam1=n*lam/4   //for n1=4
12 printf('For n1=4 wavelength is = %.10f \n',lam1)
13
14 lam2=n*lam/5   //for n1=5
15 printf(' For n1=5 wavelength is = %.10f \n',lam2)
16
17 lam3=n*lam/6   //for n1=6
18 printf(' For n1=6 wavelength is = %.10f \n',lam3)
19
20 lam4=n*lam/7   //for n1=7
21 printf(' For n1=7 wavelength is = %.10f \n',lam4)
22
23 lam5=n*lam/8   //for n1=8
24 printf(' For n1=8 wavelength is = %.10f \n',lam5)
25

```

```

26 printf('So, in the grating spectrum spectrum lines
    with wavelengths n1=6 and n1=7 will coincide with
    fifth order line of 6*10^-7 m')

```

Scilab code Exa 2.21 Calculate Dispersive power

```

1 //Chapter -2, Example 2_21 , Page 2-41
2 clc()
3
4 //Given Data:
5 GE=18000*10^-10 //GE=(a+b) grating element
6 lam=5*10^-7 //Wavelength of red light
7
8 //Calculations:
9 DP1=1/sqrt(GE^2-lam^2)*10^-10 //Dispersive
    power
10 printf('Dispersive power for first order is = %.10f
    rad/Angstrom \n \n', DP1)
11
12 m=3
13 DP2=1/sqrt((GE/m)^2-lam^2)*10^-10 //Dispersive
    power
14 printf(' Dispersive power for second order is = %.10
    f rad/Angstrom \n \n', DP2)

```

Scilab code Exa 2.22 Find linear and angular dispersion

```

1 //Chapter -2, Example 2_22 , Page 2-42
2 clc()
3
4 //Given Data:
5 N=2.54/15000*10^-2 //N=(a+b) grating element
6 lam=5.9*10^-7 //Wavelength of light

```

```

7 m=2 //order
8 f=25*10^-2 //focal length of lens
9
10 // Calculations:
11
12 //We know, (a+b)*sin(theta)=m*lam
13 theta=asin(m*lam/N) //angular position in first
    minima
14
15 Ad=m/N/cos(theta) //angular dispersion
16
17 ld=f*Ad*10^-8 //linear dispersion (
    dx/dl) in cm/angstrom
18 printf('Linear dispersion in spectrograph is = %.5f
    cm/angstrom \n \n',ld)
19
20 dlam=(5896-5890) //difference in
    wavelength
21 dx=ld*dlam*10^-2 //separation between
    spectral lines in meter
22 printf(' Separation between spectral lines is = %.5f
    m \n \n',dx)

```

Scilab code Exa 2.23 Calculate number of lines

```

1 //Chapter -2,Example 2_23 ,Page 2-47
2 clc()
3
4 //Given Data:
5 m=1 //order
6 lam1=5.89*10^-7 //Wavelength of light
7 lam2=5.896*10^-7 //Wavelength of light
8
9 // Calculations:
10 dlam=lam2-lam1 //difference in

```

```

    wavelength
11 lam=(lam2+lam1)/2           //Mean wavelength
12
13 //We know that R.P.=m*N=lam/dlam
14 N=lam/dlam/m               //minimum number of
    lines which will just resolve
15 printf('Minimum number of lines which will just
    resolve is = %.1f \n \n',N)

```

Scilab code Exa 2.24 Calculate resolving power

```

1 //Chapter -2,Example 2_24 ,Page 2-47
2 clc()
3
4 //Given Data:
5 N=5*5000                   //N=W/(a+b) Number of lines on
    grating
6 m=2                       //order
7 lam=6*10^-7                //Wavelength of light
8
9 //Calculations:
10 //i)
11 RP=m*N                     //Resolving power
12 printf('i) Resolving power is = %.0f \n \n',RP)
13
14 //ii)
15 //We know that R.P.=lam/dlam
16 dlam=lam/RP                //Smallest wavelength which can
    be resolved
17 printf(' ii) Smallest wavelength which can be
    resolved is = %.12f m \n \n',dlam)

```

Scilab code Exa 2.25 Calculate Dispersive power

```

1 //Chapter -2,Example 2_25 ,Page 2-48
2 clc()
3
4 //GiveGE Data:
5 GE=1/4000*10^-2 //GE=(a+b) grating element
6 lam=5*10^-7 //Wavelength of red light
7 m=3 //order
8
9 //Calculations:
10
11 //We know, (a+b)*sin(theta)=m*lam
12 theta=asin(m*lam/GE) //angular position in first
    minima
13
14 DP=m/(GE*cos(theta))*10^-2 //Dispersive power
15 printf('Dispersive power is = %.0f \n \n',DP)

```

Scilab code Exa 2.26 Calculate grating element

```

1 //Chapter -2,Example 2_26 ,Page 2-48
2 clc()
3
4 //Given Data:
5 m=2 //order
6 lam=6*10^-7 //Wavelength of light
7 dlam=6*10^-10 //difference in wavelength
8 W=2*10^-2 //Width of surface
9
10 //Calculations:
11
12 //We know that R.P.=lam/dlam=m*N
13 N=lam/dlam/m //Number of lines on grating
14 GE=W/N //Grating element=(a+b)
15 printf('Grating element is = %.6f cm \n \n',GE)

```

Scilab code Exa 2.27 Calculate angular separation

```
1 //Chapter -2,Example 2_27 ,Page 2-49
2 clc()
3
4 //Given Data:
5 m=2 //order
6 lam1=5.77*10^-7 //Wavelength of light
7 lam2=5.791*10^-7 //Wavelength of light
8 GE=1/6000*10^-2 //GE=(a+b) grating
   element
9
10 //Calculations:
11
12 //We know, (a+b)*sin(theta)=m*lam
13 theta1=asin(m*lam1/GE)*180/%pi //angular
   position in first minima
14 theta2=asin(m*lam2/GE)*180/%pi //angular
   position in second minima
15
16 as=(theta2-theta1)*60 //Angular separation
   in minutes
17 printf('Angular separation is = %.0f minutes \n \n',
   as)
```

Scilab code Exa 2.28 Find the angle of first dark band

```
1 //Chapter -2,Example 2_28 ,Page 2-49
2 clc()
3
4 //Given Data:
5 n=1 //order
```



```

6 lam=5.89*10^-7      //Wavelength of light
7 a=0.3*10^-3        //width of slit
8
9 //Calculations:
10
11 //We know, a*sin(theta)=n*lam
12 theta1=asin(n*lam/a)*180/%pi*60    //angular
    position in first dark band in minutes
13 printf('Angular position in first dark band is = %.1
    f minutes \n \n',theta1)
14
15 //We know,for bright band a*sin(theta)=(2n+1)*lam
    /2
16 theta2=asin(1.5*lam/a)*180/%pi*60    //angular
    position in first bright band in minutes
17 printf(' Angular position in first bright band is =
    %.0f minutes ',theta2)

```

Scilab code Exa 2.29 Calculate maximum order of spectrum

```

1 //Chapter-2,Example 2_29 ,Page 2-50
2 clc()
3
4 //Given Data:
5 GE=2.54/16000*10^-2    //GE=(a+b) grating element
6 lam=6*10^-7           //Wavelength of light
7
8 //Calculations:
9
10 //We know, (a+b)*sin(theta)=m*lam
11 //maximum value of sin(theta)=1
12 m=GE/lam              //Maximum order of spectra
13 printf('Maximum order of spectra is = %.1f \n \n',m)

```

Scilab code Exa 2.30 Find maximum resolving power

```
1 //Chapter -2,Example 2_30 ,Page 2-50
2 clc()
3
4 //Given Data:
5 GE=1/5000*10^-2           //GE=(a+b) grating element
6 lam=5.89*10^-7           //Wavelength of light
7 N=3*5000                 //N=W/(a+b) Number of lines
   on grating
8
9 //Calculations:
10
11 //We know, (a+b)*sin(theta)=m*lam
12 //maximum value of sin(theta)=1
13 m=GE/lam                 //Maximum order of spectra
14 printf('Maximum order of spectra is = %.0f \n \n',m)
15
16 RP=3*N                   //Resolving power (round of m
   to 3)
17 printf('Resolving power is = %.0f \n \n',RP)
```

Scilab code Exa 2.32 Find number of lines

```
1 //Chapter -2,Example 2_32 ,Page 2-52
2 clc()
3
4 //Given Data:
5 lam1=5.89*10^-7           //Wavelength of light
6 lam2=5.896*10^-7         //Wavelength of light
7
8 //Calculations:
```

```

9 dlam=lam2-lam1           //difference in
  wavelength
10 lam=(lam2+lam1)/2      //Mean wavelength
11
12 //i)
13 m1=1                   //first order
14 //We know that R.P.=lam/dlam=m*N
15 N1=lam/dlam/m1        //Number of lines on grating
16 printf('i)Number of lines on grating for first order
  is = %.0f \n \n',N1)
17
18 //ii)
19 m2=2                   //second order
20 //We know that R.P.=lam/dlam=m*N
21 N2=lam/dlam/m2        //Number of lines on grating
22 printf('ii)Number of lines on grating for second
  order is = %.0f \n \n',N2)

```

Scilab code Exa 2.33 Calculate number of lines

