Scilab Textbook Companion for Physics- For Students Of Science And Engineering(Part 2) by D. Halliday and R. Resnick[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 26

CHARGE AND MATTER

Scilab code Exa 26.1 Magnitude of total charges in a copper penny

```
//chapter26
//Example 1.1
clc
m=3.1 //mass of copper penny in grams
e=4.6*10^-18 //charge in coulombs
N0=6*10^23 //avogadro's number atoms/mole
M=64 //molecular weight of copper in gm/mole
//Calculation
N=(N0*m)/M;  //No.of copper atoms in penny
q=N*e; //magnitude of the charges in coulombs
disp(q,"magnitude of the charges in coul is")
```

Scilab code Exa 26.2 Seperation between total positive and negative charges

```
//Chapter26
//Example 2
clc
F=4.5 //Force of attraction in nt
```

```
q=1.3*10^5 //total charge in coul
r=q*sqrt((9*10^9)/F);
disp(r,"Seperation between total positive and
   negative charges in meters is")
```

Scilab code Exa 26.3 Force acting on charge q1

```
//Chapter26
//example 3
clc
//given three charges q1,q2,q3
q1=-1.0*10^-6 //charge in coul
q2=+3.0*10^-6
q3=-2.0*10^-6
r12=15*10^-2 //seperation between q1 and q2 in m
r13=10*10^-2 // seperation between q1 and q3 in m
angle=%pi/6 //in degrees
F12=(9.0*10^9)*q1*q2/(r12^2) //in nt
F13=(9.0*10^9)*q1*q3/(r13^2) //in nt
F12x=-F12 ; //ignoring signs of charges
F13x=F13*sin(angle);
F1x=F12x+F13x
F12y=0 //from fig.263
F13y=-F13*cos(angle);
F1y=F12y+F13y //in nt
disp(F1x,"X component of resultant force acting on
   q1 in nt is")
disp(F1y,"Y component of resultant force acting on
   q1 in nt is")
```

Scilab code Exa 26.4 Electrical and Gravitational force between two particles

```
//chapter26
//Example 4
clc
r=5.3*10^-11 //distance b/w elecctron and proton in
    the hydrogen atom in meter
e=1.6*10^-19 //charge in coul
G=6.7*10^-11 //gravitatinal constant in nt-m2/kg2
m1=9.1*10^-31 //mass of electron in kg
m2=1.7*10^-27 //mass of proton in kg
F1=(9*10^9)*e*e/(r^2) //coulmbs law
F2=G*m1*m2/(r^2) //gravitational force
disp(F1,"Coulomb force in nt is")
disp(F2,"Gravitational force in nt is")
```

Scilab code Exa 26.5 Repulsive force betwwen two protons in a nucleus of iron

```
//chapter 26
//Example 5
clc
r=4*10^-15 //separation b/w proton annd nucleus in
    iron in meters
q=1.6*10^-19 //charge in coul
F=(9*10^9)*(q^2)/(r^2); //coulombs law
printf("Repulsive coulomb force F=%d nt",F)
```

Chapter 27

THE ELECTRIC FIELD

Scilab code Exa 27.1 Electric field strength

```
//chapter27
//Example 1
clc
m=9.1*10^-31 //mass of electron in kg
g=9.8 //acceleration due to gravity in m/s
q=1.6*10^-19 //charge of electron in coul
disp("Electric field strength E=F/q where F=mg")
E=m*g/q
disp(E,"electric field strength in nt/coul is")
```

Scilab code Exa 27.4 The point on the line joining two charges for the electric field strength to be zero

```
//chapter27
//example 4
clc
//given
q1=1.0*10^-6 //in coul
```

```
q2=2.0*10^-6 //in coul
l=10 //sepearation b/w q1 and q2 in cm
disp("for the electric field strength to be zero the
    point should lie between the charges where E1=E2
  ")
//"Refer to the fig 27.9"
//E1=electric fied strength due to q1
//E2=electric fied strength due to q2
disp("E1=E2 which implies q1/4   x 2 = q2/4    (l-x)
  2")
x=l/(1+sqrt(q2/q1))
printf("Electric field strength is zero at x=%f cm",
  x)
```

