

Scilab Textbook Companion for
Engineering Physics (volume - 2)
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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

De Broglie Matter Waves

Scilab code Exa 1.1 Calculation of de Broglie wavelength of Earth

```
1  clc
2  //given that
3  M = 6e24 // Mass of earth in Kg
4  v = 3e4 // Orbital velocity of earth in m/s
5  h = 6.625e-34 // Plank constant
6
7  printf("Example 1.1")
8  lambda = h/(M*v) // calculation of de Broglie
   wavelength
9
10 printf("\\n de Broglie wavelength of earth is %e m.\\n
    \\n\\n", lambda)
```

Scilab code Exa 1.2 Calculation of de Broglie wavelength of a body

```
1  clc
2  //given that
```

```

3 M = 1 // Mass of object in Kg
4 v = 10 // velocity of object in m/s
5 h = 6.625e-34 // Plank constant
6
7 printf("Example 1.2")
8 lambda = h/(M*v) // calculation of de Broglie
   wavelength
9
10 printf("\n de Broglie wavelength of body is %e m.\n\
   n\n", lambda)

```

Scilab code Exa 1.3 Calculation of de Broglie wavelength of electron

```

1 clc
2 // Given that
3 m = 1e-30 // Mass of any object in Kg
4 v = 1e5 // velocity of object in m/s
5 h = 6.625e-34 // Plank constant
6
7 printf("Example 1.3")
8 lambda = h/(m*v) // calculation of de Broglie
   wavelength
9
10 printf("\n de Broglie wavelength of body is %e m.\n\
   n\n", lambda)

```

Scilab code Exa 1.4 Calculation of velocity momentum and wavelength of electron

```

1 clc

```

```

2 // Given that
3 KE = 4.55e-25 // Kinetic energy of an electron in
    Joule
4 m = 9.1e-31 // Mass of any object in Kg
5 h = 6.62e-34 // Plank constant
6 printf("Example 1.4")
7 v = sqrt(2*KE/m) // Calculation of velocity of
    moving electron
8 p = m*v //Calculation of momentum of moving electron
9 lambda = h/p // calculation of de Broglie wavelength
10 printf("\n velocity of electron is %e m/s.",v)
11 printf("\n momentum of electron is %e Kgm/s.",p)
12 printf("\n de Broglie wavelength of electron is %e m
    .\n\n\n",lambda)

```

Scilab code Exa 1.5 Calculation of de Broglie wavelength of proton

```

1
2 clc
3 //Given that
4 c = 3e8 // speed of light in m/s
5 v = c/20 // Speed of proton in m/s
6 m = 1.67e-27 // Mass of proton in Kg
7 h = 6.625e-34 // Plank constant
8 printf("Example 1.5")
9 lambda = h/(m*v) // calculation of de Broglie
    wavelength
10 printf("\n de Broglie wavelength of proton is %e m.\n
    n\n\n",lambda)
11 // Answer in book is 6.645e-14m which is a
    calculation mistake

```

Scilab code Exa 1.6 Calculation of de Broglie wavelength of neutron

```
1 clc
2 //Given that
3 e = 12.8 // Energy of neutron in MeV
4 c = 3e8 // speed of light in m/s
5 m = 1.675e-27 // Mass of neutron in Kg
6 h = 6.62e-34 // Plank constant
7 printf("Example 1.6")
8 rest_e = m*c^2/(1e6*1.6e-19) // rest mass energy of
   neutron in MeV
9 if e/rest_e < 0.015 then
10     E = e;
11     else E = rest_e +e;
12 end
13 lambda = h/(sqrt(2*m*e*1e6*1.6e-19)) // calculation
   of de Broglie wavelength
14
15 printf("\n de Broglie wavelength of neutron is %e
   angstrom.\n\n\n", lambda*1e10)
16 // Answer in book is 8.04e-5 angstrom which is
   misprinted
```

Scilab code Exa 1.7 Calculation of de Broglie wavelength of electron

```
1 clc
2 //Given that
3 e = 1.632e-19 // charge on electron in coulomb
```

```

4 V = 50 // Applied voltage in volts
5 m = 9.1e-31 // Mass of electron in Kg
6 h = 6.62e-34 // Plank constant
7 printf("Example 1.7")
8
9 lambda = h/(sqrt(2*e*V*m)) // calculation of de
    Broglie wavelength
10 printf("\n de Broglie wavelength of neutron is %f
    angstrom.\n\n\n", lambda*1e10)
11 // Answer in book is 1.735 angstrom which is
    misprinted

```

Scilab code Exa 1.9 Calculation of de Broglie wavelength of electron

```

1 clc
2 //Given that
3 e = 1.6e-19 // charge on electron in coulomb
4 V = 54 // Applied voltage in volts
5 m = 9.1e-31 // Mass of electron in Kg
6 h = 6.63e-34 // Plank constant
7 printf("Example 1.9")
8
9 lambda = h/(sqrt(2*e*V*m)) // calculation of de
    Broglie wavelength
10 printf("\n de Broglie wavelength of neutron is %f
    angstrom.\n\n\n", lambda*1e10)

```

Scilab code Exa 1.10 Calculation of de Broglie wavelength of electron

```

1  clc
2  //Given that
3  E = 10 // Energy of electron in KeV
4  m_e = 9.1e-31 // Mass of electron in Kg
5  h = 6.63e-34 // Plank constant
6  printf("Example 1.10")
7  v = sqrt(2*E*1.6e-16/m_e) // Calculation of velocity
    of moving electron
8  p = m_e*v //Calculation of momentum of moving
    electron
9  lambda = h/p // calculation of de Broglie wavelength
10 printf("\\n velocity of electron is %0.2e m/s.",v)
11 printf("\\n momentum of electron is %.3e Kgm/s.",p)
12 printf("\\n de Broglie wavelength of electron is %.2f
    angstrom.\\n\\n\\n", lambda*1e10)
13 // Answers in book are v = 5.93e6 m/s, p = 5.397e
    -24 kgm/s, lambda = 1.23 angstrom
14 // Which is due to wrong calculation

```

Scilab code Exa 1.11 Calculation of velocity and kinetic energy of neutron

```

1
2  clc
3  //Given that
4  lambda = 1 // de Broglie wavelength of neutron in
    angstrom
5  m = 1.67e-27 // Mass of electron in Kg
6  h = 6.62e-34 // Plank constant
7  printf("Example 1.11")
8
9  v = h/(m*lambda*1e-10) // Calculation of velocity of
    moving neutron
10 E = 1/2*m*v^2 // Calculation of kinetic energy of

```



```

    moving neutron
11 printf("\n velocity of neutron is %e m/s.",v)
12 printf("\n Kinetic energy of neutron is %f eV.\n\n\n
    ",E/1.6e-19)

```

Scilab code Exa 1.12 Calculation of de Broglie wavelength of electron

```

1
2
3 clc
4 //Given that
5 E = 2 // Energy of accelerated electron in KeV
6 m = 9.1e-31 // Mass of electron in Kg
7 h = 6.62e-34 // Plank constant
8 printf("Example 1.12")
9 lambda = h/sqrt(2*m*E*1e3*1.6e-19) // Calculation of
    velocity of moving electron
10 printf("\n Wavelength of electron is %e m.\n\n\n",
    lambda)
11 // Answer in book is 2.74e-12m

```

Scilab code Exa 1.13 Calculation of de Broglie wavelength of proton

```

1
2
3 clc
4 //Given that
5 v = 2e8 // speed of moving proton in m/s
6 c = 3e8 // speed of light in m/s

```

```

7 m = 1.67e-27 // Mass of proton in Kg
8 h = 6.62e-34 // Plank constant
9 printf("Example 1.13")
10 lambda = h/(m*v/sqrt(1-(v/c)^2)) // Calculation of
    velocity of moving electron
11 printf("\n Wavelength of electron is %e angstrom.\n\n",
    lambda*1e10)

```

Scilab code Exa 1.14 Comparison of momentum total energy and ratio of kinetic ener

```

1 clc
2 //given that
3 lambda = 1 // wavelength in m/s
4 m_e = 9.1e-31 // Mass of electron in Kg
5 m_p = 1.67e-27 // Mass of proton in kg
6 c = 3e8 // speed of light in m/s
7 h = 6.63e-34 // Plank constant
8 printf("Example 1.14")
9 p_p = h/(lambda*1e-10) // Momentum of photon
10 p_e = h/(lambda*1e-10) // Momentum of electron
11 E_e = p_e^2/(2*m_e) +m_e*c^2 // Total energy of
    electron
12 E_p = h*c/(lambda*1e-10) // Total energy of photon
13 K_e = p_e^2/(2*m_e) // Kinetic energy of electron
14 K_p = h*c/(lambda*1e-10) // Kinetic energy of photon
15 r_K = K_e/K_p // Ratio of kinetic energies
16 printf("\n Momentum of photon is %e Kgm/s while
    Momentum of electron is %e Kgm/s \n which are
    equal.", p_p, p_e)
17 printf("\n Total Energy of photon is %f KeV while
    Total Energy of electron is %f MeV ", E_p/(1.6e
    -19*1e3), E_e/(1.6e-19*1e6))
18 printf("\n Ratio of kinetic energies is %e \n\n",

```

r_K)

Scilab code Exa 1.15 Calculation of de Broglie wavelength of neutron

```
1
2 clc
3 //Given that
4 e = 25 // Energy of neutron in eV
5 c = 3e8 // speed of light in m/s
6 m = 1.67e-27 // Mass of neutron in Kg
7 h = 6.62e-34 // Plank constant
8 printf("Example 1.15")
9 rest_e = m*c^2/(1e6*1.6e-19) // rest mass energy of
   neutron in MeV
10 if e/rest_e < 0.015 then
11     E = e;
12     else E = rest_e +e;
13 end
14 lambda = h/(sqrt(2*m*e*1.6e-19)) // calculation of
   de Broglie wavelength
15 printf("\\n de Broglie wavelength of neutron is %f
   angstrom.\\n\\n\\n", lambda*1e10)
16 // Answer in book is 8.04e-5 angstrom
```