```

1 //Chapter -2,Example 2-33,Page 2-48
2 clc()
3
4 //Given Data:
5 m=1                     //order
6 lam=6.553*10^-7        //Wavelength of light
7 dlam=1.8*10^-10       //difference in wavelength
8
9
10 //Calculations:
11
12 //We know that R.P.=lam/dlam=m*N
13 N=lam/dlam/m           //Number of lines on grating
14 printf('Number of lines on grating is = %.0f \n \n',
  ,N)

```

Scilab code Exa 2.34 Find resolution possible or not

```
1 //Chapter -2,Example 2_34 ,Page 2-53
2 clc()
3
4 //Given Data:
5 lam1=5.14034*10^-7 //Wavelength of
   light
6 lam2=5.14085*10^-7 //Wavelength of
   light
7
8 //Calculations:
9 dlam=lam2-lam1 //difference in
   wavelength
10 lam=(lam2+lam1)/2 //Mean wavelength
11
12 //We know that R.P.=lam/dlam=m*N
13 N=lam/dlam/1 //Number of lines on grating
14 printf('Number of lines on grating for first order
   is = %.0f \n \n',N)
15
16 //Hence R.P. for second order should be
17 RP1=2*N
18 printf(' Resolving power in second order should be
   is= %.0f \n \n',RP1)
19 //But here ,
20
21 lam3=8.03720*10^-7 //Wavelength of
   light
22 lam4=8.03750*10^-7 //Wavelength of
   light
23 dlam2=lam4-lam3 //difference in
   wavelength
24 lam2=(lam4+lam3)/2 //Mean wavelength
```

```

25
26 RP2=lam2/dlam2
27 printf(' Resolving power in second order is= %.0f \
      n \n',RP2)
28
29 printf(' So, the grating will not be able to resolve
      8.0372*10^-7 and 8.03750*10^-7 in second order.\
      n')
30 printf(' Because Resolving power is greter than
      actual Resolving power.')
```

Scilab code Exa 2.35 Show that First order spectra is possible

```

1 //Chapter -2,Example 2_35 ,Page 2-53
2 clc()
3
4 //For grating , Condition of maxima is (a+b)sin(
      theta)=n*lam
5 //Given (a+b) < 2*lam
6 //For maximum order , sin(90)=1
7 //So, n must be less than 2
8 //i.e. only first order possible if width of grating
      element is less than twice the wavelength
9 printf('Hence, Only first order possible if width of
      grating element is less than twice the
      wavelength.')
```

Scilab code Exa 2.36 Calculate angle of first dark band

```

1 //Chapter -2,Example 2_36 ,Page 2-54
2 clc()
3
4 //Given Data:
```

```

5 n=1 //order
6 lam=5.89*10^-7 //Wavelength of light
7 a=0.3*10^-3 //width of slit
8
9 //Calculations:
10
11 //We know,  $a \sin(\theta) = n \lambda$ 
12 theta1=asin(n*lam/a)*180/%pi //angular position
    in first dark band
13 printf('Angular position in first dark band is = %.3
    f degrees \n \n',theta1)
14
15 //We know, for bright band  $a \sin(\theta) = (2n+1) \lambda / 2$ 
16 theta2=asin(1.5*lam/a)*180/%pi //angular position
    in first bright band
17 printf(' Angular position in first bright band is =
    %.3f degrees ',theta2)

```

Chapter 3

Optical Fibre

Scilab code Exa 3.1 Find NA of fibre

```
1 //Chapter -3,Example 3_1 ,Page 3-19
2 clc()
3
4 //Given Data:
5 n1=1.61 //Core index
6 n2=1.55 //Cladding index
7
8 //Calculations:
9 NA=sqrt(n1^2-n2^2) //Formula
10
11 printf('Numerical Aperture of Fibre is = %.3f ',NA)
```

Scilab code Exa 3.2 Find NA of fibre

```
1 //Chapter -3,Example 3_2 ,Page 3-19
2 clc()
3
4 //Given Data:
```

```

5 n1=1.65 //Core index
6 n2=1.53 //Cladding index
7
8 //Calculations:
9 NA=sqrt(n1^2-n2^2) //Formula
10
11 printf('Numerical Aperture of Fibre is = %.3f ',NA)

```

Scilab code Exa 3.3 Find acceptance angle

```

1 //Chapter –3,Example 3_3 ,Page 3–19
2 clc()
3
4 //Given Data:
5 n1=1.48 //R.I. of Core
6 n2=1.39 //R.I. of Cladding
7
8 //Calculations:
9 NA=sqrt(n1^2-n2^2) //Formula to find NA
10 phi=asin(NA)*180/%pi //Acceptance angle
11
12 printf('Numerical Aperture of Fibre is = %.3f \n \n',
13        ,NA)
13 printf(' Acceptance angle of Fibre is =%.1f degrees',
14        ,phi)

```

Scilab code Exa 3.4 Find velocity and wavelengths

```

1 //Chapter –3,Example 3_4 ,Page 3–20
2 clc()
3
4 //given data:

```



```

5 u1=3.6          //Refractive Index of the Substance at
   850 nm
6 u2=3.4          //Refractive Index of the Substance at
   1300 nm
7 Vv=3*10^8      //Velocity of light in free space
8
9 //Calculations:
10 // i)Finding wavelength at 850 nm
11 Vs1=Vv/u1      //Velocity of light in
   substance at 850 nm
12 printf('Velocity of light in substance at 850 nm =%
   .2f m/sec \n \n',Vs1)
13
14 lam1=850*10^-9/u1 //Wavelength of light in
   substance at 850nm
15 printf(' Wavelength of light in substance at 850nm =
   %.10f m \n \n',lam1)
16
17
18 // ii)Finding wavelength at 1300 nm
19 Vs2=Vv/u2      //Velocity of light in
   substance at 1300 nm
20 printf(' Velocity of light in substance at 1300 nm =
   %.2f m/sec \n \n',Vs2)
21
22 lam2=1300*10^-9/u2 //Wavelength of light in
   substance at 1300nm
23 printf(' Wavelength of light in substance at 1300nm
   =%.10f m \n',lam2)

```

Scilab code Exa 3.5 Find NA acceptance angle and critical angle

```

1 //Chapter –3,Example 3_5 ,Page 3–20
2 clc()
3

```

```

4 //Given Data:
5 u1=1.5 //R.I. of Core
6 u2=1.45 //R.I. of Cladding
7 del=(u1-u2)/u1 //Fractional Refractive
  index
8
9 //Calculations:
10 NA=u1*sqrt(2*del) //Formula to find NA
11 theta0=asin(NA)*180/%pi //Acceptance angle
12 thetac=asin(u2/u1)*180/%pi //Critical angle
13
14 printf('Numerical Aperture of Fibre is =%.3f \n \n',
  NA)
15 printf(' Acceptance angle of Fibre is =%.2f degrees
  \n \n',theta0)
16 printf(' Critical angle of Fibre is =%.1f degrees \n
  ',thetac)

```

Scilab code Exa 3.6 Calculate RI of core and cladding

```

1 //Chapter –3,Example 3_6 ,Page 3–20
2 clc()
3
4 //Given Data:
5 NA=0.22 // Numerical Aperture of Fibre
6 delta=0.012 //Fractional index
7
8 //Calculations:
9 //Delta=(u1-u2)/u1
10 u1=NA/sqrt(2*delta) //Formula
11 u2=u1-(u1*delta) //Formula
12
13 printf('Refractive Index of core of fibre is =%.2f \
  n \n',u1)
14 printf(' Refractive Index of cladding of fibre is =%

```

.2 f \n', u2)

Scilab code Exa 3.7 Calculate core radius NA and spot size

```
1 //Chapter –3,Example 3_7 ,Page 3–21
2 clc()
3
4 //Given Data:
5 u1=1.466 //R.I. of Core
6 u2=1.46 //R.I. of Cladding
7 V=2.4 //Cut off parameter
8 lam=0.8*10^-6 //wavelength in meter
9
10 //Calculations:
11 NA=sqrt(u1^2-u2^2) //Formula to find Numerical
    Aperture
12 printf('Numerical Aperture of Fibre is =%.2 f \n',NA)
13 //(printing mistake in book)printed answer is 1.13
    but correct answer is 0.13
14 printf('(printing mistake in book) \n \n')
15
16 // V = 2*%pi*a*NA / lam
17 a=V*lam/(2*%pi*NA) //core radius
18 printf(' Core radius of Fibre is (a) =%.8 f m \n \n',
    a)
19
20 //w/a= 1.1
21 w=1.1*a //Spot size
22 printf(' Spot size of Fibre is =%.8 f m \n \n',w)
23
24 theta=2*lam*180/%pi/(%pi*w) //Divergence angle
25 printf(' Divergence angle of Fibre is =%.2 f degrees
    \n \n',theta)
26
27 w10=lam*10/(%pi*w) //Spot size at 10 m
```

```
28 printf(' Spot size at 10 m of Fibre is =%.2f m \n \n
    ',w10)
```

Scilab code Exa 3.8 Calculate cut off parameter and number of modes