Scilab code Exa 27.9 Deflection of electron

```
//chapter27
//example 9
clc
//given
e=1.6*10^-19 //charge in coul
E=1.2*10^4 //electric field in nt/coul
x=1.5*10^-2 //length of deflecting assembly in m
K0=3.2*10^-16 //kinetic energy of electron in joule
//calculation
y=e*E*x^2/(4*K0)
disp(y,"Corresponding deflection in meters is")
```

Scilab code Exa 27.11 Torque and work done by external agent on electric dipole

```
//chapter 27
//Example 11
```

```
clc
//Given
q=1.0*10^-6 //magnitude of two opposite charges of a
    electric dipole in coul
d=2.0*10^-2 // seperation b/w charges in m
E=1.0*10^5 //external field in nt/coul
//calculations
//(a)Max torque if found when theta=90 degrees
//Torque =pEsin(theta)
p=q*d //electric dipole moment
T=p*E*sin(%pi/2)
disp("(a)Maximum torque exerted by the fied in nt-m
   is")
disp(T)
//(b)work done by the external agent is the
   potential energy b/w the positions theta=180 and
   0 degree
W=(-p*E*cos(%pi))-(-p*E*cos(0))
disp("(b) work done by the external agent to turn
   dipole end for end in joule is ")
disp(W)
```

Chapter 28

GAUSS S LAW

Scilab code Exa 28.3 Electric field strength

```
//chapter 28
//Example 3
clc
//Given
r=1*10^-10 //radius of the atom in meter
Z=79 //gold atomic number
e=1.6*10^-19 //charge in coul
q=Z*e //total positive charge in coul
E=(9.0*10^9)*q/r^2
disp(E,"Electric field strength at the surface of
    the gold atom in nt/coul is")
```

Scilab code Exa 28.4 Electric field strength at the nuclear surface

```
//chapter 28
//Example 4
clc
//given
```

```
r=6.9*10^-15 //radius of the gold nucleus in meter
Z=79 //gold atomic number
e=1.6*10^-19 //charge in coul
q=Z*e //total positive charge in coul
E=(9.0*10^9)*q/r^2
disp("Electric field strength at the surface of the
    gold atom in nt/coul is")
disp(E)
```

Chapter 29

ELECTRIC POTENTIAL

Scilab code Exa 29.3 Magnitude of an isolated positive point charge

```
//chapter 29
//example 3
clc
//given
V=100 //electric potential in volts
r=10*10^-2 //in meters
epsilon0=8.85*10^-12 //coul2/nt-m2
disp("Potential due to a point charge is V=q/4*pi*
   epislon0*r")
q=V*4*%pi*epsilon0*r
disp(q,"Magnitude of positive point charge in coul
   is ")
```

Scilab code Exa 29.4 Electric potential at the surface of a gold nucleus

```
//chapter 29
//example 4
clc
```

```
//given
r=6.6*10^-15 //radius of the gold nucleus in meter
Z=79 //gold atomic number
e=1.6*10^-19 //charge in coul
q=Z*e //total positive charge in coul
epsilon0=8.85*10^-12 //coul2/nt−m2
V=q/(4*%pi*epsilon0*r)
disp(V,"Electric potential at the surface of the
    nucleus in volts is")
```

Scilab code Exa 29.5 Potential at the center of the square

```
//chapter 29
//example 5
clc
//given
q1=1.0*10^-8 //in coul
q2=-2.0*10^-8 //in coul
q3=3.0*10^-8 //in coul
q4=2.0*10^-8 //in coul
a=1 //side of square in meter
epsilon0=8.85*10^-12 //coul2/nt−m2
//refer to the fig 29.7
r=a/sqrt(2) //distance of charges from centre in
    meter
V=(q1+q2+q3+q4)/(4*%pi*epsilon0*r)
disp(V,"Potential at the center of the square in
    volts is")
```