Scilab code Exa 1.16 Calculation of de Broglie wavelength of alpha particle

```
1 clc
2 //Given that
3 e = 2*1.6e-19 // charge on alpha particle in coulomb
```

```

4 V = 200 // Applied voltage in volts
5 m = 4*1.67e-27 // Mass of alpha particle in Kg
6 h = 6.63e-34 // Plank constant
7 printf("Example 1.16")
8
9 lambda = h/(sqrt(2*e*V*m)) // calculation of de
  Broglie wavelength
10 printf("\n de Broglie wavelength of neutron is %f
  angstrom.\n\n\n", lambda*1e10)
11 // while answer in book is 0.00715 angstrom

```

Scilab code Exa 1.17 Calculation of de Broglie wavelength of a body and electron

```

1 clc
2 //Given that
3 M = 20 // Mass of ball in Kg
4 V = 5 // velocity of of ball in m/s
5 m = 9.1e-31 //Mass of electron in Kg
6 v = 1e6 // velocity of of electron in m/s
7 h = 6.62e-34 // Plank constant
8
9 printf("Example 1.17")
10 lambda_b = h/(M*V) // calculation of de Broglie
  wavelength for ball
11 lambda_e = h/(m*v) // calculation of de Broglie
  wavelength electron
12 printf("\n de Broglie wavelength of ball is %e
  angstrom.",lambda_b*1e10)
13 printf("\n de Broglie wavelength of electron is %f
  angstrom.\n\n\n",lambda_e*1e10)
14 // answer in book is 6.62e-22 angstrom for ball

```

Scilab code Exa 1.18 Calculation of de Broglie wavelength of neutron

```
1
2 clc
3 //Given that
4 E = 1 // Energy of neutron in eV
5 m = 1.67e-27 // Mass of neutron in Kg
6 h = 6.62e-34 // Plank constant
7 printf("Example 1.18")
8 lambda = h/sqrt(2*m*E*1.6e-19) // Calculation of
    velocity of moving electron
9 printf("\\n Wavelength of electron is %f angstrom.\\n\\n",lambda*1e10)
10 // Answer in book is 6.62e-22 angstrom
```

Scilab code Exa 1.19 Calculation of applied voltage

```
1
2 clc
3 //Given that
4 lambda = 0.5 // wavelength of electron in angstrom
5 m = 9.1e-31 // Mass of electron in Kg
6 h = 6.62e-34 // Plank constant
7 q = 1.6e-19 // charge on electron in coulomb
8 printf("Example 1.19")
9 V = h^2/(2*m*q*(lambda*1e-10)^2) // Calculation of
    velocity of moving electron
```

```

10 printf("\n Applied voltage on electron is %f V.\n\n\
    n",V)
11 // Answer in book is 601.6 Volt

```

Scilab code Exa 1.21 Calculation of de Broglie wavelength of neutron at 37 degree

```

1 clc
2 //Given that
3 k = 8.6e-5 // Boltzmann constant
4 t = 37 // Temperature in degree Celsius
5 h = 6.62e-34 // Plank constant
6 m = 1.67e-27 // Mass of neutron
7 printf("Example 1.21")
8 lambda = h/sqrt(3*m*(k*1.6e-19)*(t+273))//
    Calculation of wavelength
9 printf("\n Wavelength of neutron at %d degree
    Celsius is %f angstrom.\n\n\n",t,lambda*1e10)

```

Scilab code Exa 1.22 Calculation of de Broglie wavelength of Helium at 27 degree C

```

1 clc
2 //Given that
3 k = 8.6e-5 // Boltzmann constant
4 t = 27 // Temperature in degree Celsius
5 h = 6.62e-34 // Plank constant
6 m = 6.7e-27 // Mass of helium atom
7 printf("Example 1.22")
8 lambda = h/sqrt(3*m*(k*1.6e-19)*(t+273))//
    Calculation of wavelength

```

```
9 printf("\n Wavelength of helium at %d degree Celsius
      is %f angstrom.\n\n\n",t,lambda*1e10)
```

Scilab code Exa 1.23 Calculation of inter atomic spacing for crystal

```
1 clc
2 //Given that
3 E = 200 // energy of electrons in eV
4 x = 20 // distance of screen in cm
5 D = 2 // diameter of ring in cm
6 h = 6.62e-34 // Plank constant
7 m = 9.1e-31 // Mass of electron in kg
8 printf("Example 1.23")
9 lambda = h/sqrt(2*m*E*1.6e-19) // Calculation of
      wavelength
10 theta = atan(D/(2*x))
11 d = lambda/(2*sin(theta))// calculation of
      interatomic spacing of crystal
12 printf("\n Interatomic spacing of crystal is %f
      angstrom.\n\n\n",d*1e10)
```

Scilab code Exa 1.24 Calculation of velocity of electron in Bohr orbit

```
1
2 clc
3 //Given that
4 r = 0.5 // Bohr radius of hydrogen in angstrom
5 m = 9.1e-31 // Mass of neutron in Kg
6 h = 6.6e-34 // Plank constant
```

```

7 printf("Example 1.24")
8 v = h/(2*%pi*r*1e-10*m) // velocity of electron in
    ground state
9 printf("\n Velocity of electron in ground state is
    %e m/s.\n\n\n",v)
10 // Answer in book is 2.31e6 m/s

```

Scilab code Exa 1.25 Calculation of velocity of electron so that de Broglie wavele

```

1
2 clc
3 //Given that
4 lambda = 5890 // wavelength of yellow radiation in
    angstrom
5 m = 9.1e-31 // Mass of neutron in Kg
6 h = 6.63e-34 // Plank constant
7 printf("Example 1.25")
8 v = h/(lambda*1e-10*m) // velocity of electron in
    ground state
9 printf("\n Velocity of electron in ground state is
    %e m/s.\n\n\n",v)
10 // Answer in book is 1.24e3 m/s

```

Scilab code Exa 1.26 Calculation of velocity and kinetic energy of neutron

```

1
2 clc
3 //Given that
4 lambda = 2 // wavelength of neutron in angstrom

```



```

5 m = 1.67e-27 // Mass of neutron in Kg
6 h = 6.63e-34 // Plank constant
7 printf("Example 1.26")
8 v = h/(lambda*1e-10*m) // velocity of neutron
9 k = 0.5*m*v^2 // Kinetic energy of neutron
10 printf("\n Velocity of neutron is %e m/s.",v)
11 printf("\n Kinetic energy of neutron is %f eV.\n\n\n
    ",k/1.6e-19)
12 // Answer in book is 0.021eV

```

Scilab code Exa 1.29 Calculation of angle for first order diffraction

```

1 clc
2 //given that
3 v1 = 50 // Previous applied voltage
4 v2 = 65 // final applied voltage
5 k = 12.28
6 d = 0.91 // Spacing in a crystal in angstrom
7 printf("Example 1.29")
8
9 lambda = k/sqrt(v1)
10 theta= asin(lambda/(2*d))// Angel for initial
    applied voltage
11 lambda1 = k/sqrt(v2)// wavelength for final applied
    voltage
12 theta1 = asin(lambda1/(2*d))// Angel for final
    applied voltage
13 printf("\n For first order , sin(theta) is %f \n For
    second order sin(theta) must be %f \n which is
    not possible for any value of angle. \n So no
    maxima occur for higher orders \n\n\n",sin(theta)
    ,2*sin(theta))
14 printf("\n Angle of diffraction for first order of

```

```

        beam \n is %f degree at %d Volts\n\n\n",theta1
        *180/%pi,v2)
15 // Answer in book is 57.14 degree

```

Scilab code Exa 1.30 Calculation of group velocity and phase velocity of wave

```

1 clc
2 //Given that
3 lambda = 680 // Wavelength in m
4 g = 9.8 //Acceleration due to gravity
5 printf("Example 1.30")
6 v_g = 1/2*sqrt(g*lambda/(2*pi)) // Calculation of
    group velocity
7 printf("\n Group velocity of seawater waves is %f m/
    s.\n\n\n",v_g)
8 // Answer in book is 16.29 m/s

```

Scilab code Exa 1.32 Calculation of group velocity and phase velocity of wave

```

1 clc
2 //Given that
3 lambda = 2e-13 // de Broglie wavelength of an
    electron in m
4 c = 3e8 // Speed of light in m/s
5 m = 9.1e-31 // Mass of electron in Kg
6 h = 6.63e-34 // Plank constant
7 printf("Example 1.32")
8 E = h*c/(lambda*1.6e-19)

```

```

9 E_rest = m*c^2/(1.6e-19) // Calculation of rest mass
  energy
10 E_total = sqrt(E^2+E_rest^2) // Total energy in eV
11 v_g = c*sqrt(1-(E_rest/E_total)^2) // Group velocity
12 v_p = c^2/v_g // Phase velocity
13 printf("\n Group velocity of de Broglie waves is %fc
  and\n phase velocity is %fc .\n\n\n",v_g/c,v_p/
  c)

```

Scilab code Exa 1.33 Calculation of kinetic energy group velocity and phase velocity

```

1
2 clc
3 //Given that
4 lambda = 2e-12 // de Broglie wavelength of an
  electron in m
5 c = 3e8 // Speed of light in m/s
6 m = 9.1e-31 // Mass of electron in Kg
7 h = 6.63e-34 // Plank constant
8 printf("Example 1.33")
9 E = h*c/(lambda*1.6e-19) // Energy due to momentum
10 E_rest = m*c^2/(1.6e-19) // Calculation of rest mass
  energy
11 E_total = sqrt(E^2+E_rest^2) // Total energy in eV
12 KE = E_total - E_rest // Kinetic energy
13 v_g = c*sqrt(1-(E_rest/E_total)^2) // Group velocity
14 v_p = c^2/v_g // Phase velocity
15
16 printf("\n Kinetic energy of electron is %f KeV.",KE
  /1000)
17 printf("\n Group velocity of de Broglie waves is %fc
  m/s and\n phase velocity is %fc m/s.\n\n\n",v_g/
  c,v_p/c)