```
1 //Chapter –3,Example 3_8 ,Page 3–21
2 clc()
3
4 //Given Data:
5 w=98 //Spot size in meter
6 d=50*10^-6 //Core diameter in meter
7 a=d/2 //core radius
8 u1=1.47 //R.I. of Core
9 u2=1.45 //R.I. of Cladding
10 lam=0.85*10^-6 //Wavelength in meter
11 NA=sqrt(u1^2-u2^2) //Formula to find NA
12
13 //Calculations:
14 V=2*pi*a*NA/lam //cut off parameter
15 N=(V^2)/2 //Number of modes
16
17 printf('Cut off parameter of Fibre is =%.4f \n \n',V
    )
18 printf(' Number of modes of Fibre is =%.0f \n',N)
```

Scilab code Exa 3.9 Calculate maximum radius

```
1 //Chapter –3,Example 3_9 ,Page 3–21
2 clc()
3
4 //Given Data:
5 u1=1.47 //R.I. of Core
6 u2=1.46 //R.I. of Cladding
```

```

7 lam=1.3*10^-6           //wavelength in meter
8
9 // Calculations:
10 NA=sqrt(u1^2-u2^2)      //Formula to find Numerical
    Aperture
11
12 //The condition for single mode is V<2.405
13 //2*%pi*a*NA/lam < 2.405
14
15 a=2.405*lam/(2*%pi*NA) //Maximum radius of fibre
16
17 printf('Maximum radius of Fibre is =%.8f meter \n',a
    )

```

Scilab code Exa 3.10 Calculate refractive index

```

1 //Chapter -3,Example 3_10 ,Page 3-22
2 clc()
3
4 //Given Data:
5 u1=1.465                //R.I. of Core
6 u2=1.46                 //R.I. of Cladding
7 lam=1.25*10^-6         //operating wavelength
8
9 // Calculations:
10 del=(u1-u2)/u1         //Fractional Refractive
    index
11 printf('Fractional Refractive index of Fibre is =%.6
    f \n \n', del)
12
13 //For single mode propagation condition is
14 // a/lam< 1.4/(%pi*sqrt(u1(u1-u2)))
15
16 a=lam*1.4/(%pi*u1*sqrt(del)) //core radius
17

```

```

18 u=u1-(sqrt(2*del)/(2*pi*(a/lam))) //effective
    refractive index
19 printf(' Effective Refractive index for lowest mode
    propagation is =%.3f \n',u)

```

Scilab code Exa 3.11 Calculate cut off parameter and number of modes

```

1 //Chapter –3,Example 3_11 ,Page 3–22
2 clc()
3
4 //Given Data:
5 u1=1.54 //R.I. of Core
6 u2=1.5 //R.I. of Cladding
7 lam=1.3*10^-6 //wavelength in meter
8 a=25*10^-6 //core radius in meter
9
10 //Calculations:
11 NA=sqrt(u1^2-u2^2) //Formula to find Numerical
    Aperture
12
13 V=2*pi*a*NA/lam //cut off parameter
14 printf('Cut off parameter of Fibre is =%.2f \n \n',V
    )
15
16 N=(V^2)/2 //Number of modes
17 printf(' Number of modes of Fibre is =%.0f \n',N)

```

Scilab code Exa 3.11.1 Find Normalised frequency and number of modes

```

1 //Chapter –3,Example 3_11_1 ,Page 3–25
2 clc()
3
4 //Given Data:

```

```

5 u1=1.52 //R.I. of Core
6 u2=1.5189 //R.I. of Cladding
7 lam=1.3*10^-6 //wavelength in meter
8 d=29*10^-6 //core diameter in meter
9 a=d/2
10
11 // Calculations:
12 NA=sqrt(u1^2-u2^2) //Formula to find Numerical
    Aperture
13 V=2*pi*a*NA/lam //Normalised frequency
14 Nm=(V^2)/2 //Number of modes
15
16 printf('Normalised frequency of Fibre is (V)=%.3f \n
    \n',V)
17 printf(' The Maximum Number of modes the Fibre will
    support is (Nm) =%.0f \n',Nm)

```

Scilab code Exa 3.12 Compute delta and acceptance angle

```

1 //Chapter –3,Example 3_12 ,Page 3–22
2 clc()
3
4 //Given Data:
5 u1=1.5 //R.I. of Core
6 d=10*10^-6 //diameter of core
7 a=d/2 //core radius
8 lam=1.3*10^-6 //wavelength
9 V=2.405 //cut off parameter for
    single mode
10
11 // Calculations:
12
13 //We know, V=2*pi*a*NA/lam
14 NA=V*lam/(2*pi*a) //Numerical Aperture
15

```

```

16 theta=asin(NA)*180/%pi //Acceptance angle
17 printf('Acceptance angle of Fibre is =%.2f degrees \
    n \n',theta)
18
19 //Also , NA=u1*sqrt(2*del)
20 del=(NA/u1)^2/2 //Fractional index
21 printf(' Maximum Fractional Refractive index of
    Fibre is =%.4f \n \n',del)
22
23 //del=(u1-u2)/u1
24 u2=u1*(1-del) //R.I. of cladding
25 printf(' Refractive index of cladding of Fibre is =%
    .3f \n',u2)

```

Scilab code Exa 3.13 Calculate cladding index various angles and NA of fibre

```

1 //Chapter -3,Example 3_13 ,Page 3-23
2 clc()
3
4 //Given Data:
5 n1=1.5 //R.I. of core
6 delta=0.0005 //Fractional index difference
7
8 //Calculations:
9 //(a):
10 //Delta=(u1-u2)/u1
11 n2=n1-(n1*delta) //R.I. of cladding
12 printf('(a) Refractive Index of cladding of fibre is
    =%.2f \n \n',n2)
13
14 //(b):
15 phi=asin(n2/n1)*180/%pi //Critical internal
    reflection angle
16 printf('(b) Critical internal reflection angle of

```



```

    Fibre is =%.1f degrees \n \n',phi)
17
18 //(c):
19 theta0=asin(sqrt(n1^2-n2^2))*180/%pi    //External
    critical Acceptance angle
20 printf(' (c)External critical Acceptance angle of
    Fibre is =%.2f degrees \n \n',theta0)
21
22 //(d):
23 NA=n1*sqrt(2*delta)    //Formula to find
    Numerical Aperture
24 printf(' (d)Numerical Aperture of Fibre is =%.4f \n'
    ,NA)

```

Scilab code Exa 3.14 Calculate acceptance angle

```

1 //Chapter –3,Example 3_14 ,Page 3–24
2 clc()
3
4 //Given Data:
5 NA1=0.20    //Numerical Aperture of Fibre
6 n2=1.59    //R.I. of cladding
7
8 //Calculations:
9 // NA=sqrt(n1^2-n2^2)
10 //In air , n0=1
11 n1=sqrt(NA1^2+n2^2)    //R.I. of core
12
13 //Now, in water
14 n0=1.33
15 NA2=sqrt(n1^2-n2^2)/n0    //Numerical Aperture in
    water
16 theta0=asin(NA2)*180/%pi    //Acceptance angle of
    fibre in water
17 printf('Acceptance angle of Fibre in water is =%.1f

```

```
degrees \n',theta0)
```

Scilab code Exa 3.15 Calculate NA and acceptance angle

```
1 //Chapter -3,Example 3_15 ,Page 3-24
2 clc()
3
4 //Given Data:
5 n1=1.45 //R.I. of core
6 n2=1.40 //R.I. of cladding
7
8 //Calculations:
9 NA=sqrt(n1^2-n2^2) //Numerical Aperture
10 printf('Numerical Aperture of Fibre is =%.4f \n \n',
    NA)
11
12 theta0=asin(NA)*180/%pi //Acceptance angle of
    fibre
13 printf(' Acceptance angle of Fibre is =%.2f degrees
    \n',theta0)
```

Scilab code Exa 3.16 Calculate acceptance angle and RI of cladding

```
1 //Chapter -3,Example 3_16 ,Page 3-24
2 clc()
3
4 //Given Data:
5 NA=0.16 //Numerical Aperture of Fibre
6 n1=1.45 //R.I. of core
7 d=90*10^-6 //Core diameter
8
9 //Calculations:
10 //NA=sqrt(n1^2-n2^2)
```

```

11 n2=sqrt(n1^2-NA^2) //R.I. of cladding
12 printf('(a) Refractive Index of cladding of fibre is
    =%.3f \n \n',n2)
13
14 theta0=asin(NA)*180/%pi //Acceptance angle of
    fibre
15 printf('(b) Acceptance angle of Fibre is =%.2f
    degrees \n',theta0)

```

Scilab code Exa 3.17 Find NA Cladding index acceptance angle and number of modes

```

1 //Chapter –3,Example 3_17 ,Page 3–25
2 clc()
3
4 //Given Data:
5 n1=1.48 //R.I. of core
6 delta=0.055 //Realtive R.I.
7 lam=1*10^-6 //Wavelength of light
8 a=50*10^-6 //core radius
9
10 //Calculations:
11 //Delta=(u1-u2)/u1
12 n2=n1-(n1*delta) //R.I. of cladding
13 NA=n1*sqrt(2*delta) //Formula to find Numerical
    Aperture
14 printf('Numerical Aperture of Fibre is =%.4f \n \n',
    NA)
15
16
17 theta0=asin(NA)*180/%pi //Acceptance angle of
    fibre
18 printf(' Acceptance angle of Fibre is =%.2f degrees
    \n \n',theta0)
19

```

