

Scilab Textbook Companion for
Principles of Physics
by P .V. Naik¹

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

Motion

Scilab code Exa 1.e.1 Tensions in the cables

```
1  clc
2  clear
3  //Input data
4  w=50//Weight in N
5  a=[40,50]//Angles made by two cables in degrees
6
7  //Calculations
8  //Solving two equations obtained from fig. 1.10 on
   page no.10
9  // $-T_1\cos 40+T_2\cos 50=0$ 
10 // $T_1\sin 40+T_2\sin 50=50$ 
11 A=[-cosd(a(1)) cosd(a(2))
12     sind(a(1)) sind(a(2))]//Coefficient matrix
13 B=[0
14     w]//Constant matrix
15 X=inv(A)*B//Variable matrix
16
17 //Output
18 printf('Tensions in all three cables are %3.2f N, %3
   .2f N, %i N',X(1),X(2),w)
```

Scilab code Exa 1.e.5 Acceleration of the block

```
1  clc
2  clear
3  m=100 //Mass of block in kg
4  F=500 //Force in N
5  q=30 //Angle made with the horizontal in degrees
6  u=0.4 //Coefficient of sliding friction
7
8  //Calculations
9  R=m*9.8 //Reaction force in N
10 f=(u*R) //Frictional force in N
11 a=(F*cosd(q)-f)/m //Acceleration of the block in m/s
    ^2
12
13 //Output
14 printf('The acceleration of the block is %3.2f m/s^2
    ',a)
```

Scilab code Exa 1.e.6 Acceleration and Tension

```
1  clc
2  clear
3  //Input data
4  m=[20,80] //Masses of blocks in kg
5  F=1000 //Force with which 20kg block is pulled in N
6
7  //Calculations
8  a=(F/(m(1)+m(2))) //Acceleration of the block in m/s
    ^2
9  T=F-(m(1)*a) //Tension in the string in N
10
```

```
11 //Output
12 printf('The acceleration produced is %i m/s^2 \n The
    tension in the string connecting the blocks is
    %i N',a,T)
```

Scilab code Exa 1.e.8 Weight of the person

```
1 clc
2 clear
3 //Input data
4 w=588//Weight of the person in N
5 a=3//Acceleration in m/s^2
6
7 //Calculations
8 m=(w/9.8)//Mass of the person in kg
9 P=(w+(m*a))//Weight of the person when the elevator
    is accelerated upwards in N
10
11 //Output
12 printf('Weight of the person when the elevator is
    accelerated upwards is %i N',P)
```

Scilab code Exa 1.1 Orbital speed and centripetal acceleration

```
1 clc
2 clear
3 //Input data
4 d=180//Distance of satellite above the surface of
    earth in km
5 t=90//Time taken to complete one revolution of the
    earth in minutes
6 r=6400//Radius of the earth in kms
7
```

```

8 //Calculations
9 R=(r+d)*1000//Total distance in m
10 T=t*60//Time in seconds
11 v=(2*3.14*R)/T//Orbital speed in m/s
12 a=(v^2/R)//Centripetal acceleration in m/s^2
13
14 //Output
15 printf('Orbital speed is %i m/s \n Centripetal
    acceleration is %3.1f m/s^2 ',v,a)

```

Scilab code Exa 1.2 Speed

```

1 clc
2 clear
3 //Input data
4 m=0.05//Mass of the stone in kg
5 r=0.4//Radius of the string in m
6
7 //Calculations
8 vh=sqrt(9.8*r)//Minimum speed when the stone is at
    the top of the circle in m/s
9 vl=sqrt(((2/m)*(((1/2)*m*vh^2)+(m*9.8*2*r))))//Minimum
    speed when the stone is at the bottom of the
    circle in m/s
10
11 //Output
12 printf('Minimum speed when the stone is at the top
    of the circle is %3.2f m/s \n Minimum speed when
    the stone is at the bottom of the circle is %3.2f
    m/s ',vh,vl)

```

Scilab code Exa 1.3 Tension and acceleration

```

1  clc
2  clear
3  //Input data
4  m=0.2//Mass of the ball in kg
5  r=1.5//Radius of vertical circle in m
6  q=35//Angle made by the ball in degrees
7  v=6//Velocity of the ball in m/s
8
9  //Calculations
10 T=(m*((v^2/r)+(9.8*cosd(q))))//Tension in the string
    in N
11 at=9.8*sind(q)//Tangential acceleration in m/s^2
12 ar=(v^2/r)//Radial acceleration in m/s^2
13 a=sqrt(at^2+ar^2)//Acceleration in m/s^2
14
15 //Output
16 printf('Tension in the string is %3.1f N \n
    Tangential acceleration is %3.2f m/s^2 \n Radial
    acceleration is %i m/s^2',T,at,ar)

```

Scilab code Exa 1.4 Acceleration

```

1  clc
2  clear
3  //Input data
4  //A small ball is released from height of 4r
    measured from the bottom of the loop, where r is
    the radius of the loop
5
6  //Calculations
7  ar=(6*9.8)//Radial acceleration in m/s^2
8  at=(9.8*sind(90))//Tangential acceleration in m/s^2
9
10 //Output
11 printf('Radial acceleration is %3.1f m/s^2 \n

```

Tangential acceleration is %3.1f m/s²',ar,at)

Scilab code Exa 1.5 Period of rotation

```
1  clc
2  clear
3  //Input data
4  l=0.95//Length of the string in m
5  m=0.15//Mass of the bob in kg
6  r=0.25//Radius of the circle in m
7
8  //Calculations
9  h=sqrt(l^2-r^2)//Height of the pendulum in m
10 t=2*3.14*sqrt(h/9.8)//Period of rotation in s
11
12 //Output
13 printf('The period of rotation is %3.4f s',t)
```

Scilab code Exa 1.6 Coefficient of limiting friction

```
1  clc
2  clear
3  //Input data
4  N=40//Minimum speed of rotor in rpm
5  r=2.5//Radius of rotor in m
6
7  //Calculations
8  t=60/N//Time period in s
9  u=(9.8*t^2)/(4*3.14^2*r)//Coefficient of limiting
    friction
10
11 //Output
```

```
12 printf('The coefficient of limiting friction between
    the object and the wall of the rotor is %3.4f',u
    )
```

Scilab code Exa 1.7 Speed

```
1 clc
2 clear
3 //Input data
4 a=30//Angle of inclination in degrees
5 t=3//Time in s
6
7 //Calculations
8 a=(9.8*sind(a))//Acceleration in m/s^2
9 v=(0+a*t)//Velocity in m/s
10
11 //Output
12 printf('Speed of the block after %i s is %3.1f m/s',
    t,v)
```

Scilab code Exa 1.8 Coefficient of static and kinetic friction

```
1 clc
2 clear
3 //Input data
4 m=10//Mass of the block in kg
5 F1=40//Horizontal force to start moving in N
6 F2=32//Horizontal force to move with constant
    velocity in N
7
8 //Calculations
9 u1=(F1/(m*9.8))//Coefficient of static friction
10 u2=(F2/(m*9.8))//Coefficient of kinetic friction
```

```
11
12 //Output
13 printf('Coefficient of static friction is %3.3f \n
        Coefficient of kinetic friction is %3.3f',u1,u2)
```

Scilab code Exa 1.9 Tension and coefficient of friction

```
1 clc
2 clear
3 //Input data
4 m=[3,12]//Masses of the blocks in kg
5 q=50//Angle made by the string in degrees
6 a=3//Acceleration of 12kg block in m/s^2
7
8 //Calculations
9 T=m(1)*(9.8+a)//Tension in the string in N
10 u=(m(2)*(9.8*sind(q)-a)-T)/(m(2)*9.8*cosd(q))//
    Coefficient of kinetic friction
11
12 //Output
13 printf('Tension in the string is %3.1f N \n The
        coefficient of kinetic friction between %i kg
        block and the plane is %3.3f',T,m(2),u)
```