```

18 // Answer in book is $v_g = 0.6035c$ & $v_p = 1.657c$

Chapter 2

Uncertainty Principle and Schrodinger wave Equation

Scilab code Exa 2.1 Calculation of uncertainty in momentum of electron

```
1  clc
2  //given that
3  del_x = 0.2 // Uncertainty in position in angstrom
4  h = 6.63e-34 // Plank constant
5
6  printf("Example 2.1")
7  h_bar = h / (2*%pi) // constant
8  del_p = h_bar/(2*del_x*1e-10) // Calculation of
   uncertainty in momentum
9  printf("\\n Uncertainty in momentum of particle is %e
   kgm/sec \\n\\n\\n",del_p)
```

Scilab code Exa 2.2 Calculation of minimum uncertainty in momentum of electron

```

1
2 clc
3 //given that
4 del_x = 4e-10 // Uncertainty in position in m
5 h = 6.63e-34 // Plank constant
6
7 printf("Example 2.2")
8 h_bar = h / (2*%pi) // constant
9 del_p = h_bar/(2*del_x) // Calculation of
    uncertainty in momentum
10 printf("\\n Uncertainty in momentum of particle is %e
    kgm/sec.\\n\\n\\n",del_p)
11 // Answer in book is given as 1.32e-23 kgm/sec

```

Scilab code Exa 2.3 Calculation of minimum uncertainty in position of electron

```

1 clc
2
3 //given that
4 v = 3e7 // Velocity of moving electron in m/s
5 m = 9.1e-31 // mass of electron in kg
6 h = 6.63e-34 // Plank constant
7 c = 3e8 // speed of light in m/s
8 printf("Example 2.3")
9 h_bar = h / (2*%pi) // constant
10 del_p = m*v/(sqrt(1-(v/c)^2)) // calculation of
    uncertainty in momentum
11 del_x = h_bar/(2*del_p) // Calculation of
    uncertainty in position
12 printf("\\n Uncertainty in position of particle is %f
    angstrom.\\n\\n\\n",del_x*1e10)
13 //Answer in book is 0.0194 angstrom which is due to
    using approximate values at intermediate steps

```

Scilab code Exa 2.5 Calculation of minimum uncertainty in position of electron

```
1 clc
2 //given that
3 v = 1.05e4 // Velocity of moving electron in m/s
4 v_error = 0.02 //Percentage error in measurement of
   velocity
5
6 m = 9e-31 // mass of electron in kg
7 h = 6.63e-34 // Plank constant
8 printf("Example 2.5")
9 h_bar = h / (2*pi) // constant
10 p = m*v
11 del_p = v_error*p/100 // calculation of uncertainty
   in momentum
12 del_x = h_bar/del_p
13 printf("\n Uncertainty in position of particle is %e
   m.\n\n",del_x)
14 // Answer in book is given as 5.58e-3 m
```

Scilab code Exa 2.6 Calculation of minimum uncertainty in position of electron

```
1 clc
2 //given that
3 v = 600 // Velocity of moving electron in m/s
4 v_error = 0.005 //Percentage error in measurement of
   velocity
```

```

5 m = 9.1e-31 // mass of electron in kg
6 h = 6.63e-34 // Plank constant
7 printf("Example 2.6")
8 h_bar = h / (2*pi) // constant
9 p = m*v
10 del_p = v_error*p/100 // calculation of uncertainty
    in momentum
11 del_x = h_bar/(del_p) // Calculation of uncertainty
    in position
12 printf("\n Uncertainty in position of particle is %e
    m.\n\n",del_x)
13 // Answer in book is 0.39e-2 m

```

Scilab code Exa 2.7 Comparison of uncertainty in velocities of electron and proton

```

1 clc
2 //given that
3 del_x = 1 // let uncertainty in position is unity
4 m_e = 9.1e-31 // mass of electron in kg
5 m_p = 1.67e-27 // mass of proton in kg
6 h = 6.63e-34 // Plank constant
7 printf("Example 2.7")
8 h_bar = h / (2*pi) // constant
9 del_v_ratio = m_p/m_e // calculation in
    uncertainties in the velocity of electron and
    proton
10 printf("\n Ratio of uncertainties in the velocity of
    electron to proton is %d.\n\n",del_v_ratio)

```

Scilab code Exa 2.8 Calculation of kinetic energy of H atom needed for confinement

```
1 clc
2 //given that
3 r = 0.5 // radius of hydrogen atom in angstrom
4 m_e = 9.1e-31 // mass of electron in kg
5 h = 6.63e-34 // Plank constant
6 printf("Example 2.8")
7 h_bar = h / (2*%pi) // constant
8 del_x = 2*r // calculation of uncertainty in
    position
9 del_p = h_bar/(2*del_x*1e-10) // calculation of
    uncertainty in momentum
10 p = del_p
11 E = p^2/(2*m_e*1.6e-19) // Calculation of energy in
    eV
12 printf("\n Kinetic energy needed by an electron to
    be \n confined in electron is %f eV.\n\n\n",ceil(
    E*100)/100)
```

Scilab code Exa 2.9 Calculation of uncertainty in position of electron

```
1 clc
2 //given that
3 v = 5e3 // Velocity of moving electron in m/s
4 v_error = 0.003 //Percentage error in measurement of
    velocity
5
6 m = 9.1e-31 // mass of electron in kg
7 h = 6.63e-34 // Plank constant
8 printf("Example 2.9")
9 h_bar = h / (2*%pi) // constant
10 p = m*v
```

```

11 del_p = v_error*p/100 // calculation of uncertainty
    in momentum
12 del_x = h_bar/(2*del_p) // Calculation of
    uncertainty in position
13 printf("\n Uncertainty in position of particle is %e
    m.\n\n",del_x)

```

Scilab code Exa 2.10 Calculation of minimum energy with which an electron can exist

```

1  clc
2
3  //given that
4  r = 0.53 // radius of hydrogen atom in angstrom
5  m_e = 9.1e-31 // mass of electron in kg
6  h = 6.63e-34 // Plank constant
7  printf("Example 2.10")
8  h_bar = h / (2*pi) // constant
9  del_x = 2*r // calculation of uncertainty in
    position
10 del_p = h_bar/(2*del_x*1e-10) // calculation of
    uncertainty in momentum
11 p = del_p
12 E = p^2/(2*m_e*1.6e-19) // Calculation of energy in
    eV
13 printf("\n Kinetic energy needed by an electron to
    be \n confined in electron is %f eV.\n\n",E)
14 // When problem is solved by del_x*del_p = h_bar,
    then minimum value of kinetic energy will become
    13.6eV

```

Scilab code Exa 2.11 Calculation of minimum uncertainty in energy of state in Hydro

```
1 clc
2
3 //given that
4 del_t = 2.5e-14 // lifetime in excited state in micro
   sec
5 h = 6.63e-34 // Plank constant
6 printf("Example 2.11")
7 h_bar = h / (2*pi) // constant
8 del_E = h_bar/(1.6e-19*del_t*1e-6) // calculation of
   uncertainty in momentum
9 printf("\n Minimum error in measurement of energy of
   this state is %e eV.\n\n\n",del_E)
```

Scilab code Exa 2.12 Calculation of percentage uncertainty in momentum of electron

```
1 clc
2
3 //given that
4 E_eV = 0.5 // kinetic energy of electron in KeV
5 del_x = 0.4 // Uncertainty in position in nm
6 h = 6.63e-34 // Plank constant
7 m = 9.1e-31 // mass of electron in kg
8 printf("Example 2.12")
9 h_bar = h / (2*pi) // constant
10 E_J = E_eV*1e3*1.6e-19
```

```

11 p = sqrt(2*m*E_J) // Calculation of momentum in kgm/
    s
12 del_p = h_bar/(2*del_x*1e-9) // Calculation of
    uncertainty in momentum
13 per_error = del_p*100 / p // calculation of
    percentage error in momentum
14 printf("\n Percentage error in momentum is %f
    percent.\n\n\n",per_error)
15 // Answer in book is 1.08 percentage

```

Scilab code Exa 2.13 Calculation of minimum uncertainty in measurement of velocity

```

1 clc
2
3 //given that
4 del_x = 2e-9 // Uncertainty in position in m
5 h = 6.63e-34 // Plank constant
6 m = 9.1e-31 // mass of electron in Kg
7 printf("Example 2.13")
8 h_bar = h / (2*pi) // constant
9 del_p = h_bar/(2*del_x) // Calculation of
    uncertainty in momentum
10 del_v = del_p/m
11 printf("\n Uncertainty in velocity of particle is %e
    m/s.\n\n\n",del_v)

```

Scilab code Exa 2.15 Calculation of uncertainty in momentum of ball and comparison

```

1 clc

```

```

2
3 //given that
4 del_x = 5000 // Uncertainty in position in angstrom
5 h = 6.63e-34 // Plank constant
6 m = 200 // mass of ball in gram
7 v = 6 // velocity of moving ball in m/s
8 printf("Example 2.15")
9 h_bar = h / (2*pi) // constant
10 del_p = h_bar/(2*del_x*1e-10) // Calculation of
    uncertainty in momentum
11 p = m*v/1000 // Calculation of momentum
12 per_error = del_p*100/p // Calculation of percentage
    error in calculation of momentum
13 printf("\n Uncertainty in momentum of ball is %e kgm
    /s.",del_p)
14 printf("\n Percentage error in calculation of
    momentum is %e.\n\n\n",per_error)

```

Scilab code Exa 2.16 Calculation of uncertainty in position of proton

```

1 clc
2
3 //given that
4 c = 3e8 // speed of light in m/s
5 v = c/10 // Velocity of moving proton in m/s
6 v_error = 1 // Percentage error in measurement of
    velocity
7 m = 1.67e-27 // mass of electron in kg
8 h = 6.63e-34 // Plank constant
9
10 printf("Example 2.16")
11 h_bar = h / (2*pi) // constant
12 del_v = v*v_error/100// calculation of uncertainty

```

```

    in position
13 del_x = h_bar/(2*m*del_v) // calculation of
    uncertainty in momentum
14 printf("\n Uncertainty in position of particle is %e
    m.\n\n\n",del_x)
15 // Answer in book is 1.04e-13 m