```
20 V=2*%pi*a*NA/lam           //V number
21 N=(V^2)/2                   //Number of guided modes
22
23 //In book,instead of NA , value of delta is taken
    into calculation.
24 //Thus there is calculation mistake in values of V
    and N.
25
26 printf(' V number of Fibre is =%.3f \n \n',V)
27 printf(' Number of guided mode of Fibre is =%.3f \n'
    ,N)
28 printf('(Calculation mistake in book)')
```

Chapter 4

Laser

Scilab code Exa 4.1 Find ratio of population of two energy states

```
1 //Chapter -4,Example 4_1 ,Page 4-27
2 clc()
3
4 //Given Data:
5 lam=694.3*10^-9 //Wavelength in meter
6 T=300 //Temperature in Kelvin
7
8 h=6.63*10^-34 //Planck's Constant
9 c=3*10^8 //Velocity of light
10 K=1.38*10^-21 //Boltzmann Constant
11
12 //Calculations:
13 delE= h*c/lam //Energy difference between
    two energy states N and N0
14
15 //N=N0*e^-delE/(K*T)
16 R=%e^(-delE/(K*T)) //R=Ratio of N and N0 i.e.(R
    =N/N0)
17
18 //(Printing mistake in textbook)
19 //instead of e^-.692, it has taken e^-69.2
```

```

20
21 printf('The ratio of population of two energy states
        is = %.8f \n',R)
22 printf(' (calculation mistake in book)')

```

Scilab code Exa 4.2 Find number of photons emitted per second

```

1 //Chapter -4,Example 4_2 ,Page 4-28
2 clc()
3
4 //Given Data:
5 lam=6328*10^-10 //Wavelength in meter
6 P=4.5*10^-3 //Power in watts
7 h=6.63*10^-34 //Planck's Constant
8 c=3*10^8 //Velocity of light
9
10 //Calculations:
11 delE= h*c/lam //Energy difference
12 //N*delE=P
13 N=P/delE //number of photons emitted
    per second
14
15 printf('Number of photons emitted per second is =%.1
        f \n',N)

```

Scilab code Exa 4.3 Calculate number of photons in each pulse

```

1 //Chapter -4,Example 4_3 ,Page 4-29
2 clc()
3
4 //Given Data:
5 lam=780*10^-9 //Wavelength of photon in
    meter

```

```

6 P=20*10^-3           //Power of each pulse in
   watts
7 t=10*10^-9           //Duration of each pulse
8 h=6.63*10^-34        //Planck's Constant
9 c=3*10^8              //Velocity of light
10
11 //Calculations:
12 delE= h*c/lam        //Energy of each photon
13 E=P*t                //Energy of each pulse
14
15 N=E/delE             //Number of photons in each
   pulse
16 printf('Number of photons in each pulse is =%.1f \n'
   ,N)

```

Chapter 5

Foundations of Quantum Mechanics

Scilab code Exa 5.1 Calculate de Broglie wavelength

```
1 //Chapter -5,Example 5_1 ,Page 5-23
2 clc()
3
4 //Given Values:
5 m=6.68*10^-27 //mass of alpha particle
6 V=30*10^3 //potential difference
7 e=1.6*10^-19 //charge of an electron
8 q=2*e //Charge of alpha particle
9 h=6.63*10^-34 //Planck's constant
10
11 //Calculations:
12 lam=h/sqrt(2*m*q*V) //de Broglie wavelength
13 printf('de Broglie wavelength associated with alpha
particle is =%.16f m \n',lam)
```

Scilab code Exa 5.2 Calculate de Broglie wavelength


```

1 //Chapter -5,Example 5_2 ,Page 5-23
2 clc()
3
4 //Given Values:
5 m=1 //mass of given particle in kg
6 h=6.63*10^-34 //Planck's constant
7 v=1*10^3 //velocity of particle
8
9 //Calculations:
10 lam=h/(m*v) //de Broglie wavelength
11 printf('de Broglie wavelength associated with
particle is =%.40f m \n \n',lam)
12 printf(' This wavelength is too small for any
practical significance.')
```

Scilab code Exa 5.3 Calculate de Broglie wavelength

```

1 //Chapter -5,Example 5_3 ,Page 5-24
2 clc()
3
4 //Given Values:
5 m1=40*10^-3 //mass of bullet in kg
6 m2=9.1*10^-31 //mass of electron in kg
7 h=6.63*10^-34 //Planck's constant
8 v=1100 //velocity of bullet and
electron
9
10 //Calculations:
11 lam1=h/(m1*v) //de Broglie wavelength
12 printf('de Broglie wavelength associated with bullet
is =%.36f m \n \n',lam1)
13
14 lam2=h/(m2*v) //de Broglie wavelength
15 printf(' de Broglie wavelength associated with
electron is =%.10f m \n \n',lam2)
```

```
16
17 printf(' Wavelength of bullet is too small.Hence it
    can not be measured with help of diffraction
    effect.')
```

Scilab code Exa 5.4 Find Glancing angle

```
1 //Chapter -5,Example 5_4 ,Page 5-24
2 clc()
3
4 //Given Values:
5 V=100 //potential difference
6 d=2.15*10^-10 //lattice spacing
7
8 //Calculations:
9 lam=12.26*10^-10/(sqrt(V)) //wavelength
    associated with electron in meter
10
11 //using bragg's law for first order lam=2d sin(
    theta)
12 theta=asin(lam/(2*d))*180/%pi //glancing angle
    in degrees
13 printf('Glancing angle at which first reflection
    occurs is =%.2f degrees \n',theta)
```

Scilab code Exa 5.5 Find Energy

```
1 //Chapter -5,Example 5_5 ,Page 5-25
2 clc()
3
4 //Given Values:
5 mn=1.674*10^-27 //mass of neutron
6 h=6.63*10^-34 //Planck's constant
```

```

7 lam=1*10^-10          //wavelength of neutron
8
9 // Calculations:
10
11 //we know, lam=h/sqrt(2*m*E)      //de Broglie
    wavelength
12 E1=h^2/(2*mn*lam^2)    //Energy of neutron in joules
13 E=E1/(1.6*10^-19)     //Energy of neutron in
    electron-Volts
14
15 printf('Energy of neutron is =%.3f eV \n',E)

```

Scilab code Exa 5.6 Calculate KE and Braggs angle

```

1 //Chapter -5, Example 5_6 , Page 5-25
2 clc()
3
4 //Given Values:
5 mn=1.67*10^-27        //mass of neutron
6 h=6.6*10^-34         //Planck's constant
7 lam=3*10^-10         //wavelength of neutron
8 d=3.036*10^-10      //lattice spacing
9
10 // Calculations:
11
12 //we know, lam=h/sqrt(2*m*E)      //de Broglie
    wavelength
13 E1=h^2/(2*mn*lam^2)    //Energy of neutron in joules
14 E=E1/(1.6*10^-19)     //Energy of neutron in electron
    -Volts
15 printf('Energy of neutron is =%.5f eV \n \n',E)
16
17 //using bragg's law for first order lam=2d sin(
    theta)
18 theta=asin(lam/(2*d))*180/%pi     //glancing angle

```

```

    in degrees
19 printf(' Glancing angle at which first orde
    reflection occurs is =%.0f degrees \n',theta)

```

Scilab code Exa 5.7 Calculate kinetic energy

```

1 //Chapter -5,Example 5_7 ,Page 5-26
2 clc()
3
4 //Given Values:
5 m=9.108*10^-31 //mass of electron
6 h=6.625*10^-34 //Planck's constant
7 lam=5*10^-7 //wavelength of electron
8
9 //Calculations:
10
11 //we know, lam=h/sqrt(2*m*E) //de Broglie
    wavelength
12 E1=h^2/(2*m*lam^2) //Energy of electron in
    joules
13 E=E1/(1.6*10^-19) //Energy of electron in
    electron-Volts
14 printf('Energy of electron is =%.9f eV \n',E)

```

Scilab code Exa 5.8 Calculate wavelength energy and momentum

```

1 //Chapter -5,Example 5_8 ,Page 5-27
2 clc()
3
4 //Given Values:
5 mn=1.676*10^-27 //mass of neutron
6 me=9.1*10^-31 //mass of electron
7 h=6.625*10^-34 //Planck's constant

```

```

8
9 // Calculations:
10 // Part 1:
11 En1=0.025 //Energy in eV of neutron
12 En=En1*(1.6*10^-19) //Energy in joules
13
14 lam1=h/sqrt(2*mn*En) //wavelength of a beam of
    neutron
15 printf('wavelength of a beam of neutron is =%.13f m
    \n \n',lam1)
16
17 // Part 2:
18 lam2=2*10^-10 //wavelength of electron
    and photon
19
20 //we know, lam=h/sqrt(2*m*E) //de Broglie
    wavelength
21 Ee1=h^2/(2*me*lam2^2) //Energy of electron in
    joules
22 Ee=Ee1/(1.6*10^-19) //Energy of electron in
    electron-Volts
23 printf(' Energy of electron is =%.3f eV \n \n',Ee)
24
25 p1=h/lam2 //momentum of electron
26 printf(' Momentum of electron is =%.27f kg.m/s \n \n
    ',p1)
27
28 C=3*10^8 //Velocity of light
29 Ep=h*C/lam2 //Energy of photon in joules
30 printf(' Energy of photon is =%.19f Joules \n \n',Ep
    )
31
32 p2=h/lam2 //momentum of photon
33 printf(' Momentum of photon is =%.27f kg.m/s \n \n',
    p2)

```

Scilab code Exa 5.9 Find shortest wavelength