Scilab code Exa 29.8 Mutual potential energy

```
//chapter 29
//example 8
```

```
clc
//given
q1=1.6*10^-19 //charge in coul
q2=1.6*10^-19 //charge in coul
r=6.0*10^-15 //seperation b/w two protons in meter
epsilon0=8.85*10^-12 //coul2/nt-m2
U=(q1*q2)/(4*%pi*epsilon0*r)
disp("Mutual electric potential energy of two proton in joules is")
disp(U)
V=U/q1
disp(V,"Mutual electric potential energy of two proton in ev is")
```

Scilab code Exa 29.9 Mutual potential energy

```
//chapter 29
//example 9
clc
//given
q=1.0*10^-7 //charge in coul
a=10*10^-2 //side of triangle in meter
q1=q
q2=-4*q
q3=2*q
epsilon0=8.85*10^-12 //coul2/nt-m2
disp("Total energy is the sum of each pair of particles ")
U=(1/(4*%pi*epsilon0))*(((q1*q2)/a)+((q1*q3)/a)+((q2*q3)/a))
disp(U,"Mutual potential energy of the particles in joules is")
```

Chapter 30

CAPACITORS AND DIELECTRICS

Scilab code Exa 30.1 Plate area

```
//chapter 30
//example 1
clc
//given
C=1.0 //capacitance in farad
d=1.0*10^-3 //separation b/w plates in meter
epsilon0=8.85*10^-12 //coul2/nt-m2
A=d*C/epsilon0
disp(A,"Plate area in square meter is")
```

Scilab code Exa 30.5 To calculate Capacitance Free charge Electric field strength Potential diffrence between plates

```
//chapter 30
//example 5
clc
```

```
//given
epsilon0=8.85*10^-12 //coul2/nt-m2
A=100*10^-4//area of the plate in square meter
d=1*10^-2 //separation b/w plates in meter
b=5*10^-3 //thickness of dielectric lab in meter
V0=100//in volts
k=7
//(a)
C0=epsilon0*A/d
disp(C0,"(a)Capacitance before the slab is inserted
    in farad is")
//(b)
q=C0*V0
disp(q,"(b)Free charge in coul is")
//(c)
E0=q/(epsilon0*A)
disp(E0,"(c)Electric field strength in the gap in
    volts/meter is")
//(d)
E=q/(k*epsilon0*A)
disp(E,"(d)Electric field strength in the dielectric
     in volts/meter is")
//(e)
//Refer to fig30-12
V=E0*(d-b)+E*b
disp(V,"(e)Potential difference between the plates
    in volts is")
//(f)
C=q/V
disp(C,"Capacitance with the slab in place in farads
     is")
```

Scilab code Exa 30.6 To calculate Electric displacement and Electric polarisation in dielectric and air gap

```
//chapter 30
//example 6
clc
//given
epsilon0=8.85*10^-12 //coul2/nt-m2
A=100*10^-4//area of the plate in square meter
d=1*10^-2 //separation b/w plates in meter
V0=100//in volts
E0=1*10^4 //Electric field in the air gap in volts/meter
k=7
k0=1
E=1.43*10^3 //in volts/metre
D=k*E*epsilon0
P=epsilon0*(k-1)*E
//(a)
disp(D,"(a)Electric displacement in dielectric in coul/square metre is ")
disp(P,"Electric polarisation in dielectric in coul/square meter is")
//(b)
D0=k0*epsilon0*E0
disp(D0,"(b)Electric displacement in air gap in coul/square metre is ")
P0=epsilon0*(k0-1)*E0
disp(P0,"Electric polarisation in air gap in coul/square meter is")
```

Chapter 31

CURRENT AND RESISTANCE

Scilab code Exa 31.1 Current density

```
//chapter 31
//example1
clc
//given
d1=0.10 //diameter of aluminium wire in inches
d2=0.064 //diameter of copper wire in inches
i=10 //current carried by composite wire in amperes
A1=%pi*(d1/2)^2 //crosssectional area of aluminium
   wire in square inches
A2=%pi*(d2/2)^2 //crosssectional area of copper wire
    in square inches
j1=i/A1
j2=i/A2
disp(j1,"Current density in Aluminium wire in amp/
   square inches")
disp(j2,"Current density in copper wire in amp/
   square inches")
```