```

Scilab code Exa 2.17 Calculation of uncertainty in velocity of ball

```

1  clc
2
3  //given that
4  del_x = 1e-9 // Uncertainty in position in m
5  h = 6.63e-34 // Plank constant
6  m = 200 // mass of ball in gram
7  printf("Example 2.17")
8  h_bar = h / (2*pi) // constant
9  del_v = h_bar/(2*del_x*m/1000) // Calculation of
    uncertainty in momentum
10 printf("\n Uncertainty in velocity of ball is %e m/s
    .\n\n\n",del_v)
11 // Answer in book is 2.64e-25 m/s

```

Scilab code Exa 2.18 Calculation of uncertainty in energy of gamma ray radiation

```

1  clc
2  //given that
3  del_t = 2e-12 // lifetime of exited state in sec
4  h = 6.63e-34 // Plank constant

```

```

5 printf("Example 2.18")
6 h_bar = h / (2*pi) // constant
7 del_E = h_bar/(1.6e-19*2*del_t) // calculation of
    uncertainty in momentum
8 printf("\n Minimum error in measurement of energy of
    this state is %e eV.\n\n",del_E)
9 // Answer in book is 1.65e-4 eV

```

Scilab code Exa 2.19 Calculation of uncertainty in frequency of photon

```

1 clc
2 //given that
3 del_t = 1e-8 // lifetime of excited state in sec
4 h = 6.63e-34 // Plank constant
5 printf("Example 2.19")
6 h_bar = h / (2*pi) // constant
7 del_nu = h_bar/(2*del_t*h) // calculation of
    uncertainty in frequency
8 printf("\n Minimum error in measurement of \n
    frequency of photon is %e per second.\n\n",
    del_nu)
9 // Answer in book is 8e6 per second

```

Scilab code Exa 2.20 Calculation of uncertainty in position of dust particle

```

1 clc
2 //given that
3 del_v = 5.5e-20 // Uncertainty in velocity in m/s
4 h = 6.63e-34 // Plank constant

```

```

5 m = 1 // mass of dust particle in mg
6 printf("Example 2.20")
7 h_bar = h / (2*pi) // constant
8 del_x = h_bar/(2*del_v*m*1e-6) // Calculation of
    uncertainty in momentum
9 printf("\n Uncertainty in position of ball is %f
    angstrom.\n\n\n",del_x*1e10)
10 // Answer in book is 9.6 angstrom

```

Scilab code Exa 2.21 Calculation of energy of moving electron

```

1 clc
2
3
4 //given that
5 l = 1 // width of potential well in angstrom
6 n = 1 // order corresponding to ground state
7 h = 6.63e-34 // Plank constant
8 m = 9.1e-31 // mass of electron in Kg
9 printf("Example 2.21")
10 E = n^2*h^2/(8*m*(1*1e-10)^2) // Calculation of
    energy in Joule
11 E_eV = E/1.6e-19 // Calculation of energy in eV
12
13 printf("\n Energy of electron is %f eV.\n\n\n",E_eV)
14 // Answer in book is 37.74 eV angstrom

```

Scilab code Exa 2.24 Calculation of lowest permitted energy value of electrons


```

1  clc
2
3  //given that
4  l = 2.5e-10 // width of potential well in m
5  h = 6.63e-34 // Plank constant
6  m = 9.1e-31 // mass of electron in Kg
7  printf("Example 2.24")
8  for n = 1:2
9      E = n^2*h^2/(8*m*l^2) // Calculation of energy
        in Joule
10 E_eV = E/1.6e-19 // Calculation of energy in eV
11
12 printf("\n Energy of electron for state %d is %f eV.
        ",n,E_eV);
13 end

```

Scilab code Exa 2.26 Calculate probability of particle

```

1  clc
2  // given that
3  L = 1 // let unit length
4  l1 = 0.45*L // initial point
5  l2 = 0.55*L // Final point
6
7
8  printf("Example 2.26 \n")
9  p = (1/L)*((12-(L/(2*pi) *sin(2*l2*pi/L)))- (11-(L
        /(2*pi) *sin(2*l1*pi/L)))) // Calculation of
        probability of finding particle
10 p_per = p*100 // probability of finding particle in
        percentage
11 printf("\n Probability of finding electron between \
        n %fL and %fL is %f percent.",l2,l1,p_per)

```

Scilab code Exa 2.27 Calculation of energy difference between two states

```
1 clc
2
3
4 //given that
5 l = 1e-8 // width of potential well in cm
6 h = 6.63e-34 // Plank constant
7 m = 9.1e-31 // mass of electron in Kg
8 printf("\nExample 2.27")
9 E_1 = (h)^2/(8*m*(1*1e-2)^2) // Calculation of
    energy of ground state in Joule
10 E_1_eV = E_1/1.6e-19 // Calculation of energy in eV
11 E_2 = (2)^2*h^2/(8*m*(1*1e-2)^2) // Calculation of
    energy of first state in Joule
12 E_2_eV = E_2/1.6e-19 // Calculation of energy in eV
13 del_E = E_2_eV - E_1_eV // calculation of difference
    between first state and ground state
14 printf("\n Difference between first state \n and
    ground state energies is %f eV.\n\n\n",del_E);
15 // Answer in book is 113.04 eV
```

Scilab code Exa 2.28 Calculation of de Broglie wavelength representing first three

```
1 clc
2
3 //given that
```

```

4 l = 1 // width of potential well in angstrom
5 h = 6.63e-34 // Plank constant
6 m = 9.1e-31 // mass of electron in Kg
7 printf("Example 2.28")
8 for n = 1:3
9     lambda = 2*l/n // Calculation of wavelength
10    E = n^2*h^2/(8*m*(1*1e-10)^2) // Calculation of
        energy in Joule
11 E_eV = E/1.6e-19 // Calculation of energy in eV
12 printf("\n For state:%d Energy is %f eV &
        wavelength is %f angstrom ",n,E_eV,lambda);
13 end

```

Scilab code Exa 2.29 Can we observe energy states of a ball

```

1 clc
2
3 //given that
4 m = 100 //mass of ball in gram
5 l = 1 // length of box in m
6 h = 6.63e-34 // Plank constant
7 printf("\nExample 2.29")
8 for n = 1:3
9     E = (n^2*h^2)/(8*m*1e-3*1^2*1.6e-19)
10    printf("\n Energy state E%d of ball is %e eV"
        ,n,E)
11 end
12 printf("\n As energy difference is very small so we
        cannot see energy states.\n")

```

Scilab code Exa 2.30 Calculation of probability of finding particle in given length

```
1  clc
2
3  //given that
4  l = 30 // width of potential well in angstrom
5  x = l/2
6  del_x = 2 // interval of length at centre in
   angstrom
7  h = 6.63e-34 // Plank constant
8  n = 1 // ground state
9  printf("\nExample 2.30")
10 phi_x = ((sqrt(2/l))*sin(n*pi*x/l))^2
11 p = phi_x*del_x // Calculation of probability at
   centre
12 printf("\n Probability of finding particle at centre
   is %d percent.\n\n\n",p*100)
13 // Answer given in book is 16 percent. It is due to
   wrong calculation
```

Chapter 3

X ray and Compton Effect

Scilab code Exa 3.1 Calculation of longest wavelength which can be analyzed by roc

```
1  clc
2  //given that
3  d = 2.82 // crystal spacing in angstrom
4  n = 2 // order for longest passing wavelength
5  theta = 90 // angle for longest passing wavelength
6  printf("Example 3.1")
7  lambda = 2*d*sin(theta*pi/180)/n // Calculation of
   longest wavelength
8
9  printf("\n Longest wavelength is %f angstrom. \n\n\n
   ",lambda)
```

Scilab code Exa 3.2 Calculation of angles at which second and third order Braggs d

```
1  clc
2  //given that
3  lambda = 0.3 // Wavelength in angstrom
```

```

4 d = 0.5 // crystal spacing in angstrom
5 n = 2 // order
6 m = 3 // order
7 printf("Example 3.2")
8 theta_n = asin(n*lambda/(2*d))*180/%pi //
    Calculation of angle for order n
9 theta_m = asin(m*lambda/(2*d))*180/%pi //
    Calculation of angle for order m
10
11 printf("\nAngle for %dnd order maxima is %f degree.
    ",n,theta_n)
12 printf("\nAngle for %drd order maxima is %f degree.
    \n\n\n",m,theta_m)
13 // Answers in book are 40.97 degree and 72.29 degree
    which are due to wrong calculation

```

Scilab code Exa 3.3 Calculation of wavelength

```

1
2
3 clc
4 //given that
5 d = 1.87 // crystal spacing in angstrom
6 n = 2 // order for longest passing wavelength
7 theta = 30 // angle for longest passing wavelength
8 printf("Example 3.3")
9 lambda = 2*d*sin(theta*%pi/180)/n // Calculation of
    longest wavelength
10
11 printf("\n Longest wavelength is %f angstrom. \n\n\n
    ",lambda)

```

Scilab code Exa 3.4 Calculation for inter plane separation of atomic planes

```
1  clc
2  //given that
3  lambda = 3.6e-9 // Wavelength in cm
4  theta = 4.8 // glancing angle in degree
5  n = 1 // order
6
7  printf("Example 3.4")
8  d = n*lambda/(2*sin(theta*pi/180)) // calculation
   of crystal spacing in angstrom
9
10 printf("\n Crystal spacing in angstrom is %e cm. \n\
    n\n",d)
```

Scilab code Exa 3.5 Calculation of wavelength of X ray used

```
1  clc
2  //given that
3  d = 2.5 // crystal spacing in angstrom
4  n = 1 // order for longest passing wavelength
5  theta = 20 // angle for longest passing wavelength
6  printf("Example 3.5")
7  lambda = 2*d*sin(theta*pi/180)/n // Calculation of
   longest wavelength
8
9  printf("\nLongest wavelength is %f angstrom. \n\n\n",
    ,lambda)
```

Scilab code Exa 3.6 Calculation of longest wavelength which can be analyzed by roc

```
1  clc
2  //given that
3  d = 2.5 // crystal spacing in angstrom
4  n = 1 // order for longest passing wavelength
5  theta = 90 // angle for longest passing wavelength
6  printf("Example 3.6")
7  lambda = 2*d*sin(theta*pi/180)/n // Calculation of
   longest wavelength
8
9  printf("\nLongest wavelength is of %d angstrom. \n\
n\n", lambda)
```

Scilab code Exa 3.7 Show that given crystal is simple cubic crystal

```
1  clc
2  // given that
3  theta1_deg = 5 // Absolut degree part of angle for
   first angle
4  theta1_min = 23//remainder minute part of angle for
   first angle
5  theta2_deg = 7 // Absolut degree part of angle for
   second angle
6  theta2_min = 37//remainder minute part of angle for
   second angle
7  theta3_deg = 9 // Absolut degree part of angle for
   third angle
```



```

8 theta3_min = 25//remainder minute part of angle for
   third angle
9
10 printf("Example 3.7 \n")
11 val1 = sin((theta1_deg+ theta1_min/60)*%pi/180)//
   Sin value for first angle
12 val2 = sin((theta2_deg+ theta2_min/60)*%pi/180) //
   Sin value for second angle
13 val3 = sin((theta3_deg+ theta3_min/60)*%pi/180)//Sin
   value for third angle
14 ratio_21 = val2/val1
15 ratio_31 = val3/val1
16 printf("\n Interatomic layer separation ratios in
   crystal are as\n 1 : %f : %f",ratio_21,ratio_31)
17 printf("\n Above relation shows that crystal is
   simple cubic crystal structure.")