```
1 //Chapter –5,Example 5_9 ,Page 5–28
2 clc()
3
4 //Given data:
5 //We have alpha particle ,neutron ,proton and electron
6
7 //To find: shortest wavelength
8
9 printf('We know, lam=h/sqrt(2*m*E) //de Broglie
   wavelength \n \n')
10
11 //Wavelength is inversely proportional to mass of
   particle for constant energy
12 printf(' i.e., Wavelength is inversely proportional
   to mass of particle for constant energy. \n \n')
13
14 printf(' We have alpha particle ,neutron ,proton and
   electron. \n \n')
15
16 //AS,alpha particle has highest mass.Thus it will
   have shortest wavelength.
17 printf(' Out of above, alpha particle has highest
   mass. \n \n')
18
19 printf(' Hence it will have shortest wavelength. \n
   \n')
```

Scilab code Exa 5.10 Calculate energies

```

1 //Chapter -5,Example 5_10 ,Page 5-28
2 clc()
3
4 //Given Values:
5 me=9.108*10^-31 //mass of electron
6 mp=1.66*10^-27 //mass of proton
7 h=6.625*10^-34 //Planck's constant
8 lam=1*10^-10 //wavelength of electron and
    proton
9
10 //Calculations:
11
12 //we know, lam=h/sqrt(2*m*E) //de Broglie
    wavelength
13 Ee1=h^2/(2*me*lam^2) //Energy of electron in
    joules
14 Ee=Ee1/(1.6*10^-19) //Energy of electron in
    electron-Volts
15 printf('Energy of electron is =%.2f eV \n \n',Ee)
16
17 Ep1=h^2/(2*mp*lam^2) //Energy of photon in
    joules
18 Ep=Ep1/(1.6*10^-19) //Energy of photon in
    electron-Volts
19 printf(' Energy of photon is =%.2f eV \n \n',Ep)

```

Scilab code Exa 5.11 Compare de Broglie wavelengths

```

1 //Chapter -5,Example 5_11 ,Page 5-29
2 clc()
3
4 //Given Values:
5 m1=50*10^-9 //mass of particle in kg
6 m2=9.1*10^-31 //mass of electron in kg
7 h=6.625*10^-34 //Planck's constant

```

```

8 v1=1 //velocity of particle
9 v2=3*10^6 //velocity of electron
10
11 //Calculations:
12 lam1=h/(m1*v1)*10^10 //de Broglie wavelength
13 printf('de Broglie wavelength associated with
particle is =%.20f Angstrom \n \n',lam1)
14
15 lam2=h/(m2*v2)*10^10 //de Broglie wavelength
16 printf(' de Broglie wavelength associated with
electron is =%.3f Angstrom \n \n',lam2)
17
18 printf(' Wavelength of electron is measurable.')
```

Scilab code Exa 5.12 Calculate de Broglie wavelength

```

1 //Chapter -5,Example 5_12 ,Page 5-29
2 clc()
3
4 //Given Values:
5 me=9.1*10^-31 //mass of electron in kg
6 h=6.63*10^-34 //Planck's constant
7
8 //Calculations:
9
10 E1=2*10^3 //Energy in eV of electron
11 E=E1*(1.6*10^-19) //Energy in joules
12
13 lam=h/sqrt(2*me*E) //wavelength of electron
14 printf('Wavelength of electron is =%.13f m \n',lam)
```

Scilab code Exa 5.13 Calculate momentum and energies


```

1 //Chapter -5,Example 5_13 ,Page 5-30
2 clc()
3
4 //Given Values:
5 me=9.1*10^-31 //mass of electron
6 h=6.63*10^-34 //Planck's constant
7 lam=2*10^-10 //wavelength of electron and
    photon
8
9 //Calculations:
10 p1=h/lam //momentum of electron
11 printf('Momentum of electron is =%.27f kg.m/s \n \n',
    ,p1)
12
13 Ee=p1^2/(2*me) //Energy of electron in
    joules
14 printf(' Energy of electron is =%.21f Joules \n \n',
    Ee)
15
16 p2=h/lam //momentum of photon
17 printf(' Momentum of photon is =%.27f kg.m/s \n \n',
    p2)
18
19 c=3*10^8 //Velocity of light
20 Ep=h*c/lam //Energy of photon in joules
21 printf(' Energy of photon is =%.19f Joules \n \n',Ep
    )

```

Scilab code Exa 5.14 Compare energies

```

1 //Chapter -5,Example 5_14 ,Page 5-31
2 clc()
3
4 //Given Values:
5 m=1.676*10^-27 //mass of neutron

```

```

6 h=6.625*10^-34           //Planck's constant
7 lam=1*10^-10           //wavelength of neutron
8
9 //Calculations:
10 C=3*10^8               //Velocity of light
11 Ep1=h*C/lam           //Energy of photon in joules
12 E1=Ep1/(1.6*10^-19)   //Energy of photon in
    electron-Volts
13 printf('Energy of photon is =%.2f eV \n \n',E1)
14
15 //we know, lam=h/sqrt(2*m*E) //de Broglie
    wavelength
16 En1=h^2/(2*m*lam^2)   //Energy of neutron in
    joules
17 E2=En1/(1.6*10^-19)   //Energy of neutron in
    electron-Volts
18 printf(' Energy of neutron is =%.3f eV \n \n',E2)
19
20 R=E1/E2               //Ratio of energies of
    proton to neutron
21 printf(' Ratio of energies of proton to neutron is =
    %.0f \n \n',R)

```

Scilab code Exa 5.14.1 Find uncertainty in position

```

1 //Chapter-5,Example 5_14_1 ,Page 5-36
2 clc()
3
4 //Given Values:
5 v=900                   //velocity of electron in m/s
6 delv=v*0.001/100       //uncertainty in velocity
7 h=6.63*10^-34          //Planck's constant
8 m=9.1*10^-31           //mass of an electron
9
10 //Calculations:

```

```

11 delp=m*delv //uncertainty in the
    measured values of momentum
12
13 //using heisenberg's uncertainty formula
14 delx=h/(2*pi*delp) //uncertainty in its
    position
15 printf('Uncertainty with which position of electron
    can be located is >=%0.5f m \n',delx)

```

Scilab code Exa 5.14.2 Calculate de Broglie wavelength

```

1 //Chapter -5,Example 5_14_2 ,Page 5-37
2 clc()
3
4 //Given Values:
5 m=1.6*10^-27 //mass of proton in kg
6 h=6.63*10^-34 //Planck's constant
7 v=3/20*10^8 //velocity of particle
8
9 //Calculations:
10 lam=h/(m*v) //de Broglie wavelength
11 printf('de Broglie wavelength associated with proton
    is =%0.18f m \n \n',lam)

```

Scilab code Exa 5.14.3 Calculate wavelength

```

1 //Chapter -5,Example 5_14_3 ,Page 5-37
2 clc()
3
4 //Given Values:
5 m=1.676*10^-27 //mass of neutron
6 h=6.634*10^-34 //Planck's constant
7

```

```

8 // Calculations :
9 E1=0.025 //Energy in eV of neutron
10 E=E1*(1.6*10^-19) //Energy in joules
11 //As  $E=m*v^2/2$ 
12 v=sqrt(2*E/m) //Velocity of neutron beam
13
14 lam=h/(m*v) //wavelength of a beam of
    neutron
15 printf('wavelength of a beam of neutron is =%.13f m
    \n', lam)

```

Scilab code Exa 5.14.4 Find percent of uncertainty in momentum

```

1 //Chapter -5, Example 5_14_4 , Page 5-37
2 clc()
3
4 //Given Values :
5 delx=10*10^-9 //uncertainty in position of
    electron
6 h=6.63*10^-34 //Planck's constant
7 m=9.1*10^-31 //mass of an electron
8 E=10^3*1.6*10^-19 //Energy of electron in
    joules
9
10 //Calculations :
11 p=sqrt(2*m*E) //momentum of electron
12 //using heisenberg's uncertainty formula
13 delp=h/(2*pi*delx) //uncertainty in the
    momentum
14
15 P=delp/p*100 //percentage of uncertainty
    in momentum
16 printf('Percentage of uncertainty in momentum of
    electron is =%.5f percent \n', P)

```

Scilab code Exa 5.15 Calculate KE phase and group velocity

```
1 //Chapter -5,Example 5_15 ,Page 5-31
2 clc()
3
4 //Given Values :
5 m=1.676*10^-27 //mass of neutron
6 h=6.63*10^-34 //Planck's constant
7 lam=2*10^-12 //wavelength of neutron
8 c=3*10^8 //Velocity of light
9
10 //Calculations :
11 p=h/lam //momentum of neutron
12 KE=p^2/(2*m) //Kinetic Energy of neutron
    in joules
13 printf('Kinetic Energy of electron is =%.21f Joules
    \n \n',KE)
14
15 //velocity of particle is same as group velocity.
    Thus,
16 vg=p/m //group velocity
17 printf(' group velocity of neutron is =%.0f m/s \n \
    n',vg)
18
19 //using , vg*vp=c^2
20 vp=c^2/vg //phase velocity
21 printf(' phase velocity of neutron is =%.0f m/s \n \
    n',vp)
```

Scilab code Exa 5.16 Calculate de Broglie wavelength and group and phase velocity