Chapter 2

Work Energy and Power

Scilab code Exa 2.1 Workdone

```
1  clc
2  clear
3  //Input data
4  F=[6,2] //Constant force in vector form 6i+2j in N
5  s=[3,5] //Displacement in vector form 3i+5j in N
6
7  //Calculations
8  W=(F(1)*s(1))+(F(2)*s(2)) //Workdone in J
9  q=acosd(W/(sqrt(F(1)^2+F(2)^2)*sqrt(s(1)^2+s(2)^2)))
   //Angle between Force and displacement in degrees
10
11 //Output
12 printf('Workdone by the force is %3.0f J \n Angle
   between Force and displacement is %3.1f degrees ',
   W,q)
```

Scilab code Exa 2.2 Workdone

```

1  clc
2  clear
3  //Input data
4  m=10//Mass of block in kg
5  q=40//Angle made by the force with horizontal in
    degrees
6  s=5//Horizontal displacement of the block in m
7  u=0.3//Coefficient of kinematic friction
8
9  //Calculations
10 F=(u*m*9.8)/(cosd(q)+(u*sind(q)))//Pulling force in
    N
11 W=(F*cosd(q))*s//Workdone by the pulling force in J
12
13 //Output
14 printf('Workdone by the pulling force is %3.2f J',W)

```

Scilab code Exa 2.3 Workdone

```

1  clc
2  clear
3  //Input data
4  r1=[0,1]//Interval in m
5  r2=[1,2]//Interval in m
6  r3=[2,4]//Interval in m
7  r4=[0,5]//Interval in m
8  y=[6,12]//Y- coordinates from the graph 2.5 on page
    no. 27
9
10 //Calculations
11 a1=(1/2)*(r1(2)-r1(1))*y(1)//Area under the curve in
    J
12 a2=(r2(2)-r2(1))*y(1)//Area under the curve in J
13 a3=((r3(2)-r3(1))*y(1))+((1/2)*((r3(2)-r3(1))/2)*(y
    (2)-y(1)))+(((r3(2)-r3(1))/2)*(y(2)-y(1)))//Area

```

```

    under the curve in J
14 a4=(a1+a2+a3+((1/2)*y(2)*(r4(2)-r3(2))))//Area under
    the curve in J
15
16 //Output
17 X=[0,1,2,3,4,5]//X- coordinate is distance in m
18 Y=[0,6,6,12,12,0]//Y- coordinate is Force in N
19 plot(X,Y)//Graph shown in figure 2.5 on page no.27
20 xtitle('Distance versus Force','Distance in m','
    Force in N')
21
22 printf('The work done in the intervals: \n (a)%i<=x
    <=%i m is %i J \n (b)%i<=x<=%i m is %i J \n (c)%i
    <=x<=%i m is %i J \n (d)%i<=x<=%i m is %i J \n',
    r1(1),r1(2),a1,r2(1),r2(2),a2,r3(1),r3(2),a3,r4
    (1),r4(2),a4)

```

Scilab code Exa 2.4 Kinetic energy

```

1 clc
2 clear
3 //Input data
4 m=0.05//Mass of the body in kg
5 v=[3,5]//Velocity in vector form 3i+4j in m/s
6
7 //Calculations
8 ke=(1/2)*m*(v(1)^2+v(2)^2)//Kinetic energy in J
9
10 //Output
11 printf('Kinetic energy is %3.2f J',ke)

```

Scilab code Exa 2.5 Workdone

```

1  clc
2  clear
3  //Input data
4  k=50//Spring force constant in N/m
5  x=-0.02//Length of compression in m
6
7  //Calculations
8  W=(1/2)*k*(x)^2//Work done by the spring in J
9
10 //Output
11 printf('Work done by the spring when the block comes
    from the compressed position to the equilibrium
    position is %3.2f J',W)

```

Scilab code Exa 2.6 Force constant of the spring

```

1  clc
2  clear
3  //Input data
4  x=0.03//Length stretched by the spring in m
5  m=0.25//Mass of the body in kg
6
7  //Calculations
8  k=(m*9.8)/x//Force constant of the spring in N/m
9
10 //Output
11 printf('Force constant of the spring is %3.2f N/m',k
    )

```

Scilab code Exa 2.7 Speed of the block

```

1  clc
2  clear

```

```

3 //Input data
4 m=5//Mass of block in kg
5 F=20//Constant force in N
6 x=6//Distance moved by the block in m
7
8 //Calculations
9 W=(F*x)//Workdone by the block in J
10 v=sqrt((2*W)/m)//Speed of the block in m/s
11
12 //Output
13 printf('Speed of the block when it moves through a
        distance of %3.0f m is %3.2f m/s',x,v)

```

Scilab code Exa 2.8 Workdone and average power

```

1 clc
2 clear
3 //Input data
4 m=50//Mass of the object in kg
5 v=8//Speed in m/s
6 t=4//Time taken in s
7
8 //Calculations
9 a=(v-0)/t//Acceleration in m/s^2
10 s=(v^2/(2*a))//Distance in m
11 W=(m*a*s)//Workdone in J
12 P=(W/t)//Power delivered in watt
13
14 //Output
15 printf('Workdone on the object is %i J \n The
        average power delivered by the force in the first
        %i s is %i watt',W,t,P)

```

Chapter 3

Potential Energy

Scilab code Exa 3.1 Potential energy

```
1  clc
2  clear
3  //Input data
4  m=0.04//Mass of stone in kg
5  vi=25//Initial velocity in m/s
6  vf=0//Final velocity in m/s
7  yi=0//Initial height in m
8
9  //Calculations
10 Ui=(m*9.81*yi)//Initial potential energy in J
11 Ki=(1/2)*m*vi^2//Initial kinetic energy in J
12 Etotal=(Ui+Ki)//Total energy in J
13 h=(Etotal/(m*9.8))//Maximum height in m
14 //when the stone is at (2/3)h, total energy is again
    same
15 v=sqrt((Etotal-(m*9.8*(2/3)*h))/((1/2)*m))//Velocity
    at (2/3) of its maximum height in m/s
16
17 //Output
18 printf('Maximum height it will reach is %3.1f m \n
    Potential energy at that height is %3.1f J \n
```

velocity when it is at the two-third of its maximum height is %3.2f m/s',h,Ettotal,v)

Scilab code Exa 3.2 Potential energy

```
1 clc
2 clear
3 //Input data
4 m=0.5//Mass of the sphere in kg
5 vi=100//Initial velocity in m/s
6 vf=20//Final velocity in m/s
7
8 //Calculations
9 h=(vi^2-vf^2)/(2*9.8)//Height in m
10 PE=(m*9.8*h)//Potential energy in J
11
12 //Calculations
13 printf('Potential energy of the sphere is %i J',PE)
```

Scilab code Exa 3.3 Potential Energy

```
1 clc
2 clear
3 //Input data
4 m=0.5//Mass of the block in kg
5 x=0.05//Distance to which block is pulled in m
6 k=300//Force constant of the spring in N/m
7
8 //Calculations
9 U=(1/2)*k*x^2//Potential energy of the block in J
10 v=x*sqrt(k/m)//Velocity of the block in m/s
11
12 //Output
```

```
13 printf('Potential energy of the block when spring is
    in stretched position is %3.3f J \n Velocity of
    the block when it passes through the equilibrium
    position is %3.2f m/s',U,v)
```