```

Scilab code Exa 3.8 Calculation of possible spacing

```

1  clc
2  //given that
3  lambda = 1.2 // wavelength in angstrom
4  theta_deg = 9 // angle fraction in degree
5  theta_min = 30 // Angle fraction in minute
6  printf("Example 3.8\n")
7  theta = theta_deg+theta_min/60 // Total angel
8  for n = 1:4
9      d = lambda/(n*2*sin(theta*%pi/180)) // Inter
   layer spacing
10     printf(" If order is %d then spacing is %f
   angstrom.\n",n,d)
11 end

```

Scilab code Exa 3.9 Determining the spacing of crystal

```
1  clc
2  //given that
3  h = 6.62e-34 // Planks constant
4  m_e = 9.1e-31 // mass of electron in kg
5  e = 1.6e-19 // charge on electron in coulomb
6  v = 340 // Applied voltage in volt
7  n = 1 // order for longest passing wavelength
8  theta = 60 // angle for longest passing wavelength
9  printf("Example 3.9")
10 lambda= h/sqrt(2*m_e*e*v) // calculation of
    wavelength
11 d = n*lambda/(2*sin(theta*%pi/180))// calculation of
    spacing of crystal
12
13 printf(" \nSpacing of crystal is %f angstrom. \n\n\n"
    ,d*1e10)
```

Scilab code Exa 3.10 Calculate the energy of recoiled electron

```
1  clc
2  //given that
3  E = 100 // Energy of X ray beam in KeV
4  theta = 30 // Scattering angle in degree
5  m = 9.1e-31 // mass of electron in kg
6  c = 3e8 // Speed of light in m/s
7  printf("Example 3.10")
```

```

8 E_rest = m*c^2/(1.6e-19*1e3) // Rest mass energy in
  KeV
9 k = 1/E + (1-cos(theta*pi/180))/(E_rest)
10 del_e = E - 1/k // Energy of recoiled electron
11 printf("\n Energy of recoiled electron is %f
      KeV\n\n\n",del_e)

```

Scilab code Exa 3.11 Calculation of Compton shift

```

1  clc
2  //given that
3  lambda = 1 //wavelength in angstrom
4  h = 6.62e-34 // Planks constant
5  m_e = 9.1e-31 // mass of electron in kg
6  c = 3e8 // speed of light in m/sec
7  theta = 90 // angle for longest passing wavelength
8  printf("Example 3.11")
9  d_lambda= h*(1-cos(theta*pi/180))/(m_e*c) //
  calculation of wavelength shift
10
11 printf("\nWavelength shift is %f angstrom. \n\n\n",
      d_lambda*1e10)

```

Scilab code Exa 3.12 Calculation of wavelength of scattered radiation

```

1  clc
2  //given that
3  lambda = 0.015 //wavelength in angstrom
4  h = 6.63e-34 // Planks constant

```

```

5 m_e = 9.1e-31 // mass of electron in kg
6 c = 3e8 // speed of light in m/sec
7 theta = 60 // angle for longest passing wavelength
8 printf("Example 3.12")
9 d_lambda= h*(1-cos(theta*pi/180))*1e10/(m_e*c) //
    calculation of wavelength shift in angstrom
10 lambda_n = lambda+d_lambda
11
12 printf("\n Wavelength shift is %f angstrom. \n\n\n",
    lambda_n)

```

Scilab code Exa 3.13 Calculation of Compton shift kinetic energy imported to the r

```

1  clc
2  //given that
3  lambda = 1 //wavelength in angstrom
4  h = 6.63e-34 // Planks constant
5  m_e = 9.1e-31 // mass of electron in kg
6  c = 3e8 // speed of light in m/sec
7  theta = 90 // angle for longest passing wavelength
8  printf("Example 3.13")
9  d_lambda= h*(1-cos(theta*pi/180))*1e10/(m_e*c) //
    calculation of wavelength shift in angstrom
10 lambda_n = lambda+d_lambda // Calculation of
    recoiled electron wavelength
11 d_E = h*c*(lambda_n-lambda)*1e10/(1.6e-19*lambda_n*
    lambda)// Calculation of recoiled electron energy
    in eV
12 printf("\nWavelength shift is %f angstrom.",lambda_n
    )
13 printf("\nEnergy of recoiled electron is %deV. \n\n\
    n",ceil (d_E))

```

Scilab code Exa 3.14 Calculation of wavelength and energy of incident photon

```
1  clc
2  //given that
3  lambda = 1 //let wavelength in angstrom
4  lambda_n = 2*lambda // recoiled electron wavelength
5  h = 6.63e-34 // Planks constant
6  m_e = 9.1e-31 // mass of electron in kg
7  c = 3e8 // speed of light in m/sec
8  theta = 90 // angle for longest passing wavelength
9  printf("Example 3.14")
10 lambda = h*1e10/(m_e*c) // calculation of wavelength
    in angstrom
11 E = h*c*1e10/(lambda*1.6e-19) // calculation of
    energy of electron
12
13 printf("\nWavelength shift is %f angstrom. ",lambda)
14 printf("\nEnergy of recoiled electron is %f KeV. \n\
    n\n",E/1e3)
```

Scilab code Exa 3.15 Calculation fraction of energy lost by photon in collision

```
1  clc
2  //given that
3  lambda = 2 //wavelength in angstrom
4  h = 6.63e-34 // Planks constant
5  m_e = 9.1e-31 // mass of electron in kg
6  c = 3e8 // speed of light in m/sec
```

```

7 theta = 45 // scattering angle
8 printf("Example 3.15")
9 d_lambda= h*(1-cos(theta*pi/180))*1e10/(m_e*c) //
    calculation of wavelength shift in angstrom
10 lambda_n = lambda+d_lambda // Calculation of
    recoiled electron wavelength
11
12 f = d_lambda/lambda // Calculation of fraction of
    energy lost by photon
13
14 printf("\nFraction of energy lost by photon is %f\n\
    n\n",f)

```

Scilab code Exa 3.16 Calculation of wavelength of scattered radiation at 90 degree

```

1
2 clc
3 //given that
4 E_eV = 510 // Energy of gamma ray in keV
5 lambda = 2 //wavelength in angstrom
6 h = 6.63e-34 // Planks constant
7 m_e = 9.1e-31 // mass of electron in kg
8 c = 3e8 // speed of light in m/sec
9 theta = 90 // scattering angle in degree
10 printf("Example 3.16")
11 E_j = E_eV*1e3*1.6e-19 // Energy of gamma ray in
    Joule
12 lambda = h*c*1e10/E_j // Calculation of wavelength
    in angstrom
13
14 d_lambda= h*(1-cos(theta*pi/180))*1e10/(m_e*c) //
    calculation of wavelength shift in angstrom
15 lambda_n = lambda+d_lambda // Calculation of

```

```

    recoiled electron wavelength
16 printf("\nWavelength of scattered radiation is %f
    Angstrom \n\n\n", lambda_n)

```

Scilab code Exa 3.17 Calculation of wavelength of radiation being scattered at ninety degrees

```

1
2  clc
3  //given that
4  lambda = 2 //wavelength in angstrom
5  h = 6.63e-34 // Planks constant
6  m_e = 9.1e-31 // mass of electron in kg
7  c = 3e8 // speed of light in m/sec
8  theta = 90 // angle for longest passing wavelength
9  printf("Example 3.17")
10 d_lambda= h*(1-cos(theta*pi/180))*1e10/(m_e*c) //
    calculation of wavelength shift in angstrom
11 lambda_n = lambda+d_lambda // Calculation of
    recoiled electron wavelength
12 d_E = h*c*(lambda_n-lambda)*1e10/(1.6e-19*lambda_n*
    lambda)// Calculation of recoiled electron energy
    in eV
13 printf("\n Scattered wavelength is %f angstrom.",
    lambda_n)
14 printf("\n Energy of recoiled electron is %feV. \n\n
    \n", d_E)