```

1 //Chapter -5,Example 5_16 ,Page 5-32
2 clc()
3
4 //Given Values:
5 m=1.157*10^-30 //mass of particle in kg
6 h=6.63*10^-34 //Planck's constant
7 c=3*10^8 //Velocity of light
8
9 //Calculations:
10 E1=80 //Energy in eV of particle
11 E=E1*(1.6*10^-19) //Energy in joules
12
13 lam=h/sqrt(2*m*E) //wavelength of particle
14 printf('Wavelength of particle is =%.13f m \n \n',
    lam)
15
16 //Now,
17 vg=h/(lam*m) //group velocity
18 printf(' Group velocity of particle is =%.0f m/s \n
    \n',vg)
19
20 //using , vg*vp=c^2
21 vp=c^2/vg //phase velocity
22 printf(' Phase velocity of particle is =%.0f m/s \n
    \n',vp)

```

Scilab code Exa 5.17 Find accuracy in position

```

1 //Chapter -5,Example 5_17 ,Page 5-33
2 clc()
3
4 //Given Values:
5 v=400 //velocity of electron in m/s
6 delv=0.01/100 //uncertainty in velocity
7 h=6.63*10^-34 //Planck's constant

```

```

8 m=9.11*10^-31          //mass of an electron
9
10 //Calculations:
11 p=m*v                 //momentum of an electron
12 delp=p*delv           //uncertainty in the measured
    values of momentum
13
14 //using heisenberg's uncertainty formula
15 delx=h/(2*pi*delp)    //accuracy in its position
16 printf('Accuracy in its position is >=%0.6f m \n \n',
    delx)

```

Scilab code Exa 5.18 Calculate minimum uncertainty in velocity

```

1 //Chapter -5,Example 5_18 ,Page 5-33
2 clc()
3
4 //Given Values:
5 delx=10^-8             //maximum uncertainty in
    position of electron
6 h=6.63*10^-34         //Planck's constant
7 m=9.1*10^-31         //mass of an electron
8
9 //Calculations:
10 //using heisenberg's uncertainty formula
11 delp=h/(2*pi*delx)    //minimum uncertainty in the
    measured values of momentum
12
13 delv=delp/m           //minimum uncertainty in the
    velocity of an electron
14 printf('Minimum uncertainty in the velocity of an
    electron is =%0.0f m/s \n \n',delv)

```

Scilab code Exa 5.19 Find minimum space required

```
1 //Chapter -5,Example 5_19 ,Page 5-34
2 clc()
3
4 //Given Values:
5 delv=2*10^4 //uncertainty in velocity
6 h=6.63*10^-34 //Planck's constant
7 m=9.1*10^-31 //mass of an electron
8
9 //Calculations:
10 delp=m*delv //uncertainty in the
    measured values of momentum
11
12 //using heisenberg's uncertainty formula
13 delx=h/(2*%pi*delp) //accuracy in its position
14 printf('Minimum space required by electron to be
    confined in an atom is >=%.12f m \n \n',delx)
```

Scilab code Exa 5.20 Find uncertainty in energy

```
1 //Chapter -5,Example 5_20 ,Page 5-34
2 clc()
3
4 //Given Values:
5 delt=1.4*10^-10 //uncertainty in time spent
    by nucleus in excited state
6 h=6.63*10^-34 //Planck's constant
7
8 //Calculations:
9
10 //using , delE*delt>= h/(2*%pi)
11 delE1= h/(2*%pi*delt) //uncertainty in its
    energy in excited state in joules
12 delE=delE1/(1.6*10^-19) //uncertainty in its
```



```

    energy in excited state in eV
13 printf('Uncertainty in its energy in excited state
    is >=%0.8f eV \n', delE)

```

Scilab code Exa 5.21 Find energies

```

1 //Chapter -5,Example 5_21 ,Page 5-35
2 clc()
3
4 //Given Values:
5 a=2*10^-10 //width of potential well in
    m
6 h=6.63*10^-34 //Planck's constant
7 m=9.1*10^-31 //mass of an electron
8
9 //Calculations:
10 //we know equation for energy of an electron
11 n0=1
12 E01=n0^2*h^2/(8*m*a^2) //Energy in ground state
13 E0=E01/(1.6*10^-19) //Energy in eV
14 printf('Energy of an electron in ground state is=%0.3
    f eV \n \n',E0)
15
16 n1=2
17 E11=n1^2*h^2/(8*m*a^2) //Energy in first excited
    state
18 E1=E11/(1.6*10^-19) //Energy in eV
19 printf(' Energy of an electron in first excited
    state is=%0.2f eV \n \n',E1)
20
21
22 n2=3
23 E21=n2^2*h^2/(8*m*a^2) //Energy in second excited
    state
24 E2=E21/(1.6*10^-19) //Energy in eV

```

```
25 printf(' Energy of an electron in second excited
state is=%0.2f eV \n',E2)
```

Scilab code Exa 5.22 calculate probability of finding particle

```
1
2 //Chapter -5,Example 5_22 ,Page 5-36
3 clc()
4
5 //Given Values:
6 a=25*10^-10 //width of well
7 delx=5*10^-10 //uncertainty in position
of particle
8 n=1 //ground state
9
10 //calculation:
11 x1=a/2
12 psi1=sqrt(2/a)*sin(n*pi/a*x1)
13 P1=(psi1^2)*delx //Probability of
finding particle at distance of x1
14 printf('Probability of finding particle at a
distance of x1 is =%0.2f \n \n',P1)
15
16 x2=a/3
17 psi2=sqrt(2/a)*sin(n*pi/a*x2)
18 P2=(psi2^2)*delx //Probability of
finding particle at distance of x2
19 printf(' Probability of finding particle at a
distance of x2 is =%0.2f \n',P2)
20 printf(' (There is print mistake in book). \n \n')
21
22 x3=a
23 psi3=sqrt(2/a)*sin(n*pi/a*x3)
24 P3=(psi3^2)*delx //Probability of
finding particle at distance of x3
```

```
25 printf(' Probability of finding particle at a  
distance of x3 is =%.2f \n',P3)
```

Chapter 6

Magnetic Materials and Circuits

Scilab code Exa 6.1 Find flux density and Relative permeability

```
1 //Chapter –6,Example 6_1 ,Page 6–26
2 clc()
3
4 //Given Values:
5 H=198 //Magnetizing Force in Ampere
   per meter
6 M=2300 //Magnetization in Ampere per
   meter
7 u0=4*%pi*10^-7 //Permeability in vacuum
8
9 //Calculations:
10 //H=(B/u0)-M
11 B=u0*(H+M) //Flux Density
12 ur=B/(u0*M) //Relative Permeability
13
14 printf('Corresponding Flux Density is =%.5f Wb/m^2 \
   n \n',B)
15 printf(' Relative Permeability is =%.2f \n',ur)
```

Scilab code Exa 6.2 Find relative permeability

```
1 //Chapter –6,Example 6_2 ,Page 6–26
2 clc()
3
4 //Given Values:
5 x=3.7*10^-3 //Susceptibility at T=300 K
6 T=300 //Temperature in kelvin
7 T1=250 //Temperature in kelvin
8 T2=600 //Temperature in kelvin
9
10 //Calculations:
11 C=x*T //Curie's law
12 ur1=C/T1 //Relative permeability at 250
    K
13 ur2=C/T2 //Relative permeability at 600
    K
14
15 printf('Relative Permeability at 250 K is =%.6f \n \
    n',ur1)
16 printf('Relative Permeability at 600 K is =%.6f \n'
    ,ur2)
```

Scilab code Exa 6.3 Calculate temperature

```
1 //Chapter –6,Example 6_3 ,Page 6–27
2 clc()
3
4 //Given Values:
5 u=0.8*10^-23 //Magnetic dipole moment of an
    atom in paramagnetic gas in J/T
6 B=0.8 //Magnetic field in tesla
```

```

7 K=1.38*10^-23          //Boltzmann constant
8
9 //To find Temperature at which Average thermal
  energy is equal to Magnetic energy
10 //i.e. uB=3KT/2
11 T=2*u*B/(3*K)        //Required temperature
12
13 printf('Required temperature is =%.3f Kelvin \n',T)

```

Scilab code Exa 6.4 Calculate Magnetization

```

1 //Chapter -6,Example 6_4 ,Page 6-27
2 clc()
3
4 //Given Values:
5 T=27+273              //Temperature in kelvin
6 B=0.5                 //Magnetic field in tesla
7 C=2*10^-3             //Curie's Constant
8 u0=4*pi*10^-7        //Permeability in vacuum
9
10 // C=u0*M*T/B (Curie's law)
11 M=C*B/(u0*T)         //Magnetization of material at 300
  K
12
13 printf('Magnetization of material at 300 K is =%.2f
  A/m \n',M)

```

Scilab code Exa 6.5 Calculate horizontal component of B