Scilab code Exa 3.4 Speed

```
1 clc
2 clear
3 //Input data
4 l=0.8//Length of a simple pendulum in m
5 q=30//Angle with the vertical through which the bob
    is released in degrees
6 q1=10//Required angle in degrees
7
8 //Calculations
9 v=sqrt(2*9.8*l*(cosd(q1)-cosd(q)))//Speed in m/s
10
11 //Output
12 printf('Speed when the bob is at the angle of %i
    degrees with the vertical is %3.2f m/s',q1,v)
```

Scilab code Exa 3.5 Rest and total energy

```
1 clc
2 clear
3 //Input data
4 m=(9.1*10^-31)//Mass of the electron in kg
5 v=(3*10^8)//Velocity of light in m/s
6 c=(1.6*10^-19)//Charge of the electron in coulombs
7
8 //Calculations
9 Re=(m*v^2)/(c*10^6)//Rest energy in MeV
```



```
10 E=(Re/sqrt(1-0.9^2))//Total energy in MeV
11
12 //Output
13 printf('Rest energy of the electron is %3.3f MeV \n
    Total energy is %3.4f MeV',Re,E)
```

Chapter 4

Rotational motion of Rigid Objects

Scilab code Exa 4.1 Moment of inertia and Kinetic energy

```
1  clc
2  clear
3  //Input data
4  w=4//Angular velocity in rad/s
5  m=[1,2,3,4]//Masses in kg from the figure 4.17 on
   page no.54
6  r=[2.5,1.5]//Centre position in m
7
8  //Calculations
9  I=(m(1)+m(2)+m(3)+m(4))*(r(1)^2+r(2)^2)//Moment of
   inertia in kg.m^2
10 KE=(1/2)*I*w^2//Kinetic energy of the system in J
11
12 //Output
13 printf('The moment of inertia is %i kg.m^2 \n
   Kinetic energy of the system is %i J',I,KE)
```

Scilab code Exa 4.2 Velocity and acceleration

```
1 clc
2 clear
3 //input data
4 q=30//Angle of inclination in degrees
5 h=1//Height in m
6
7 //Calculations
8 v=sqrt((10/7)*9.8*h)//Velocity in m/s
9 a=(5/7)*9.8*sind(q)//Acceleration in m/s^2
10
11 //Output
12 printf('Velocity and acceleration of the centre of
    mass of the sphere is %3.2f m/s and %3.1f m/s^2',
    v,a)
```

Scilab code Exa 4.3 Period of oscillation

```
1 clc
2 clear
3 //Input data
4 m=1.2//Mass of the rod in kg
5 l=0.8//Length of the rod in m
6
7 //Calculations
8 T=2*3.14*sqrt((2*l)/(3*9.8))//Time period in s
9
10 //Output
11 printf('Period of oscillation is %3.2f s',T)
```

Scilab code Exa 4.4 Period of oscillation

```

1  clc
2  clear
3  //Input data
4  r=0.2//Radius of uniform disc in m
5  d=0.15//Distance from the centre in m
6
7  //Calculations
8  T=2*3.14*sqrt((17*r)/(12*9.8))//Period of
    oscillations in s
9
10 //Output
11 printf('The period of oscillation is %3.2f s',T)

```

Scilab code Exa 4.5 Angular speed of rotation

```

1  clc
2  clear
3  //Input data
4  m=3//Mass of the rotor in kg
5  I=0.03//Moment of inertia in kg.m^2
6  d=0.25//Distance of pivot from the centre in m
7  p=30//Precession in rpm
8
9  //Calculations
10 T=m*9.8*d//Torgue in N.m
11 w=(p*2*3.14)/60//Angular velocity in rad/s
12 w1=(T/(I*w))//Angular speed of rotation of the rotor
    in rpm
13
14 //Output
15 printf('Angular speed of rotation of the rotor is %i
    rpm ',w1)

```

Chapter 5

Properties of Matter

Scilab code Exa 5.1 Period of pendulum

```
1  clc
2  clear
3  //Input data
4  m=1//Mass of torsional pendulum in kg
5  R=0.06//Radius of torsional pendulum in m
6  l=1.2//Length of the wire in m
7  r=0.0008//Radius of wire in m
8  S=(9*10^9)//Modulus of rigidity of the material in N
   /m^2
9
10 //Calculations
11 I=(1/2)*m*R^2//Moment of inertia in kg.m^2
12 C=(3.14*S*r^4)/(2*l)//Couple per unit twist in N.m
13 T=2*3.14*sqrt(I/C)//Period of pendulum in s
14
15 //Output
16 printf('Period of pendulum is %3.1f s',T)
```

Scilab code Exa 5.2 Work done

```

1  clc
2  clear
3  //Input data
4  l=0.8//Length of the wire in m
5  d=(1.8*10^-3)//Diameter of the wire in m
6  a=1.5//Angle of twist in degrees
7  S=(1.8*10^11)//Modulus of rigidity of the material
   in N/m^2
8
9  //Calculations
10 r=(a*3.14)/180//Angle of twist in radians
11 W=((3.14*S*(d/2)^4*r^2)/(4*l))/10^-5//Work required
   to twist the wire in J*10^-5
12
13 //Output
14 printf('Work required to twist the wire is %3.2f
   *10^-5 J',W)

```

Scilab code Exa 5.3 PProperties of Material

```

1  clc
2  clear
3  //Input data
4  l=2//Length of wire in m
5  d=(0.4*10^-3)//Diameter of the wire in m
6  x=(1.03*10^-3)//Extension in length in m
7  L=2//Load in kg
8  C=(4.52*10^-6)//Couple in N/m
9  a=0.03//Twist angle in radians
10
11 //Calculations
12 Y=((L*9.8*l)/(x*3.14*(d/2)^2))/10^11//Young's
   modulus in N/m^2*10^11
13 S=((C*2*l)/(3.14*(d/2)^4*a))/10^11//Modulus of
   rigidity in N/m^2*10^11

```

```

14 s=(Y/(2*S))-1//Poisson 's ratio
15
16 //Output
17 printf('Youngs modulus is %3.2f*10^11 N/m^2\nModulus
    of rigidity is %3.2f*10^11 N/m^2\nPoissons ratio
    is %3.4f',Y,S,s)

```

Scilab code Exa 5.4 Excess pressure

```

1 clc
2 clear
3 //Input data
4 r=0.003//Radius of drop of glycerine in m
5 T=(63.1*10^-3)//Surface tension of glycerine in N/m
6
7 //Calculations
8 P=((2*T)/r)//Excess pressure inside the drop of
    glycerine in N/m^2
9
10 //Output
11 printf('Excess pressure inside the drop of glycerine
    is %3.2f N/m^2',P)

```

Scilab code Exa 5.5 Rate of change of pressure

```

1 clc
2 clear
3 //Input data
4 r1=0.001//Initial radius in m
5 r2=0.004//Final radius in m
6 t=2*10^-3//Time in s
7 s=(7*10^-2)//Surface tension of water in N/m
8

```

```

9 //Calculations
10 P=((2*s)*((1/r2)-(1/r1)))/(t*10^4)//Rate of change
    of pressure in N/m^2.s*10^4
11
12 //Output
13 printf('Rate of change of pressure is %3.2f*10^4 N/m
    ^2.s',P)

