Scilab Textbook Companion for
Principles of Physics
by P .V. Naik[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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List of Scilab Codes

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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  //-T1cos40+T2cos50=0
10 //T1sin40+T2sin50=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
```

Scilab code Exa 1.5 `Period of rotation`

```
1  clc
2  clear
3  //Input data
4  l=0.95//Length of the strring 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

16

```
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  3 i +4 j  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  %3.2 f  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  %3.2 f  m/ s ' , h , Etotal , 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
```

22

```
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 coloumbs
7
8  //Calculations
9  Re=(m*v^2)/(c*10^6)//Rest energy in MeV
```

23

```
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
```

29

```
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//Diamter 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)//Boltzmans 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 m^2/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*10^5//Pressure at STP in N/m^2
8 T=273//Temperature at STP in K
9
10 //Calculations
11 n=((1/(3.14*d^2))*sqrt((8*k*T*m)/(9*3.14)))/10^-5//
      Viscosity of gas at STP in N.s/m^2
12
13 //Output
14 printf('Viscosity of a gas at STP is %3.5f *10^-5 N.
      s/m^2',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*l)/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 = %3.2f
```

cm, O2F2 = %3.2f cm, O1H1 = %3.2f cm, O2H2 = %3.2f cm\n The system is in air, therfore, nodal points coincide with unit points',O1F1,O2F2,O1H1,O2H2)

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  fl=[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=(fl(1)/fl(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=-(fl(1)/fl(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
```

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```
 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

```scilab
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

```scilab
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`

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```
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  ciriuit  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  circiut  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  %3.1 f  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 //Inut 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
```

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```
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  //Inut 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 Currrent at time t is I(t) = %3.1 f exp
      (-t/%3.1 f) 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 %3.2 f 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//resitance 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)//Impedence 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)//Impedence 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 %3.2 f V',Vl)
```

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)//Impedence 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 impedence is %3.1 f ohms \n Current is
      %3.3 f A \n Phase angle is %3.2 f degrees \n
      Voltage across resistor is %3.2 f V \n Voltage
      across capacitor is %3.2 f V \n Voltage across
      inductor is %3.3 f 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)
```

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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 %3.2 f
        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 %3.0 f *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 coloumbs
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 %3.6f 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 coloumbs
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 coloumbs
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 coloumbs
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 coloumbs
10
11 //Calculations
12 dl=(h/(m*v))*(1-cosd(q))/10^-10//Wavelength in
       Angstrom
```

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