```

1 //Chapter -6,Example 6_5 ,Page 6-27
2 clc()
3
4 //Given Values:

```

```

5 B=10.9*10^-5           //Horizontal component of B
   in wb/m^2
6 u0=4*%pi*10^-7       //Permeability in free space
7
8 H=B/u0                //Horizontal component of
   magnetic field
9 printf('Horizontal component of magnetic field is =%
   .1f Ampere/meter \n',H)
10 printf(' (Print mistake in unit in book)')

```

Scilab code Exa 6.6 Calculate current

```

1 //Chapter -6,Example 6_6 ,Page 6-28
2 clc()
3
4 //Given Values:
5 u0=4*%pi*10^-7       //Permeability in vacuum
6 ur=900               //Relative permeability of medium
7 l=2                  //length in meter
8 A=60*10^-4          //Cross sectional area of ring
   in m^2
9 phi=5.9*10^-3       //flux in weber
10 n=700               //Number of turns
11
12 //Calculations:
13 //We know, phi=B*A
14 B=phi/A             //Flux density
15 //But, B=u*H
16 H=B/(u0*ur)        //Magnetic field strength
17
18 I=H*l/n             //Required current
19 printf('Current required to produce given flux is =%
   .2f Ampere \n',I)

```

Scilab code Exa 6.7 Calculate current

```
1 //Chapter –6,Example 6_7 ,Page 6–28
2 clc()
3
4 //Given Values:
5
6 u0=4*%pi*10^-7 //Permeability in vacuum
7 ur=900 //Relative permeability of medium
8 r=25*10^-2 //radius of ring
9 A=25*10^-4 //Cross sectional area of ring
   in m^2
10 Ag=1*10^-3 //Air gap
11 phi=2.7*10^-3 //flux in weber
12 N=400 //Number of turns
13
14 //Calculations:
15 //We know, phi=B*A
16 B=phi/A //Flux density
17 //But, B=u*H
18 H=B/(u0*ur) //Magnetic field strength
19 L=H*2*%pi*r+(B*Ag/u0) //Total amp turns required (
   iron+air)
20 I=L/N //Required current
21
22 printf('Current required to produce given flux is =%
   .2f Ampere \n',I)
```

Scilab code Exa 6.8 Calculate permeability and susceptibility

```
1 //Chapter –6,Example 6_8 ,Page 6–29
2 clc()
```



```

3
4 //Given Values:
5
6 u0=4*pi*10^-7 //Permeability in vacuum
7 A=0.2*10^-4 //Crosss sectional area of iron
   bar in m^2
8 H=1600 //magnetising field in A/m
9 phi=2.4*10^-5 //Magnetic flux in weber
10
11
12 //Calculations:
13 //We know, phi=B*A
14 B=phi/A //Flux density
15 u=B/H //magnetic permeability
16 ur=u/u0 //relative permeability
17 xm=ur-1 //susceptibility of the iron bar
18
19 printf('magnetic permeability of iron bar is =%.6f N
   /(A^2) \n \n',u)
20 printf(' susceptibility of the iron bar is =%.2f \n'
   ,xm)

```

Scilab code Exa 6.9 Calculate permeability and susceptibility

```

1 //Chapter -6,Example 6_9 ,Page 6-29
2 clc()
3
4 //Given Values:
5 u0=4*pi*10^-7 //Permeability in vacuum
6 xm=948*10^-11 //susceptibility of the iron
   bar
7
8 //Calculations:
9 ur=1+xm //relative permeability
10 u=u0*ur //permeability of medium

```

```

11
12 printf('Relative Permeability of medium is =%.8f \n
        \n',ur)
13 printf(' Permeability of medium is =%.9f H/m \n',u)

```

Scilab code Exa 6.10 Calculate relative permeability

```

1 //Chapter –6,Example 6_10 ,Page 6–30
2 clc()
3
4 //Given Values:
5 B=2.5 //Magnetic field in tesla
6 u0=4*pi*10^-7 //Permeability in free space
7 i0=0.7 //current in the core
8 ri=11*10^-2 //inner radii of core
9 ro=12*10^-2 //outer radii of core
10
11 //Calculations:
12 r=(ri+ro)/2 //Average radii of core
13 n=3000/(2*pi*r) //Number of turns
14
15 //We know,  $B=u0*ur*n*i0$  .Thus,
16 ur=B/(u0*n*i0)
17
18 printf('Relative Permeability of medium is =%.2f \n'
        ,ur)

```

Scilab code Exa 6.11 Calculate relative permeability

```

1 //Chapter –6,Example 6_11 ,Page 6–31
2 clc()
3
4 //Given Values:

```

```

5 B=1.0 //Flux density in tesla
6 u0=4*pi*10^-7 //Permeability in free space
7 i=2.0 //current in the core
8 n=10*100 //n=N/l i.e. turns per meter
9
10 //Calculations:
11 H=n*i //Magnetising force produced in
    wire
12 printf('Magnetising force produced in wire is =%.2f
    Amp-turn/meter \n \n',H)
13
14 //We know that, B=u0(H+I).Thus,
15 I=B/u0-H //Magnetisation of material
16 printf(' Magnetisation of material is =%.2f Amp-turn
    /meter \n \n',I)
17
18 //u=B/H, i.e. ur*u0=B/H.
19 ur=B/(u0*H) //Relative permeability of core
20 printf(' Relative Permeability of core is =%.1f \n',
    ur)

```

Scilab code Exa 6.12 Calculate energy loss

```

1 //Chapter-6,Example 6_12,Page 6-31
2 clc()
3
4 //Given Values:
5 M=40 //Mass of an iron core
6 D=7.5*10^3 //Density of iron
7 f=100 //Frequency
8 A=3800*10^-1 //Loss due to Area of hysteresis
    loop in J/m^3
9
10 //Calculations:
11 V=M/D //Volume of iron core

```

```

12 L1=A*V //Loss of energy in core per cycle
13 printf('Loss of energy in core per cycles is =%.2f
    Joules \n \n',L1)
14
15 N=f*60 //Number of cycles per minute
16 L=L1*N //Loss of energy per minute
17
18 printf(' Loss of energy per minute is =%.1f Joules \
    n',L)

```

Scilab code Exa 6.13 Calculate flux density and permeability

```

1 //Chapter -6,Example 6_13 ,Page 6-32
2 clc()
3
4 //Given Values:
5 u0=4*pi*10^-7 //Permeability in vacuum
6 l=30*10^-2 //length in meter
7 A=1*10^-4 //Cross sectional area of ring
    in m^2
8 phi=2*10^-6 //flux in weber
9 N=300 //Number of turns
10 I=0.032 //Current in winding
11
12 //Calculations:
13 //(i):
14 B=phi/A //Flux density
15 printf('i) Flux Density in the ring is =%.2f Wb/m^2 \
    n \n',B)
16
17 //(ii):
18 H=N*I/l //Magnetic intensity
19 printf(' ii) Magnetic intensity is =%.0f Amp-turn/
    meter \n \n',H)
20

```

```

21 //(iii):
22 u=B/H //Permeability of ring
23 printf(' iii)Permeability of ring is =%.6f Wb/A-m \n
      \n',u)
24 ur=u/u0 //Relative permeability of ring
25 printf(' Relative Permeability of ring is =%.1f \n \
      n',ur)
26
27 //(iv):
28 xm=ur-1 //susceptibility of the ring
29 printf(' iv)Magnetic susceptibility of the ring is =
      %.2f \n \n',xm)

```

Scilab code Exa 6.14 Calculate loss of energy

```

1 //Chapter-6,Example 6_14 ,Page 6-32
2 clc()
3
4 //Given Values:
5 M=12*10^3 //Mass of an iron core in grams
6 D=7.5 //Density of iron in gm/cc
7 f=50 //Frequency
8 A=3000 //Loss due to Area of hysteresis
      loop in ergs/cm^3
9
10 //Calculations:
11 V=M/D //Volume of iron core
12 L1=A*V //Loss of energy in core per cycle
13
14 L=L1*f*3600 //Loss of energy per hour
15
16 printf('Loss of energy per hour is =%.0f Erg \n',L)

```

Scilab code Exa 6.15 Calculate hysteresis power loss

```
1 //Chapter-6,Example 6_15 ,Page 6-33
2 clc()
3
4 //Given Values:
5 A=0.5*10^3           //Area of B-H loop in Joules
   per m^3
6 V=10^-3             //Volume of specimen in m^3
7 n=50                //Frequency of a.c.
8
9 //Calculations:
10 H=n*V*A            //Hysteresis power loss
11
12 printf('Hysteresis power loss is =%.0f Watt \n',H)
```

Scilab code Exa 6.16 Find magnetic moment

```
1 //Chapter-6,Example 6_16 ,Page 6-3
2 clc()
3
4 //Given Values:
5 u0=4*%pi*10^-7      //Permeability in vacuum
6 ur=1000             //Relative permeability of medium
7 V=10^-4             //Volume of iron rod in m^3
8 n=500               //Number of turns per meter
9 i=0.5               //Current in windings of solenoid
   in Amperes
10
11 //Calculations:
12 //We know  $I=(\mu_r-1)H$ 
13 //and  $H=ni$  , hence
14  $I=(\mu_r-1)*n*i$  //Intensity of magnetisation
15  $M=I*V$           //Magnetic moment
16
```