```

Scilab code Exa 5.6 Work done

```

1 clc
2 clear
3 //Input data
4 d=0.02//Diamter of soap bubble in m
5 s=(25*10^-3)//Surface tension in N/m
6 //Initial surface area of the bubble is zero and
    final area is 2*4*pie*r^2 where r is the radius
    of the bubble
7
8 //Calculations
9 W=(s*2*4*3.14*(d/2)^2)/10^-5//Work done in blowing a
    soap bubble in J*10^-5
10
11 //Output
12 printf('Work done in blowing a soap bubble is %3.2f
    *10^-5 J',W)

```

Scilab code Exa 5.7 Energy required

```

1 clc
2 clear
3 //Input data
4 r=0.01//Radius of liquid drop in m

```



```

5 n=500 //Number of drops
6 s=(63*10^-3) //Surface tension in N/m
7
8 //Calculations
9 r1=((4*3.14*r^3)/3)/((n*4*3.14)/3)^(1/3) //Radius
    of one small drop in m
10 As=(n*4*3.14*r1^2) //Total surface of 500 drops in m
    ^2
11 as=4*3.14*r^2 //Original surface area of the drop in
    m^2
12 W=(s*(As-as))/10^-4 //Work done in J*10^-4
13
14 //Output
15 printf('Energy required to break up a drop of a
    liquid is %3.1f*10^-4 J',W)

```

Scilab code Exa 5.8 Speed of flow

```

1 clc
2 clear
3 //Input data
4 d=0.04 //Inside diameter of garden hose in m
5 D=0.01 //Diameter of nozzle opening in m
6 v1=0.6 //speed of flow of water in the hose in m/s
7
8 //calculations
9 a=3.14*(d/2)^2 //Area of hose in m^2
10 A=3.14*(D/2)^2 //Area of nozzle in m^2
11 v2=(v1*a)/A //Speed of flow through the nozzle in m/s
12
13 //Output
14 printf('Speed of flow through the nozzle is %3.1f m/
    s',v2)

```

Chapter 6

Real gas and Transport Processes in Gas

Scilab code Exa 6.1 Critical constants

```
1 clc
2 clear
3 //Input data
4 a=(2.1*10^-2)//Vanderwaals constant a for neon gas
   in Nm^4/mol^2
5 b=(1.71*10^-5)//Vanderwaals constant b for neon gas
   in m^3/mol
6 R=8.314//Gas constant in J/mol.K
7
8 //Calculations
9 Tc=(8*a)/(27*b*R)//Critical temperature in K
10 Vc=(3*b)/10^-5//Critical volume in m^3/mol * 10^-5
11 Pc=(a/(27*b^2))/10^6//Critical pressure in N/m^2 *
   10^6
12
13 //Output
14 printf('Critical temperature is %3.2f K \n Critical
   volume is %3.2f * 10^-5 m^3/mol \n Critical
   pressure is %3.3f * 10^6 N/m^2 ',Tc,Vc,Pc)
```

Scilab code Exa 6.2 Mean free path

```
1 clc
2 clear
3 //Input data
4 n=181*10^-6//Coefficient of viscosity of a gas in p
5 v=3*10^4//Average speed of molecules in cm/s
6 d=1.2929*10^-3//Density in g/cm^3
7
8 //Calculations
9 lemda=((3*n)/(d*v))/10^-6//Mean free path in cm
   *10^-6
10
11 //Output
12 printf('Mean free path is %3.0f * 10^-6 cm',lemda)
```

Scilab code Exa 6.3 Diffusion coefficient of the gas

```
1 clc
2 clear
3 //Input data
4 m=(28*1.66*10^-27)//Molecular mass of a gas in kg
5 d=(3.48*10^-10)//Diameter in m
6 k=(1.38*10^-23)//Boltzmanns constant in J/K
7 P=1.01*10^5//Pressure at STP in N/m^2
8 T=273//Temperature at STP in K
9
10 //Calculations
11 D=((1/(P*3*d^2*sqrt(m)))*((2*k*T)/3.14)^(3/2))/10^-5
   //Diffusion coefficient of a gas at STP in m^2/s
12
```

```

13 //Output
14 printf('Diffusion coefficient of a gas at STP is %3
    .2f * 10-5 m2/s',D)

```

Scilab code Exa 6.4 Viscosity of a gas

```

1 clc
2 clear
3 //Input data
4 m=(32*1.66*10-27) //Molecular mass of a gas in kg
5 d=(3.65*10-10) //Diameter in m
6 k=(1.38*10-23) //Boltzmans constant in J/K
7 P=1.01*105 //Pressure at STP in N/m2
8 T=273 //Temperature at STP in K
9
10 //Calculations
11 n=((1/(3.14*d2))*sqrt((8*k*T*m)/(9*3.14)))/10-5 //
    Viscosity of gas at STP in N.s/m2
12
13 //Output
14 printf('Viscosity of a gas at STP is %3.5f *10-5 N.
    s/m2',n)

```

Scilab code Exa 6.5 Thermal conductivity

```

1 clc
2 clear
3 //Input data
4 v=460 //Average speed of molecules in m/s
5 l=(720*10-10) //Mean free path in m
6 Cv=21.06 //Specific heat at constant volume in J/K.
    mol
7 k=(1.38*10-23) //Boltzmans constant in J/K

```

```
8 P=1.01*10^5//Pressure at STP in N/m^2
9 T=273//Temperature at STP in K
10 N=6.022*10^23//Avagadro constant
11
12 //Calculations
13 K=((1/3)*(Cv/N)*(P/(k*T))*v*1)/10^-2//Thermal
    conductivity of the gas at STP in W/m.K *10^-2
14
15 //Output
16 printf('Thermal conductivity of the gas at STP is %3
    .5f *10^-2 W/m.K',K)
```

Chapter 7

Thin Lens and Coaxial systems and Aberrations

Scilab code Exa 7.1 Position of cardinal points

```
1  clc
2  clear
3  //Input data
4  f1=-12//Focal length of a converging lens in cm
5  f2=25//Focal length of a diverging lens in cm
6  d=8//Distance between the lens in cm
7
8  //Calculations
9  C=(1/f1)+(1/f2)+(d/(f1*f2))//Inverse of focal length
    in cm-1
10 D=(d/f2)+1//Constant value
11 A=(d/f1)+1//Constant value
12 O1F1=(-D/C)//Poistion of cardinal point in cm
13 O2F2=(A/C)//Poistion of cardinal point in cm
14 O1H1=(1-D)/C//Poistion of cardinal point in cm
15 O2H2=(A-1)/C//Poistion of cardinal point in cm
16
17 //Output
18 printf('Position of cardinal points are O1F1 = %3.2 f
```

cm, $O_2F_2 = 3.2 f$ cm, $O_1H_1 = 3.2 f$ cm, $O_2H_2 = 3.2 f$ cm
 The system is in air, therefore, nodal points coincide with unit points ($O_1F_1, O_2F_2, O_1H_1, O_2H_2$)

Scilab code Exa 7.2 Focal lengths

```

1  clc
2  clear
3  //Input data
4  f=15//Focal length of achromatic doublet made up of
   crown and flint glasses in cm
5  f1=[0.01506,0.02427]//Dispersive power of crown and
   flint glasses respectively
6
7  //Calculations
8  //Solving two equations
9  //(1/f)=(1/f1)+(1/f2)
10 //(f1/f2)=(-0.01506/0.02427)
11 fx=(f1(1)/f1(2))//Ratio of focal lengths
12 f2=(-(1/fx)+1)/(1/f)//Focal length of converging
   lens in cm
13 f1=(-fx*f2)//Focal length of diverging lens in cm
14
15 //Output
16 printf('Focal length of converging lens is %3.4f cm
   \n Focal length of diverging lens is %3.1f cm',f2
   ,f1)