```

Scilab code Exa 3.18 Calculation of wavelength of scattered radiation at ninety degrees

```

1
2  clc
3  //given that
4  E_eV = 510 // Energy of gamma ray in keV
5  h = 6.63e-34 // Planks constant
6  m_e = 9.1e-31 // mass of electron in kg
7  c = 3e8 // speed of light in m/sec
8  theta = 90 // scattering angle in degree
9  printf("Example 3.18")
10 E_j = E_eV*1e3*1.6e-19 // Energy of gamma ray in
    Joule
11 lambda = h*c/E_j // Calculation of wavelength in
    meter
12
13 d_lambda= h*(1-cos(theta*%pi/180))*1e10/(m_e*c) //
    calculation of wavelength shift in angstrom
14 lambda_n = lambda+d_lambda/1e10 // Calculation of
    recoiled electron wavelength
15 d_E = h*c*(d_lambda/1e10)/(1.6e-19*lambda_n*lambda)
    // Calculation of recoiled electron energy in eV
16 psi= atan(1/(tan((theta*%pi/180)/2)/(1+(h/(lambda*
    m_e*c))))))
17 phi_deg = 90 - psi*180/%pi // Calculation of degree
    part of angle of recoiled electron
18 phi_min = 60*(phi_deg - floor(phi_deg))//
    Calculation of minute part of angle of recoiled
    electron
19 printf("\\nWavelength of scattered radiation is %e m
    ",lambda_n)
20 printf("\\nEnergy of recoiled electron is %f MeV.",
    d_E/1e6)
21 printf("\\nRecoiled electron angle is %d degree%d
    minute \\n\\n\\n",phi_deg,phi_min)

```

Scilab code Exa 3.19 Calculation of after collision frequency

```
1  clc
2  //given that
3  nu = 2e19 // initial frequency of X ray photon
4  h = 6.63e-34 // Planks constant
5  m_e = 9.1e-31 // mass of electron in kg
6  c = 3e8 // speed of light in m/sec
7  theta = 90 // scattering angle in degree
8  printf("Example 3.19")
9  d_lambda = h/(m_e*c) // calculation of wavelength
   shift
10 k = 1/nu + d_lambda/c
11 nu_1 = 1/k // Frequency after collision
12 nu_1 = floor(nu_1/1e18)*1e18 // rounding off
13 printf("\nFrequency after collision is %e Hz \n\n",
   ,nu_1)
```

Chapter 4

Dielectrics

Scilab code Exa 4.4 Calculation of induced dipole moment

```
1
2 clc
3 //Given that
4 epsilon_r = 1.000074 // Dielectric constant of He at
   0C and 1atm
5 epsilon_0 = 8.854e-12 // Permittivity of free space
6 E = 100 // Electric field in V/m
7 n = 2.68e27 // Electron density in no,/m^
8 N_a = 6e23 // Avogadro number
9 V = 22.4 // Volume at STP in litter
10 printf("Example 4.4")
11 P = epsilon_0*(epsilon_r-1)*E // Calculation of
   polarization
12
13 N = N_a/(V*1e-3)// Calculation of total number of
   atoms
14 p = P/N // dipole moment per atom
15 printf("\\n Dipole moment per atom is %e Coulomb-
   meter \\n\\n",p)
16 // Answer in book is in different form and as 24.45e
   -40 coulomb-meter
```

Scilab code Exa 4.6 Calculation of electronic polarizability and relative permeability

```
1
2 clc
3 //Given that
4 r = 0.055 // Radius of hydrogen atom in nm
5 n = 9.8e26 // Number of atoms/cc
6
7 epsilon_0 = 8.854e-12 // Permittivity of free space
8
9 printf("Example 4.6")
10 alpha_e = 4*%pi*epsilon_0*(r*1e-9)^3 // Calculation
    of electronic polarisability
11 epsilon_r = 1+n*alpha_e/epsilon_0 // Calculation of
    relative permeability
12
13 printf("\\n Electronic polarisability is %eFm^2 \\n
    Relative permeability is %f \\n\\n\\n",alpha_e,
    epsilon_r)
```

Scilab code Exa 4.8 Calculation of relative permeability

```
1
2 clc
3 //Given that
4 epsilon_0 = 8.854e-12 // Permittivity of free space
5 E = 2000 // Electric field in V/m
```

```

6 P = 6.4e-8 // Polarization in C/m^2
7 printf("Example 4.8")
8 epsilon_r = 1+ P/(epsilon_0*E) // Calculation of
  relative permittivity
9
10 printf("\n Relative permittivity is %f\n\n\n",
  epsilon_r)

```

Scilab code Exa 4.9 Calculation of dielectric constant of material

```

1
2 clc
3 //Given that
4 alpha_e = 2e-40 // Electronic polarisability in Fm^2
5 N = 4e28 // density in atoms/m^3
6 epsilon_0 = 8.85e-12 // Permittivity of free space
7
8 printf("Example 4.9")
9 epsilon_r = 1+ N*alpha_e/(epsilon_0) // Calculation
  of relative permittivity
10 printf("\n Relative permittivity is %f\n\n\n",
  epsilon_r)

```

Scilab code Exa 4.10 Calculation of dielectric constant and electrical susceptibil

```

1 clc
2 //Given that
3 epsilon = 2.4e-10 // permitivity of a dielectric
  material in C^2/N?m^2

```

```

4 epsilon_0 = 8.854e-12 // Permittivity of free space
5
6 printf("Example 4.10")
7 K = epsilon/epsilon_0 // Calculation of dielectric
  constant
8 zai_e = epsilon_0*(K-1) // Calculation of electrical
  susceptibility
9
10 printf("\n Relative permittivity is %f",K)
11 printf("\n Electrical susceptibility is %e C^2/Nm^2\
  n\n\n",zai_e)

```

Scilab code Exa 4.11 Calculation of value of vectors E D and P

```

1
2 clc
3 //Given that
4 V = 100 // Applied potential in Volt
5 d = 1 // Separation between plates in cm
6 k1 = 8 // Dielectric constant
7 k2 = 9 //dielectric constant
8 epsilon_0 = 8.854e-12 // Permittivity of free space
9
10 printf("Example 4.11")
11 E_0 = V/(d*1e-2) // Calculation of electric field
12 E = E_0/k1*k2 // Calculation of electric field
13 D = k1*epsilon_0*E // Calculation of electrical
  displacement vector
14 P = (k1-1)*epsilon_0*E // Calculation of electrical
  polarization
15
16 printf("\n Magnitude of Electrical vector is %e Volt
  /meter",E) // Answer in book is 1.125e3 Volt/

```

```

    meter
17
18 printf("\n Magnitude of Electrical Displacement
    vector is %e C/m^2",D)// Answer in book is 8.85e
    -8C/m^2
19
20 printf("\n Magnitude of Electric polarization vector
    is %e C/m^2\n\n\n",P)// Answer in book is 7.774e
    -8C/m^2

```

Scilab code Exa 4.12 Calculation of deformational polarizability and orientational

```

1
2 clc
3 //Given that
4 alpha_300 = 2.5e-39 // total polarisability in C^2m/
    N at 300 K
5 alpha_600 = 1.75e-39 // total polarisability in C^2m
    /N at 600 K
6 T1 = 300 // Initial temperature in Kelvin
7 T2 = 600 // Final Temperature in Kelvin
8 printf("Example 4.12\n")
9 b = (alpha_300-alpha_600)*T2
10 al_def_300 = alpha_300 - b/300
11 al_oriant_300 = b/300
12 al_oriant_600 = b/600
13 printf("\n Deformational Polarizability is %e C^2mN
    ^-1",al_def_300)
14 printf("\n Orientational Polarizability at %d degree
    Celcius is %e C^2mN^-1",T1,al_oriant_300)
15 printf("\n Orientational Polarizability at %d degree
    Celcius is %e C^2mN^-1",T2,al_oriant_600)

```

Scilab code Exa 4.13 Calculation of dielectric constant of material

```
1
2 clc
3 //Given that
4 alpha_e = 1.5e-40 // Electronic polarizability in Fm
   ^2
5 N = 4e28 // density in atoms/m^3
6 epsilon_0 = 8.85e-12 // Permittivity of free space
7
8 printf("Example 4.13")
9 k = N*alpha_e/(3*epsilon_0)
10 epsilon_r = (1+ k*2)/(1-k) // Calculation of relative
   permittivity
11 printf("\\n Relative permittivity is %f\\n\\n\\n",
   epsilon_r)
```

Scilab code Exa 4.14 Calculation of relative dielectric constant of material

```
1
2 clc
3 //Given that
4 m = 32 // Atomic weight of sulphur
5 d = 2.08 // Density in g/cm^3
6 alpha_e = 3.5e-40 // Electronic polarizability in Fm
   ^2
7 N_a = 6.022e23 // Avogadro Number
8 epsilon_0 = 8.85e-12 // Permittivity of free space
```

```

9
10 printf("Example 4.14")
11 N = N_a*d*1e6/m // Calculation of Atoms per unit
12 k = N*alpha_e/(3*epsilon_0)
13
14 epsilon_r = (1+ k*2)/(1-k) // Calculation of relative
    permittivity
15 printf("\n Relative permittivity is %f\n\n\n",
    epsilon_r)
16 // Answer in book is 4.17

```

Scilab code Exa 4.15 Calculation of percentage of ionic polarizability

```

1
2 clc
3 //Given that
4 n = 1.5 // Refractive index
5 epsilon = 5.6 // Static dielectric constant
6 printf("Example 4.15")
7 per = (1-((n^2-1)/(n^2+2))*(epsilon+2)/(epsilon-1))
    *100 // Percentage ionic polarisability
8 printf("\n Percentage ionic polarizability is %f
    percent\n\n\n",per)
9 // Answer in book is 5.14 %

```

Scilab code Exa 4.16 Calculation of electronic polarizability of sulphur

```

1
2

```



```

3  clc
4  //Given that
5  m = 32 // Atomic weight of sulphur
6  d = 2050 // Density in Kg/m^3
7  N_a = 6.022e23 // Avogadro Number
8  epsilon_0 = 8.85e-12 // Permittivity of free space
9  epsilon_r = 3.75 // Dielectric constant of sulphur
10
11 printf("Example 4.16")
12 N = N_a*d*1e3/m // Calculation of Atoms per unit
13 alpha_e = 3*epsilon_0*((epsilon_r-1)/(epsilon_r+2))
    / N
14
15
16 printf("\n Electronic polarizability is %e Fm^2\n\n
    \n",alpha_e)