```
17 printf('Magnetic moment of the rod is =%.0f A-m^2 \n
    ',M)
```

Scilab code Exa 6.17 Find flux density and magnetic intensity

```
1 //Chapter -6,Example 6_17 ,Page 6-34
2 clc()
3
4 //Given Values:
5 u0=4*pi*10^-7 //Permeability in vacuum
6 ur=600 //Relative permeability of iron
7 d=12*10^-2 //mean diameter of ring in m
8 N=500 //Number of turns
9 i=0.3 //Current in windings of solenoid
    in Amperes
10
11 //Calculations:
12 r=d/2 //Radius of ring
13
14 B=u0*ur*N*i/(2*pi*r) //Flux density in the core
15 printf('Flux density in the core is =%.1f Wb/m^2 \n \
    n',B)
16
17 H=B/(u0*ur) //Magnetic intensity
18 printf('Magnetic intensity is =%.1f Amp-turns/m \n
    \n',H)
19
20 //We know that, B=u0(H+I)
21 I1=(B-u0*H)/u0 //magnetisation
22 I2=u0*I1 //Electronic current loop
23
24 I=I2/B*100 //Percentage flux density
    due to electronic loop currents
25 printf('Percentage flux density due to electronic
    loop currents is =%.2f percent \n \n',I)
```

Scilab code Exa 6.18 Calculate current

```
1 //Chapter –6,Example 6_18 ,Page 6–35
2 clc()
3
4 //Given Values:
5
6 u0=4*%pi*10^-7 //Permeability in vacuum
7 ur=900 //Relative permeability of iron
   ring
8 d=40*10^-2 //diameter of ring
9 l=5*10^-3 //air gap in the ring
10 A=5.8*10^-4 //Cross sectional area of ring
    in m^2
11 phi=1.5*10^-4 //flux in weber
12 N=600 //Number of turns
13
14 //Calculations:
15 r=d/2 //Radius of ring
16
17 //We know, phi=B*A
18 B=phi/A //Flux density
19
20 //But, B=u*H
21 H=B/(u0*ur) //Magnetic field strength
22
23 m1=H*ur*l //amp–turns in air gap
24 m2=H*2*%pi*r //amp–turns by ring
25 m=m1+m2 //total mmf(amp–turns) required
26
27 I=m/N //Required current
28 printf('Current required to produce given flux is =%
    .2f Amperes \n',I)
```

Scilab code Exa 6.18.1 Find magnetic flux density

```
1 //Chapter –6,Example 6_18_1 ,Page 6–38
2 clc()
3
4 //Given Values:
5 u0=4*%pi*10^-7 //Permeability in vacuum
6 X=-0.5*10^-5 //Magnetic susceptibility of
   silicon
7 H=9.9*10^4 //Magnetic field intensity
8
9 //Calculations:
10
11 //As, X=I/H. thus,
12 I=X*H //intensity of magnetisation
13 printf('Intensity of magnetisation is =%.3f \n \n',I
   )
14
15 B=u0*(H+I) //Magnetic flux density
16 printf(' Magnetic flux density is =%.3f Wb per m^2 \
   n',B)
```

Scilab code Exa 6.18.2 Determine reluctance and current

```
1 //Chapter –6,Example 6_18_2 ,Page 6–38
2 clc()
3
4 //Given Values:
5 u0=4*%pi*10^-7 //Permeability in vacuum
6 ur=380 //Relative permeability
7 d=20*10^-2 //diameter of solenoid in m
8 r=d/2 //radius of ring in m
```

```

9 A=5*10^-4           //Crosss sectional area of ring
   in m^2
10 phi=2*10^-3       //flux in weber
11 N=200              //Number of turns
12
13 //Calculations:
14 l=%pi*d            //air gap in the ring
15 S=(1/(u0*ur*A))   //Reluctance of iron ring
16 printf('Reluctance of iron ring is =%.2f Amp-turn
   per Wb \n \n',S)
17
18 //ohm's law for magnetic circuit is phi=N*I/S. thus
   ,
19 I=S*phi/N          //required current
20 printf(' Current required to obtain given magnetic
   flux is =%.2f Amperes \n',I)

```

Scilab code Exa 6.18.3 Calculate mmf reluctance B and H

```

1 //Chapter -6,Example 6_18_3 ,Page 6-39
2 clc()
3
4 //Given Values:
5 u0=4*%pi*10^-7     //Permeability in vacuum
6 ur=1                //Relative permeability of air
7 r=15*10^-2         //radius of ring in m
8 A=6*10^-4          //Crosss sectional area of ring
   in m^2
9 I=4                 //Coil current in amp
10 N=500              //Number of turns
11
12 //Calculations:
13 m=N*I              //MMF of coil
14 printf('MMF of coil is =%.0f Amp-turn \n \n',m)
15

```

```

16 l=2*%pi*r           //air gap
17 R=(1/(u0*ur*A))     //Reluctance of iron ring
18 printf(' Reluctance of iron ring is =%.0f Amp-turn
    per Wb \n \n',R)
19
20 phi=m/R             //Magnetic flux
21 printf(' Magnetic flux is =%.7f Weber \n \n',phi)
22
23 B=phi/A             //Magnetic Flux density
24 printf(' Magnetic flux density is =%.6f Weber per m
    ^2 \n \n',B)
25
26 H=B/(u0*ur)        //Magnetic field intensity
27 printf(' Magnetic field intensity is =%.0f Amperes
    per m \n \n',H)

```

Scilab code Exa 6.19 Calculate reluctance and mmf

```

1 //Chapter-6,Example 6_19 ,Page 6-36
2 clc()
3
4 //Given Values:
5 u0=4*%pi*10^-7      //Permeability in vacuum
6 ur=6*10^-3          //Relative permeability of iron
7 r=0.5               //radius of ring in m
8 l=1*10^-2           //air gap in the ring
9 A=5*10^-4           //Crosss sectional area of ring
    in m^2
10 i=5                 //current in ampere
11 N=900               //Number of turns
12
13 //Calculations:
14 S=(1/(u0*A))+((2*%pi*r-l)/ur*A) //Reluctance of
    iron
15 printf('Reluctance of iron is =%.2f Amp-turn per Wb

```

```

    \n \n',S)
16
17 m=N*i           //mmf produced
18 printf(' mmf produced is =%.2f Amp-turn \n',m)

```

Scilab code Exa 6.20 Calculate current

```

1 //Chapter -6,Example 6_20 ,Page 6-36
2 clc()
3
4 //Given Values:
5 H=5*10^3           //coercivity of bar magnet in amp
   /m
6 l=10*10^-2        //length of solenoid in m
7 N=50              //No of turns
8
9 //Calculations:
10
11 //We know that , H=NI/l ,hence
12 I=l*H/N           //current through solenoid
13
14 printf('Current through solenoid is =%.0f Amperes \n
   ',I)

```

Scilab code Exa 6.21 Find magnetic moment

```

1 //Chapter -6,Example 6_21 ,Page 6-36
2 clc()
3
4 //Given Values:
5 ur=1200           //Relative permeability of medium
6 V=10^-3           //volume of iron rod
7 N=5*10^2          //no of turns per m

```

```

8 i=0.5 //current through solenoid in amp
9
10 // Calculations:
11 x=ur-1 //susceptibility of the ring
12 H=N*i //Magnetising field
13
14 //We know, x=I/H
15 I=x*H //magnetisation
16
17 //Also, I=M/V, thus
18 M=I*V //magnetic moment
19 printf('Magnetic moment is =%.2f Amp-turn-m^2 \n',M)

```

Scilab code Exa 6.22 Find magnetic moment

```

1 //Chapter-6,Example 6_22,Page 6-37
2 clc()
3
4 //Given Values:
5 ur=100 //Relative permeability of medium
6 l=0.2 //length of iron rod
7 d=10*10^-3 //diameter of solenoid in m
8 N=300 //no of turns per m
9 i=0.5 //current through solenoid in amp
10 r=d/2 //radius of solenoid
11
12 // Calculations:
13 x=ur-1 //susceptibility of the ring
14 H=N*i //Magnetising field
15
16 //We know, x=I/H
17 I=x*H //magnetisation
18
19 V=%pi*(r^2)*l //volume of iron rod
20

```

```

21 //Also , I=M/V , thus
22 M=I*V //magnetic moment
23 printf('Magnetic moment is =%.4f Amp-turn-m^2 \n',M)

```

Scilab code Exa 6.23 Find magnetizing current

```

1 //Chapter -6,Example 6_23 ,Page 6-38
2 clc()
3
4 //Given Values :
5 l=1.2 //length of circuit in meter
6 u=7.3*10^-3 //permeability of silicon sheet
7 A=100 //cross sectional area in cm^2
8 N=150 //No of turns
9 B=0.3 //magnetic field in Wb/m^2
10
11 //Calculations :
12
13 //We know, B=u*H
14 H=B/u //Magnetic field strength
15
16 m=H*l //amp-turns in air gap
17
18 I1=m/N //Required current
19 printf('Current required to obtain given magnetic
    field is =%.3f Amperes \n \n',I1)
20
21 I=I1/A //Required current per unit area
22 printf(' Current required per unit area to obtain
    given magnetic field is =%.6f Amperes \n',I)

```