```

Scilab code Exa 7.3 Radii of curvature

```

1  clc
2  clear

```

```

3 //Input data
4 f=20//Focal length in cm
5 fl=[0.015,0.019]//Dispersive powers of crown and
   flint glasses respectively
6 r=[1.495,1.53]//Refractive indices respectively
7
8 //Calculations
9 fx=-(f1(1)/f1(2))//Ratio of focal lengths
10 //Solving two equations
11 //(1/f)=(1/f1)+(1/f2)
12 //(f1/f2)=(-0.015/0.019)
13 f2=((1/fx)+1)/(1/f)//Focal length of converging lens
   in cm
14 f1=(fx*f2)//Focal length of diverging lens in cm
15 r2=(r(2)-1)*f2//Radius of curvature of convergent
   lens in cm
16 r1=1/(((1/f1)/(r(1)-1))+(1/r2))//Radius of curvature
   of divergent lens in cm
17
18 //Output
19 printf('Radius of curvature of converging lens is %3
   .4f cm \n Radius of curvature of diverging lens
   is %3.3f cm',r2,r1)

```

Scilab code Exa 7.4 Radii of curvature

```

1 clc
2 clear
3 //Input data
4 r=1.5//Refractive index of the material of a thin
   lens
5 f=-20//Focal length of the lens in cm
6 rx=-6//Ratio of radii of curvature of lens
7
8 //Calculations

```



```
9 r1=1/((1/f)/((r-1)*(1-(1/rx))))//Radius of curvature
  of convergent lens in cm
10 r2=(rx*r1)//Radius of curvature of divergent lens in
    cm
11
12 //Output
13 printf('Radii of curvature of lens are %3.2f cm and
    %i cm',r1,r2)
```

Chapter 9

Interference

Scilab code Exa 9.1 Wavelength

```
1  clc
2  clear
3  //Input data
4  t=0.2//Thickness of film in micro m
5  r=1.25//Refractive index of liquid
6  w=[4000,5000]//Range of wavelength in Angstrom
7  q=35//Angle observed in degrees
8
9  //Calculations
10 u=asind(sind(q)/r)//Angle of reflection in degrees
11 w1=(2*t*10-6*r*cosd(u))/10-10//Wavelength in
    Angstrom
12 w2=w1/2//Wavelength in Angstrom
13
14 //Output
15 printf('Wavelength absent in reflected light is %i
    Angstrom ',w2)
```

Scilab code Exa 9.2 Thickness of the film

```

1  clc
2  clear
3  //Input data
4  r=1.39//Refractive index of the film
5  q=30//Angle observed in degrees
6  w=[5125,5000]//Wavelengths of two consecutive dark
    bands in Angstrom
7
8  //Calculations
9  r1=asind(sind(q)/r)//Angle of reflection in degrees
10 n=w(2)/(w(1)-w(2))//Constant value
11 t=((n*w(1)*10-8)/(2*r*cosd(r1)))/10-4//Thickness
    of the film in cm *10-4
12
13 //Output
14 printf('Thickness of the film is %3.4f *10-4 cm',t)

```

Scilab code Exa 9.3 Angle of wedge

```

1  clc
2  clear
3  //Input data
4  r=1.4//Refractive index of the material
5  w=5893//Wavelength of yellow light in Angstrom
6  n=10//Number of bands
7  w1=0.009//Width of band in m
8
9  //Calculations
10 b=asind((w*10-8)/(2*r*n*w1))//Angle of wedge in
    degrees
11
12 //Output
13 printf('Angle of wedge is %3.4f degrees',b)

```

Scilab code Exa 9.4 Thickness

```
1  clc
2  clear
3  //Input data
4  r=1//Refractive index
5  n=4//Number of bands
6  w=6500//Wavelength in Angstrom
7
8  //Calculations
9  t=((n+(1/2))*w*10^-8)/(2*r))/10^-4//Thickness of
    wedge shaped air film in cm *10^-4
10
11 //Output
12 printf('Thickness of wedge shaped air film is %3.4f
    *10^-4 cm',t)
```

Scilab code Exa 9.5 Radius of curvature

```
1  clc
2  clear
3  //Input data
4  d=0.5//Diameter of the ring in cm
5  n=4//number of bands
6  w=5893//Wavelength of light in Angstrom
7  q=30//Angle at which light enters in degrees
8
9  //Calculations
10 R=((d^2*cosd(q))/(2*(2*n+1)*w*10^-8))//Radius of
    curvature of lens in cm
11
12 //Output
```

```
13 printf('Radius of curvature of lens is %3.1f cm',R)
```

Chapter 10

Diffraction

Scilab code Exa 10.1 Width of central band

```
1  clc
2  clear
3  //Input data
4  D=1//Distance of screen from the slit in m
5  w=6000//Wavelength in Angstrom
6  w1=0.6//Slit width in mm
7
8  //Calculations
9  x=((2*D*w*10^-10)/(w1*10^-3))*1000//Width of central
    band in mm
10
11 //Output
12 printf('Width of central band is %i mm',x)
```

Scilab code Exa 10.2 Wavelength

```
1  clc
2  clear
```

```

3 //Input data
4 d1=6000//Diffraction grating have number of lines
   per cm
5 q=50//Diffracted second order spectral line observed
   in degrees
6 n=2//Second order
7
8 //Calculations
9 w=(sind(q)/(d1*n))*10^8//Wavelength of radiation in
   Angstrom
10
11 //Output
12 printf('Wavelength of radiation is %3.1f Angstrom ',w
   )

```

Scilab code Exa 10.3 Maximum order of diffraction

```

1 clc
2 clear
3 //Input data
4 d1=6000//Diffraction grating have number of lines
   per cm
5 w=6000//Wavelength in Angstrom
6
7 //Calculations
8 n=(1/(d1*w*10^-8))//Maxmum order of diffraction
9
10 //Output
11 printf('Maximum order of diffraction that can be
   observed is %i',n)

```

Scilab code Exa 10.4 Ratio of intensity

```

1  clc
2  clear
3  //Input data
4  B=(3*3.14)/2//First secondary maxima at B
5
6  //Calculations
7  I=(sin(B)/B)^2//Ratio of intensity of central maxima
   to first secondary maxima
8
9  //Output
10 printf('Ratio of intensity of central maxima to
    first secondary maxima is %3.3f',I)

```

Scilab code Exa 10.5 Distance

```

1  clc
2  clear
3  //Input data
4  w=6400//Wave length of light in Angstrom
5  w1=0.3//Slit width in mm
6  d=110//Distance of screen from the slit in cm
7  n=3//order
8
9  //Calculations
10 x=((n*w*10^-10*(d/100))/(w1*10^-3))*1000//Distance
    between the centre of the central maximum and the
    third dark fringe in mm
11
12 //Output
13 printf('Distance between the centre of the central
    maximum and the third dark fringe is %3.2f mm',x)

```

Chapter 11

Polarization

Scilab code Exa 11.1 Polarizing angles

```
1  clc
2  clear
3  //Input data
4  r1=1.538//Refractive index of the crown glass for
   violet
5  r2=1.52//Refractive index of the crown glass for red
6
7  //Calculations
8  ip1=atand(r1)//Polarizing angle in degrees
9  ip2=atand(r2)//Polarizing angle in degrees
10
11 //Output
12 printf('Polarizing angles for violet and red are %3
   .2f degrees and %3.2f degrees ',ip1,ip2)
```