```

Scilab code Exa 4.17 Calculation of electronic polarizability and ionic polarizabi

```

1
2  clc
3  //Given that
4  n = 1.5 // Refractive index
5  epsilon = 4 // Static dielectric constant
6  epsilon_0 = 8.85e-12 // permittivity of free space
7  printf("Example 4.17")
8  k1 = (epsilon-1)/(epsilon+2)
9  k2 = (n^2-1)/(n^2+2)
10 ratio = 1/((k1/k2)-1)
11 printf("\n Ratio of electronic to ionic
    polarizability is %f .\n\n\n",ratio)
12 // Answer in book is 1.43

```

Scilab code Exa 4.18 Calculation of frequency and phase difference

```
1
2 clc
3 //Given that
4 t = 1.8e-5 // Relaxation time in second
5 epsilon_r = 1 // let
6 printf("Example 4.18")
7 f = 1/(2*%pi*t) // Calculation of frequency
8 delta = atan(epsilon_r/epsilon_r)
9 phi = 90 - delta*180/%pi // Calculation of phase
   difference
10 printf("\\n Frequency is %f KHz\\n",f/1e3)
11 printf(" Phase difference between current and
   voltage is %d degree.",phi)
```

Chapter 6

Ultrasonic Waves

Scilab code Exa 6.1 Calculation of fundamental frequency of quartz

```
1
2 clc
3 //Given that
4 E = 7.9e10 // Youngs modulus in N/m^2
5 rho = 2650 // Density in Kg/m^3
6 t = 0.003 // Thickness of quartz crystal in m
7 printf("Example 6.1\n")
8 v = sqrt(E/rho)// Calculation of velocity
9 lambda = 2*t // Calculation of fundamental
   wavelength
10 nu = v/lambda // Calculation of fundamental
   frequency
11 printf("Fundamental frequency is %e Hz.\n\n\n",nu)
```

Scilab code Exa 6.2 Calculation of fundamental frequency of crystal

```

1
2 clc
3 //Given that
4 v = 5760 // Velocity in m/s
5 T = 1.6 // Thickness of quartz crystal in mm
6 printf("Example 6.2\n")
7 nu = v/(2*T*1e-3)// Calculation of fundamental
   frequency
8 printf("Fundamental frequency of crystal is %f MHz.\n\n",nu/1e6)

```

Scilab code Exa 6.3 Calculation of depth of defect

```

1
2 clc
3 //Given that
4 T =40 // Thickness of steel bar in cm
5 t1 = 40 // Time in ms
6 t2 = 80 // Time in ms
7 printf("Example 6.3\n")
8 X = T*t1/t2 // Calculation of depth of defect
9 printf("Depth of defect is %d cm.\n\n",X)

```

Scilab code Exa 6.4 Calculation of fundamental frequency of quartz

```

1 clc
2 //Given that
3 E = 7.9e10 // Youngs modulus in N/m^2
4 rho = 2650 // Density in Kg/m^3

```

```

5 t = 0.006 // Thickness of quartz crystal in m
6 printf("Example 6.4\n")
7 v = sqrt(E/rho) // Calculation of velocity
8 lambda = 2*t // Calculation of fundamental
   wavelength
9 nu = v/lambda // Calculation of fundamental
   frequency
10 printf("Fundamental frequency is %e Hz.\n\n\n",nu)

```

Scilab code Exa 6.5 Calculation of capacitance

```

1
2 clc
3 //Given that
4 L = 1 // Inductance in Hanery
5 nu = 2e6 // Frequency in Hz
6 printf("Example 6.5\n")
7 C= 1/(4*((%pi)^2)*nu^2*L) // Calculation of
   capacitance
8 printf("Capacitance is %e microfarad.\n\n\n",C*1e6)
9 // Answer in book is 0.00634 micro Farad

```

Chapter 7

Maxwells Equations and Electromagnetic Waves

Scilab code Exa 7.1 Calculation of average values of electrical and magnetic field

```
1
2 clc
3 //Given that
4 p = 1000 // power in watt
5 d = 2 // Distance from lamp in m
6 epsilon_0 = 8.854e-12 // Permittivity of free space
7 mu_0 = 4*%pi*1e-7 // Permeability of free space
8 printf("Example 7.1")
9 s = p/(4*%pi*d^2)// Calculation of pointing vector
10 E_H_ratio = sqrt(mu_0/epsilon_0) // Calculation of
    ratio of Electric field and magnetic field
11 E= sqrt(E_H_ratio*s) // Calculation of Electric
    field
12 printf("\\n Average value of electric field at
    distance %d m is %f Volt/m \\n\\n\\n",d,E)
13 // Answer in book is 48.87 volt/m which is due to
    wrong calculation at intermediate steps
```

Scilab code Exa 7.2 Calculation of amplitudes of electrical and magnetic field vectors

```
1
2 clc
3 //Given that
4 p = 2 // power in cal/min/cm^2
5
6 epsilon_0 = 8.854e-12 // Permittivity of free space
7 mu_0 = 4*%pi*1e-7 // permeability of free space
8 printf("Example 7.2")
9 s = p*4.2e4/60 // Calculation of pointing vector
10 E_H_ratio = sqrt(mu_0/epsilon_0) // Calculation of
    ratio of Electric field and magnetic field
11 E= sqrt(E_H_ratio*s) // Calculation of Electric
    field
12 H = s/E // Calculation of Electric field
13
14 printf(" \n Average value of electric field is %f
    Volt/m ",E*sqrt(2))
15 printf(" \nAverage value of magnetic field is %f Amp
    turn/m \n\n\n",H*sqrt(2))
```

Scilab code Exa 7.3 Calculation of skin depth for a given frequency

```
1
2 clc
3 //Given that
4 mu_0 = 4*%pi*1e-7 // permeability of free space
```

```

5 mu = mu_0 //permeability of silver
6 sigma = 3e7 // conductivity in mhos/m
7 f = 1e8 // frequency in Hz
8 printf("Example 7.3")
9 omega = 2*pi/f // Calculation of time period
10 delta = sqrt(2/(omega*sigma*mu)) // Calculation of
    skin depth penetration
11 Delta = floor (delta/100)*100 // Rounding off
12 printf("\n Skin depth penetration is %e cm. \n\n\n",
    Delta*1e-6)

```

Scilab code Exa 7.5 Calculation of frequency for a given skin depth and show that

```

1
2 clc
3 //Given that
4 k = 80 // relative Dielectric constant of sea water
5 epsilon_0 = 1/9e9 // Permittivity of free space
6 epsilon = 80*epsilon_0 // Permittivity of free space
7 sigma = 4.3 // conductivity in mho/m
8 delta = 10 // penetration depth in cm
9 mu_0 = 4*pi*1e-7 // permeability f free space
10 F = 1e8 // Given frequency in Hz
11 printf("Example 7.5")
12 f = (1/(%pi*mu_0*sigma))/(delta*1e-2)^2 //
    Calculation of frequency
13 f1= ceil(f/1e8)*1e8 // Rounding off
14 printf("\nFrequency required for penetration of
    depth %d cm is %e Hz",delta,f1)
15 omega = 2*pi*F
16 x = 2*sigma/(epsilon*omega)
17 if x>1 then
18     printf("\n Sea water is good conductor at

```



```

frequency lesser than 1e8 Hz\n\n ")
19 end

```

Scilab code Exa 7.7 Show that silicon water can be considered as good conductor for

```

1
2 clc
3 //Given that
4 k = 12 // relative Dielectric constant of sea water
5 epsilon_0 = 1/9e9 // Permittivity of free space
6 sigma = 2 // conductivity in mho/cm
7 mu_0 = 4*%pi*1e-7 // permeability f free space
8 f= 1e9 // Given frequency in Hz
9 F = 1e6 // Given frequency in Hz
10 printf("\nExample 7.7")
11 delta = sqrt(2/(2*%pi*F*mu_0*sigma*100)) //
    Calculation of frequency
12 printf("\n For %eHz frequency , Penetration depth is
    %f cm",F,delta*100)
13 omega = 2*%pi*f
14 x = 2*sigma*100/(k*epsilon_0*omega)
15 if x>1 then
16     printf("\n Silicon is good conductor at
        frequency lesser than 1e9 Hz \n\n\n")
17 end
18 // Answer in book is 3.6 cm

```

Scilab code Exa 7.8 Calculation of frequency for a given skin depth and predict na

```

1  clc
2  //Given that
3  mu_0 = 4*%pi*1e-7 // permeability of free space
4  mu = mu_0 //permeability of silver
5  sigma = 5.8e7 // conductivity in simens /m
6  delta = 0.1 // Skin depth penetration in mm
7
8  printf("Example 7.8")
9  f = 2/((delta*1e-3)^2*sigma*mu*2*%pi) // Calculation
    of skin depth penetration
10 printf("\n Required frequency is %.2e Hz",f)
11 printf("\n The incident electromagnetic wave is the
    radio part of spectrum.")
12 // Answer in book is 3.36e5 Hz. Difference is due to
    approximation at intermediate stages

```

Scilab code Exa 7.9 Calculation of skin depth for a given frequency

```

1
2
3  clc
4  //Given that
5  mu_0 = 4*%pi*1e-7 // Permeability of free space
6  mu = mu_0 //Permeability of silver
7  sigma = 3e7 // conductivity in mhos/m
8  f = 1e10 // frequency in Hz
9  printf("Example 7.9")
10 delta = sqrt(1/(%pi*sigma*f*mu)) // Calculation of
    skin depth penetration
11 printf("\n Skin depth penetration is %f micrometre.
    \n\n\n",delta*1e6)
12 // Answer in book is 0.93 micrometer

```

Scilab code Exa 7.10 Calculation of intensities of electrical and magnetic field

```
1
2 clc
3 //Given that
4 p = 500 // power in watt
5 d = 1 // Distance from lamp in m
6 epsilon_0 = 8.854e-12 // Permittivity of free space
7 mu_0 = 4*%pi*1e-7 // Permeability of free space
8 printf("Example 7.10")
9 s = p/(4*%pi*d^2)// Calculation of pointing vector
10 E_H_ratio = sqrt(mu_0/epsilon_0) // Calculation of
    ratio of Electric field and magnetic field
11 H = s/E_H_ratio // Calculation of Electric field
12 h = ceil(H*100)/100 // rounding off for 2 decimal
    places
13 E= p/(4*%pi*h) // Calculation of Electric field
14 printf("\\n Average value of electric field at
    distance %d m is %f Volt/m ",d,E)
15 printf("\\n Average value of magnetic field at
    distance %d m is %f Amp-turn/m \\n\\n\\n",d,h)
```