Scilab code Exa 11.2 Angle

```
1  clc
```

```
2 clear
3 //Input data
4 I=0.09//Ratio of observed intensity to the initial
   intensity
5
6 //Calculations
7 q=acosd(sqrt(I))//Angle between the plane of
   transmission of the analyser and that of the
   polarizer in degrees
8
9 //Output
10 printf('Angle between the plane of transmission of
   the analyser and that of the polarizer is %3.2f
   degrees ',q)
```

Chapter 12

Direct Current Circuits

Scilab code Exa 12.e.1 Current

```
1 clc
2 clear
3 //Input data
4 V=10//voltage in V from fig.12.7 on page no.175
5 R=10//Resistance in ohms from fig.12.7 on page no
   .175
6
7 //Calculations
8 I=(V/R)//Current in A
9
10 //Output
11 printf('Current in the circuit shown in fig.12.7 is
   %i A',I)
```

Scilab code Exa 12.e.2 Current

```
1 clc
2 clear
```

```

3 //Input data
4 R=[6,6,3]//Resistances in the circuit from circuit
    diagram 12.9 on page no. 175 in ohms
5 V=[24,16]//Voltages in the circuit from circuit
    diagram 12.9 on page no. 175 in V
6
7 //Calculations
8 Re1=1/((1/R(2))+(1/R(3)))//Equivalent resistance for
    parallel combination in ohms
9 Re=R(1)+Re1//Equivalent resistance of the circuit in
    ohms
10 I1=(V(1)/Re)//Current across the resistors in A
11 pd=(I1*Re1)//Potential difference across A and B
    from circuit diagram 12.9 on page no. 175 in V
12 I2=(pd/R(3))//Current across 3 ohms resistance in A
13 I3=(V(2)/(R(1)+R(2)))//Current in A
14 I=I2+I3//Total current
15
16 //Output
17 printf('The current shown in the circuit is %3.1f A'
    ,I)

```

Scilab code Exa 12.e.3 Thevenins equivalent circuit

```

1 clc
2 clear
3 //Input data
4 R=[4,12,2,12]//Resistances from circuit diagram
    12.12 on page no. 177 in ohms
5 V=12//Voltage in V from circuit diagram 12.12 on
    page no. 177
6
7 //Calculations
8 Rth=((R(1)+R(3))*R(2))/(R(1)+R(3)+R(2))//Equivalent
    resistance in ohms

```

```

9 Vth=(V*R(2))/(R(1)+R(3)+R(2))//Equivalent voltage in
  V
10 I=(Vth/(Rth+R(4)))//Current in A
11
12 //Output
13 printf('The current through the resistor is %3.1f A'
  ,I)

```

Scilab code Exa 12.e.4 Thevenins equivalent circuit

```

1 clc
2 clear
3 //Input data
4 R=[2,3,6]//Resistances from circuit diagram 12.15 on
  page no. 178 in ohms
5 I=2//Current in A from circuit diagram 12.15 on page
  no. 178
6
7 //Calculations
8 Rth=(R(2)+R(3))//Equivalent resistance in ohms
9 Vth=(R(3)*I)//Equivalent voltage in V
10
11 //Output
12 printf('Thevenin equivalent resistance is %i ohms \n
  Thevenin equivalent voltage is %i V',Rth,Vth)

```

Scilab code Exa 12.e.5 Thevenins equivalent circuit

```

1 clc
2 clear
3 //Input data
4 R=[12,8,3,6]//Resistances from circuit diagram 12.17
  on page no.179 in ohms

```

```

5 V=12//Voltage in V from circuit diagram 12.17 on
   page no.179
6
7 //Calculations
8 Rth=((R(3)*R(1))/(R(3)+R(1)))+(R(2)*R(4))/(R(2)+R
   (4))//Equivalent resistance in ohms
9 Vth=2.74//Thevenin voltage taken from the circuit
   diagram 12.19(a) on page no.179 in V
10
11 //Output
12 printf('Thevenin equivalent resistance is %3.2f ohms
   \n Thevenin equivalent voltage is %3.2f V',Rth,
   Vth)

```

Scilab code Exa 12.e.6 Nortons equivalent circuit

```

1 clc
2 clear
3 //Input data
4 R=[4,12,2,12]//Resistances from circuit diagram
   12.20 on page no.180 in ohms
5 V=12//Voltage in V from circuit diagram 12.20 on
   page no.180
6
7 //Calculations
8 RN=((R(1)+R(3))*R(2))/(R(1)+R(3)+R(2))//Equivalent
   resistance in ohms
9 IN=(V/(RN+R(3)))//Equivalent current in A
10
11 //Output
12 printf('Nortons equivalent resistance is %i ohms \n
   Nortons equivalent current is %i A',RN,IN)

```

Scilab code Exa 12.e.7 Nortons equivalent circuit

```
1  clc
2  clear
3  //Input data
4  R=[4,5,6]//Resistances from circuit diagram 12.22 on
      page no.181 in ohms
5  I=2//Current in A from circuit diagram 12.22 on page
      no.181
6
7  //Calculations
8  RN=(R(1)+R(2)+R(3))//Equivalent resistance in ohms
9  IN=(R(1)*I)/RN//Equivalent curren in A
10
11 //Output
12 printf('Nortons equivalent resistance is %i ohms \n
      Nortons equivalent current is %3.3f A',RN,IN)
```

Scilab code Exa 12.1 Current

```
1  clc
2  clear
3  //Input data
4  R=[6,6,12]//Resistances from circuit diagram 12.34
      on page no.192 in ohms
5  V=[5,2]//Voltage in V from circuit diagram 12.20 on
      page no.192
6
7  //Calculations
8  Re=((R(2)*R(3))/(R(2)+R(3)))+R(1)//Equivalent
      resistance in ohms for 5V supply
9  I=V(1)/Re//Equivalent current in A for 5V supply
10 Ve=((R(2)*R(3))/(R(2)+R(3)))*I//Voltage across 5V
      supply in V
11 I1=(Ve/R(3))//Current in A
```

```

12 Re2=(1/((1/(R(1)))+(1/(R(2)))))+R(3)//Equivalent
    resistance in ohms for 2V supply
13 I2=V(2)/Re2//Equivalent current in A for 2V supply
14 Ix=I1-I2//Current through 12 ohm resistance in A
15 Iy=1/Ix//For displaying output in fraction
16
17 //Output
18 printf('The current through %i ohm resistor is 1/%i
    A',R(3),Iy)

```

Scilab code Exa 12.2 Equivalent circuit

```

1 clc
2 clear
3 //Input data
4 R=[3,5,6,7]//Resistances from circuit diagram 12.36(
    a) on page no. 193 in ohms
5 V=12//Voltage in V from circuit diagram 12.36(a) on
    page no. 193
6
7 //Calculations
8 Vth=(V*R(3))/(R(3)+R(4)+R(2))//Equivalent voltage in
    V
9 Rth=R(1)+(((R(2)+R(4))*R(3))/(R(2)+R(4)+R(3)))//
    Equivalent resistance in ohms
10
11 //Output
12 printf('Thevenin equivalent resistance is %i ohms \n
    Thevenin equivalent voltage is %i V',Rth,Vth)

```

Scilab code Exa 12.3 Norton equivalent

```

1 clc

```



```

2 clear
3 //Input data
4 R=[2,3,4]//Resistances from circuit diagram 12.37(a)
   on page no.194 in ohms
5 V=5//Voltage in V from circuit diagram 12.37(a) on
   page no.194
6
7 //Calculations
8 RN=((R(1)+R(2))*R(3))/(R(1)+R(2)+R(3))//Equivalent
   resistance in ohms
9 IN=V/(R(1)+R(2))//Equivalent current in A
10
11 //Output
12 printf('Nortons equivalent resistance is %3.2f ohms
   \n Nortons equivalent current is %i A',RN,IN)