Scilab code Exa 7.11 Calculation of frequency for a given skin depth and and predi

```
1
2 clc
3 //Given that
4 mu_0 = 4*%pi*1e-7 // Permeability of free space
```

```

5 mu = mu_0 //Permeability of silver
6 sigma = 3.5e7 // conductivity in simens /m
7 delta = 0.03 // Skin depth penetration in mm
8
9 printf("Example 7.11")
10
11 f = 2/((delta*1e-3)^2*sigma*mu*2*%pi) // Calculation
    of skin depth penetration
12 printf("\n Required frequency is %d MHz.",f/1e6)
13 printf("\n The incident electromagnetic wave is the
    radio part of spectrum")

```

Scilab code Exa 7.12 Calculation of solar energy received by moon during solar ecl

```

1
2 clc
3 //Given that
4 p = 3.8e26 // power radiated by moon in watt
5 d_sun = 1.44e11 // Distance between sun and earth in
    meter
6 d_moon = 3e8 //Distance between moon and earth in
    meter
7 epsilon_0 = 8.854e-12 // Permittivity of free space
8 mu_0 = 4*%pi*1e-7 // Permeability of free space
9 printf("Example 7.12")
10 s = p/(4*%pi*d_sun^2)// Calculation of solar energy
    received during solar eclipse in watt /m^2
11 S = s*60/(4.2*1e4) // Unit conversion
12
13 printf("\n Solar energy received during solar
    eclipse is %f Cal per min per m^2 \n\n\n",S)
14 // Ansewr in book is 2.1 cal per min per m^2

```

Scilab code Exa 7.13 Calculation of skin depth

```
1
2
3 clc
4 //Given that
5 mu_0 = 4*%pi*1e-7 // Permeability of free space
6 mu = mu_0 //Permeability of silver
7 sigma = 3.5e7 // conductivity in simens /m
8 lambda = 6328 // Wavelength in angstrom
9 c = 3e8// Speed of light in m/sec
10
11 printf("Example 7.13")
12 f = c/(lambda*1e-10)
13 omega = 2*%pi/f // Calculation of time period
14 f = c/(lambda*1e-10) // Calculation of frequency in
    Hz
15 delta = sqrt(1/(%pi*f*sigma*mu)) // Calculation of
    skin depth penetration
16 printf("\\n Skin depth penetration is %f nm. \\n\\n\\n",
    delta*1e9)
17 // Answer in book is 3.9 mm, unit used in book is
    wrong
```

Chapter 8

Superconductivity

Scilab code Exa 8.1 Calculation of critical field at 2K

```
1  clc
2  // Given that
3  H_c_0= 0.0306 // Critical Field in tesla
4  T_c = 3.7 // Critical temperature in kelvin
5  T = 2 // Temperature in kelvin
6  printf("Example 8.1\n")
7  printf("Standard formula used \tH_c = H_c_0*(1-(T/
      T_c)^2) \n")
8  H_c = H_c_0*(1-(T/T_c)^2) // Calculation of critical
      field
9
10 printf("Magnetic Field at %d K is %f tesla.\n\n\n",T
      ,H_c)
```

Scilab code Exa 8.2 Calculation of magnitude of magnetic field

```

1
2  clc
3  // Given that
4  H_c= 3.3e4 // // Magnetic field in A/m
5  T_c = 7.2 // Critical temperature in kelvin
6  T = 5 // Temperature in kelvin
7  printf("Example 8.2\n")
8  printf("Standard formula used \tH_c = H_c_0*(1-(T/
      T_c)^2) \n")
9  H_c_0 = H_c*(1-(T/T_c)^2)^(-1) // Calculation of
      critical field
10 printf("Magnetic Field at %d K is %e A/m\n\n\n",T,
      H_c_0)

```

Scilab code Exa 8.3 Calculation of temperature

```

1
2  clc
3  // Given that
4  H_c_0= 1 // Let
5  H_c= 0.1 * H_c_0 // Magnetic field in A/m
6  T_c = 7.2 // Critical temperature in kelvin
7
8  printf("Example 8.3\n")
9  printf("Standard formula used \tH_c = H_c_0*(1-(T/
      T_c)^2) \n")
10 T = T_c*sqrt(1- (H_c/H_c_0)) // Calculation of
      Temperature
11
12 printf("Required temperature is %f K.\n\n\n",T)

```

Scilab code Exa 8.4 Calculation of critical field

```
1
2
3   clc
4   // Given that
5   H_c_0= 0.0803 // Critical Field in tesla
6   T_c = 7.2 // Critical temperature in kelvin
7   T = 4.2 // Temperature in kelvin
8   printf("Example 8.4\n")
9   printf("Standard formula used \tH_c = H_c_0*(1-(T/
      T_c)^2) \n")
10  H_c = H_c_0*(1-(T/T_c)^2) // Calculation of critical
      field
11
12  printf("Magnetic Field at %d K is %f tesla.\n\n\n",T
      ,H_c)
13  // Answer in book is 0.0548 tesla
```

Scilab code Exa 8.5 Calculation of temperature

```
1
2
3   clc
4   // Given that
5   H_c_0= 1.5e5 // Critical field in A/m
6   H_c= 1.05e5 // Magnetic field in A/m
7   T_c = 9.2 // Critical temperature in kelvin
```



```

8
9 printf ("Example 8.5\n")
10 printf("Standard formula used \tH_c = H_c_0*(1-(T/
    T_c)^2) \n")
11 T = T_c*sqrt(1- (H_c/H_c_0)) // Calculation of
    Temperature
12
13 printf("Required temperature is %f K.\n\n\n",T)

```

Scilab code Exa 8.6 Calculation of transition temperature

```

1
2
3 clc
4 // Given that
5 H_c_0= 2e5// Critical field in A/m
6 H_c= 1e5 // Magnetic field in A/m
7 T_c = 8 // Critical temperature in kelvin
8
9 printf("Example 8.6\n")
10 printf("Standard formula used \tH_c = H_c_0*(1-(T/
    T_c)^2) \n")
11 T = T_c/sqrt(1- (H_c/H_c_0)) // Calculation of
    Temperature
12
13 printf("Required temperature is %f K.\n\n\n",T)

```

Scilab code Exa 8.7 Making observation for given data

```

1
2   clc
3   // Given that
4   H_c_0= 8e5 // Critical field in A/m
5   H_c= 4e4 // Magnetic field in A/m
6   T_c = 7.26 // Critical temperature in kelvin
7
8   printf("Example 8.7\n")
9   printf("Standard formula used \tH_c = H_c_0*(1-(T/
      T_c)^2) \n")
10  T = T_c*sqrt(1- (H_c/H_c_0)) // Calculation of
      Temperature
11
12  printf("Required temperature is %f K.\n\n",T)

```

Scilab code Exa 8.8 Calculation of transition temperature and critical field

```

1
2   clc
3   // Given that
4   T1 = 14 // Temp in K
5   T2 = 13 // Temp in K
6   T = 4.2 // Temp in K
7   Hc_T1 = 0.176 // Critical field at Temp T1
8   Hc_T2 = 0.528 // Critical field at Temp T2
9
10  printf("Example 8.8\n")
11  printf("Standard formula used \tH_c = H_c_0*(1-(T/
      T_c)^2) \n")
12  T_c = sqrt((T1^2*(Hc_T2/Hc_T1)- T2^2) /(Hc_T2/Hc_T1
      - 1)) // Calculation of transition temperature
13  t_c = ceil(T_c*10)/10 // Rounding off two two
      decimal places

```

```

14 Hc_0 = Hc_T1/(1-(T1/t_c)^2) // Calculation of
    critical field
15 Hc_T = Hc_0*(1-(T/t_c)^2) // Calculation of critical
    field
16
17 printf("\n Transition temperature is %f K.\n",t_c)
18 printf(" Critical field at %f K is %fT.\n",T,Hc_0)
19 printf(" Critical field at 0 K is %fT.\n\n\n",Hc_T)
20 // Answer in book is 2.588 T for 0 K and 2.37 for
    4.2 K

```

Scilab code Exa 8.9 Calculation of depth of penetration

```

1
2   clc
3   // Given that
4   m_0 = 9.1e-31 // Mass of electron in kg
5   mu_0 = 1.256e-6 // SI
6   e = 1.6e-19 // Charge on electron in coulomb
7   eta_s = 1e28 // superelectron density in no. per
    cube
8   T_1 = 0 // First temp in kelvin
9   T_2 = 1 // Second temp in kelvin
10  T_c = 3 // Critical temp in kelvin
11
12  printf("Example 8.9\n")
13  printf("Standard formula used \tlambda_0 = sqrt(m_0
    /(mu_0*eta_s*e^2))\n")
14  lambda_0 = sqrt(m_0/(mu_0*eta_s*e^2)) // Calculation
    of penetration depth at 0K
15  lambda_t = lambda_0/sqrt(1-(T_2/T_c)^4) //
    Calculation of penetration depth at 2K
16

```

```

17 printf("Penetration depth at %d K is %d angstrom.",
    T_1, lambda_0*1e10)
18 printf("\nPenetration depth at %d K is %f angstrom
    .\n\n\n", T_2, lambda_t*1e10)

```

Scilab code Exa 8.10 Calculation of penetration depth

```

1
2   clc
3   // Given that
4   T_1 = 3.5 // Temperature in kelvin
5   T_c = 4.153 // Critical temp in kelvin
6   lambda_t = 750 // Penetration depth at T_1 in
    angstrom
7   printf("Example 8.10\n")
8   printf("Standard formula used \nlambda_0 = lambda_t*
    sqrt(1-(T_1/T_c)^4) \n")
9
10  lambda_0 = lambda_t*sqrt(1-(T_1/T_c)^4) //
    Calculation of penetration depth at 3.5K
11  printf("\n Penetration depth at 0 K is %f angstrom.\n
    n\n\n", lambda_0)

```