```

Scilab code Exa 12.4 Parameters

```

1 clc
2 clear
3 //Input data
4 C=10*10^-6//Capicitance in F
5 R=10*10^3//Resistance in ohms
6 e=6//Emf of the battery in V
7
8 //Calculations
9 t=C*R//Time constant in s
10 Qm=(C*e)/10^-6//Maximum charge in micro C
11 Im=(e/R)*1000//Maximum current in mA
12
13 //Output
14 printf('Time constant of the circuit is %3.1f s \n
   Maximum charge on the capacitor is %i micro C \n
   Maximum current in the circuit is %3.1f mA \n
   Charge at time t is Q(t) = %i(1-exp(-t/%3.1f))

```

micro C \n Current at time t is $I(t) = \%3.1f \exp(-t/\%3.1f) \text{ mA}$, t, Qm, Im, Qm, t, Im, t)

Scilab code Exa 12.5 Time constant

```
1 clc
2 clear
3 //Input data
4 L=50//Inductance in mH
5 R=5//Resistance in ohms
6 V=6//Volatage of the battery in V
7 t=5//Time in ms
8
9 //Calculations
10 t1=(L/R)//Time constant in ms
11 I=(V/R)*(1-exp(-t/t1))//Current in A
12
13 //Output
14 printf('The time constant of the circuit is %i ms \n
        The current in the circuit is %3.2f A',t1,I)
```

Scilab code Exa 12.6 Parameters

```
1 clc
2 clear
3 //Input data
4 L=6//Inductance in mH
5 C=12//Capacitance in pF
6 V=6//Voltage of the battery in V
7
8 //Calculations
9 f=(1/(2*3.14*sqrt(L*10^-3*C*10^-12)))/10^5//
    Frequency of oscillation in Hz*10^5
```

```
10 Qm=(C*10^-12*V)/10^-12//Maximum charge in C *10^-12
11 Im=(2*3.14*f*10^5*Qm*10^-12)/10^-6//Maximum current
    in micro A
12
13 //Output
14 printf('Frequency of oscillation is %3.2f *10^5 Hz \
    \n The maximum value of charge on capacitor is %i
    *10^-12 C \n The current in the circuit is %i
    micro A',f,Qm,Im)
```

Chapter 13

Alternating Current Circuits

Scilab code Exa 13.1 rms current and maximum current

```
1 clc
2 clear
3 //Input data
4 Vm=100//Maximum voltage in V
5 R=50//resistance in ohms
6
7 //Calculations
8 Vrms=(Vm/sqrt(2))//rms voltage in V
9 Irms=(Vrms/R)//rms current in A
10 Im=(Vm/R)//Maximum current in A
11
12 //Output
13 printf('rms current is %3.2f A and maximum current
         is %i A',Irms,Im)
```

Scilab code Exa 13.2 rms current

```
1 clc
```

```

2 clear
3 //Input data
4 c=50//Capacitor in micro F
5 Vm=220//Maximum voltage in V
6 f=50//Frequency in Hz
7
8 //Calculations
9 Xc=(1/(2*3.14*c*10^-6*f))//Reactance in ohms
10 I=(Vm/Xc)//Maximum current in A
11 Irms=I/sqrt(2)//rms current in A
12
13 //Output
14 printf('rms current is %3.2f A',Irms)

```

Scilab code Exa 13.3 rms current

```

1 clc
2 clear
3 //Input data
4 L=2//Inductance in H
5 Vrms=220//rms voltage in V
6 f=50//Frequency in Hz
7
8 //Calculations
9 Xl=(2*3.14*f*L)//Reactance in ohms
10 Irms=(Vrms/Xl)//rms current in A
11
12 //Output
13 printf('rms current is %3.3f A',Irms)

```

Scilab code Exa 13.4 Maximum potential difference

```

1 clc

```

```

2 clear
3 //Input data
4 Vm=220//Maximum voltage in V
5 f=50//frequency in Hz
6 R=2000//Resistance in ohms
7 C=5*10^-6//Capacitor in F
8
9 //Calculations
10 Xc=(1/(2*3.14*f*C))//Reactance in ohms
11 Z=sqrt(R^2+Xc^2)//Impedance in ohm
12 Vc=(Vm*Xc)/Z//Maximum potential difference across
    the capacitor in V
13
14 //Output
15 printf('Maximum potential difference across the
    capacitor is %3.2f V',Vc)

```

Scilab code Exa 13.5 rms potential difference

```

1 clc
2 clear
3 //Input data
4 R=5000//Resistance in ohms
5 L=2//Inductance in H
6 Vrms=200//rms Voltage in V
7 f=50//Frequency in Hz
8
9 //Calculations
10 Xl=(2*3.14*f*L)//Inductive reactance in ohms
11 Z=sqrt(R^2+Xl^2)//Impedance in ohms
12 Vl=(Vrms*Xl)/Z//rms potential difference across the
    inductor in V
13
14 //Output
15 printf('rms potential difference across the inductor

```

```
is %3.2f V',V1)
```

Scilab code Exa 13.6 Parameters

```
1  clc
2  clear
3  //Input data
4  R=10//Resistance in ohms
5  L=5*10^-3//Inductance in H
6  C=10*10^-6//Capacitance in F
7  V=100//Voltage in V
8  f=50//Frequency in Hz
9
10 //Calculations
11 Xc=(1/(2*3.14*f*C))//Capacitive reactance in ohms
12 Xl=(2*3.14*f*L)//Inductive reactance in ohms
13 Z=sqrt(R^2+(Xl-Xc)^2)//Impedance in ohms
14 I=(V/Z)//Current in A
15 q=atand((Xl-Xc)/R)//Phase angle in degrees
16 Vr=(I*R)//Voltage across resistor in V
17 Vc=(I*Xc)//Voltage across capacitor in V
18 Vl=(I*Xl)//Voltage across inductor in V
19
20 //Output
21 printf('Total impedance is %3.1f ohms \n Current is
        %3.3f A \n Phase angle is %3.2f degrees \n
        Voltage across resistor is %3.2f V \n Voltage
        across capacitor is %3.2f V \n Voltage across
        inductor is %3.3f V',Z,I,q,Vr,Vc,Vl)
```

Scilab code Exa 13.7 Resonating frequency and Q factor

```
1  clc
```

```

2 clear
3 //Input data
4 R=5//Resistance in ohms
5 L=2*10^-3//Inductance in H
6 C=25*10^-6//Capacitance in F
7 V=50//Voltage in V
8
9 //Calculations
10 w=1/sqrt(L*C)//Angular speed in rad/s
11 f=(w/(2*3.14))//Frequency in Hz
12 Q=(w*L)/R//Q factor
13
14 //Output
15 printf('Resonating frequency is %3.2f Hz \n Q factor
        is %3.2f ',f,Q)

```

Scilab code Exa 13.8 Capacitance and resistance

```

1 clc
2 clear
3 //Input data
4 L=(20*10^-3)//Inductance in H
5 Q=8//Q factor
6 f=1000//Frequency in Hz
7
8 //Calculations
9 R=(2*3.14*f*L)/Q//Resistance in ohms
10 C=(1/((2*3.14*f)^2*L))/10^-6//Capacitance in microF
11
12 //Output
13 printf('Capacitance and resistance of coil is %3.2f
        micro F and %3.1f ohms respectively ',C,R)

```

Chapter 15

Motion of a charged particle

Scilab code Exa 15.1 Speed

```
1  clc
2  clear
3  //Input data
4  E=5000//Intensity of electric field in N/C
5  d=0.02//Distance in m
6  e=(1.6*10^-19)//Charge of the electron in C
7  m=(9.1*10^-31)//Mass of the electron in kg
8
9  //Calculations
10 v=sqrt(2*e*E*d/m)/10^6//Speed of the electron in m/s
    *10^6
11
12 //Output
13 printf('Speed of the electron is %3.2f *10^6 m/s',v)
```

Scilab code Exa 15.2 Vertical displacement

```
1  clc
```

```

2  clear
3  //Input data
4  v=(5*10^6) //Velocity of the electron in m/s
5  E=2000 //Intensity of electric field in N/C
6  d=0.06 //Distance in m
7  e=(1.6*10^-19) //Charge of the electron in C
8  m=(9.1*10^-31) //Mass of the electron in kg
9
10
11 //Calculations
12 y=((-e*E*d^2)/(2*m*v^2))*100 //Vertical displacement
    of the electron when it just leaves the electric
    field in cm
13
14 //Output
15 printf('Vertical displacement of the electron when
    it just leaves the electric field is %3.2f cm',y)

```

Scilab code Exa 15.3 Time required

```

1  clc
2  clear
3  v=(4*10^5) //Velocity of the positively charged
    particle in m/s
4  E=300 //Intensity of electric field in N/C
5  e=(1.6*10^-19) //Charge of the positively charged
    particle in C
6  m=(1.67*10^-27) //Mass of the positively charged
    particle in kg
7  q=35 //Angle made by the particle in degrees
8
9  //Calculations
10 t=((v*sind(q)*m)/(e*E))/10^-6 //Time required by the
    particle to reach the maximum height in the
    electric field in micro s

```

```

11
12 //Output
13 printf('Time required by the particle to reach the
    maximum height in the electric field is %3.2f
    micro s ',t)

```

Scilab code Exa 15.4 Orbital speed

```

1 clc
2 clear
3 //Input data
4 r=0.3//Radius of circular orbit in m
5 B=0.38//Magnetic field strength in T
6 e=(1.6*10^-19)//Charge of the proton in C
7 m=(1.672*10^-27)//Mass of the proton in kg
8
9 //Calculations
10 v=((e*B*r)/m)/10^6//Orbital speed of the proton in m
    /s
11
12 //Output
13 printf('Orbital speed of the proton is %3.0f *10^6 m
    /s ',v)

```

Scilab code Exa 15.5 Pitch of helix and radius of trajectory

```

1 clc
2 clear
3 //Input data
4 e=(1.6*10^-19)//Charge of the proton in C
5 m=(1.67*10^-27)//Mass of the proton in kg
6 B=0.8//Magnetic field strength in T

```

```
7 v=[4*10^6,3*10^6]//Velocity of charged particle in
   vxi+vyj form in m/s
8
9 //Calculations
10 p=(v(1)*2*3.14*m)/(e*B)//Pitch of the helix in m
11 R=(m*v(2))/(e*B)//Radius of the trajectory in m
12
13 //Output
14 printf('The pitch of the helix is %3.3f m \n Radius
   of the trajectory is %3.5f m',p,R)
```

Chapter 16

Electrons Ions Isotopes and Nucleus

Scilab code Exa 16.1 Seperation

```
1  clc
2  clear
3  //Input data
4  E=(200*100)//Electric field in V/m
5  B=0.2//Magnetic field in T
6  B1=0.3//Magnetic field in the main chamber in T
7  q=(1.6*10^-19)//Charge of the electron in coulombs
8  m=[12,13]//Carbon isotopes C12 and C13
9  M=(1.67*10^-27)//AMU(Atomic Mass Unit) in kg
10
11 //Calculations
12 v=(E/B)//Velocity in m/s
13 s=(2*v*(m(2)-m(1))*M*100)/(q*B1)//Seperation in cm
14
15 //Output
16 printf('Seperation on photographic plate is %3.4f cm
        ',s)
```

Scilab code Exa 16.2 BE per nucleon

```
1  clc
2  clear
3  //Input data
4  a=20//Atomic number of Ca
5  m=40//mass number of Ca
6  M=39.962591//Mass of Ca nucleus in u
7  mp=1.007276//Mass of proton in AMU
8  mn=1.008665//Mass of neutron in AMU
9
10 //Calculations
11 BE=(1/m)*((a*mp)+(a*mn)-M)*1000//BE per nucleon in
    MeV
12
13 //Output
14 printf('BE per nucleon is %3.6 f MeV',BE)
```

Chapter 17

Quantum Theory

Scilab code Exa 17.1 Maximum kinetic energy

```
1  clc
2  clear
3  //Input data
4  w=4000//Wavelength of the light in Angstrom units
5  wf=2.25//Work function of potassium in eV
6  m=(9.1*10^-31)//Mass of the electron in kg
7  v=(3*10^8)//Velocity of light in m/s
8  c=(1.6*10^-19)//Charge of the electron in coulombs
9  h=6.626*10^-34//Plancks constant in Js
10
11 //Calculations
12 E=(h*v)/(w*10^-10*c)//Energy of incident photon in
    eV
13 KE=(E-wf)//Kinetic energy in eV
14
15 //Output
16 printf('Maximum kinetic energy of photoelectron is
    %3.3f eV',KE)
```

Scilab code Exa 17.2 Stopping potential

```
1  clc
2  clear
3  //Input data
4  wf=1.9//Workfunction of the material in eV
5  w=3000//Wavelength of the light in Angstrom units
6  v=(3*10^8)//Velocity of light in m/s
7  c=(1.6*10^-19)//Charge of the electron in coulombs
8  h=6.626*10^-34//Plancks constant in Js
9
10 //Calculations
11 V=(1/c)*(((h*v)/(w*10^-10))-(wf*c))//Stopping
    potential in V
12
13 //Output
14 printf('Stopping potential is %3.2f V',V)
```

Scilab code Exa 17.3 Shortest wavelength

```
1  clc
2  clear
3  //Input data
4  V=(70*10^3)//Accelerating potential in V
5  v=(3*10^8)//Velocity of light in m/s
6  c=(1.6*10^-19)//Charge of the electron in coulombs
7  h=6.626*10^-34//Plancks constant in Js
8
9  //Calculations
10 lmin=((h*v)/(c*V))/10^-9//Shortest wavelength of X-
    rays produced in mm
11
12 //Output
13 printf('Shortest wavelength of X-rays produced is %3
    .4f mm',lmin)
```

Scilab code Exa 17.4 Wavelength

```
1 clc
2 clear
3 //Input data
4 w1=2//Wavelength in Angstrom
5 Z1=24//Target one
6 Z2=42//Target two
7 a=1//Constant value
8
9 //Calculations
10 w2=w1*((Z1-a)/(Z2-a))^2//Wavelength in Angstrom
11
12 //Output
13 printf('Wavelength is %3.2f Angstrom ',w2)
```

Scilab code Exa 17.5 Wavelength

```
1 clc
2 clear
3 //Input data
4 w=3//Wavelength of the light in Angstrom
5 v=(3*10^8)//Velocity of light in m/s
6 h=6.626*10^-34//Plancks constant in Js
7 q=40//Scattering angle in degrees
8 m=(9.11*10^-31)//Mass of electron in kg
9 c=(1.6*10^-19)//Charge of the electron in coulombs
10
11 //Calculations
12 dl=(h/(m*v))*(1-cosd(q))/10^-10//Wavelength in
    Angstrom
```

```
13 l=(w+d1)//Wavelength of scattered X-rays
14
15 //Output
16 printf('Wavelength of scattered X-rays is %3.6f
    Angstrom ',l)
```