Scilab code Exa 31.2 Drift speed

```
//chapter 31
//example2
clc
//given
j=480//current density for copper wire in amp/cm2
N0=6*10^23 //avagadro number in atoms/mole
M=64//molecular wt in gm/mole
d=9.0 //density in gm/cm3
e=1.6*10^-19//elecron charge in coul
n=d*N0/M
disp(n,"No.of free electrons per unit volume in
    atoms/mole")
Vd=j/(n*e)
disp(Vd,"Drift speed of electron in cm/sec is")
```

Scilab code Exa 31.3 Resistance and resistiviy

```
//chapter 31
//example3
clc
//given
disp("Dimensions of rectangular carbon block are 1.0
    cm*1.0cm*50cm")
l=1.0*10^-2 //in meter
b=1.0*10^-2//in meter
h=50*10^-2 //in meter
p=3.5*10^-5 //resisivity of carbon in ohm-m
//(a)Resistance b/w two square ends
l1=h
A1=b*l
```

```
R1=p*l1/A1
disp(R1,"(a) Resistance measured b/w the two square
    ends in ohm is")
l2=l
A2=b*h
R2=p*l2/A2
disp(R2,"(a) Resistance measured b/w the two
    opposite rectangular faces in ohm is")
```

Scilab code Exa 31.4 Mean time and Mean free path

```
//chapter 31
//example4
clc
//given
m=9.1*10^-31 //in kg
n=8.4*10^28 //in m-1
e=1.6*10^-19 //in coul
p=1.7*10^-8 //in ohm-m
v=1.6*10^8 //in cm/sec
T=2*m/(n*p*e^2)
disp(T,"(a) Mean time b/w collisions in sec is")
Lambda=T*v
disp(Lambda,"(b) Mean free path in cm is")
```

Scilab code Exa 31.5 Power

```
//chapter 31
//example5
clc
//given
V=110 //in volt
R=24//ohms
```

```
P1=V^2/R
disp(P1,"(a)Power for the single coil in watts is")
P2=V^2/(R/2)
disp(P2,"(b)Power for a coil of half the length in
   watts is")
```

Chapter 33

THE MAGNETIC FIELD

Scilab code Exa 33.1 Force acting on a proton

```
//chapter 33
//example1
clc
//given
K=5*10^6 //ev
e=1.6*10^-19 //in coul
K1=K*e //in joules
m=1.7*10^-27 //in kg
B=1.5 //wb/m
theta=%pi/2
v=sqrt(2*K1/m)
disp(v,"Speed of the proton in meters/sec is")
F=e*v*B*sin(theta)
disp(F,"Force acting on proton in nt is")
```

Scilab code Exa 33.3 Torsional constant of the spring

```
//chapter 33
```

```
//example3
clc
//given
N=250 //turns in coil
i=1.0*10^-4 //in amp
B=0.2 //wb/m2
h=2*10^-2// coil height in m
w=1.0*10^-2 //width of coil in m
Q=30 //angular deflectin in degrees
theta=%pi/2
A=h*w
k=N*i*A*B*sin(theta)/Q
disp(k,"Torssional constant in nt-m/deg is")
```

Scilab code Exa 33.4 Work done

```
//chapter 33
//example4
clc
//given
N=100 // turns in circular coil
i=0.10 //in amp
B=1.5// in wb/m2
a=5*10^-2 //radius of coil in meter
u=N*i*%pi*(a^2) //u is dipole moment
U1=(-u*B*cos(0))
U2=-u*B*cos(%pi)
W=U2-U1
disp(W," W0rk required to turn current in an
   external magnetic field from theta=0 to theta=180
    degree in joule is ")
```

Scilab code Exa 33.5 Hall potential difference

```
//chapter 33
//example5
clc
//given
i=200 //current in the strip in amp
B=1.5 //magnetic field in wb/m2
n=8.4*10^28 //in m-3
e=1.6*10^-19 //in coul
h=1.0*10^-3 //thickness of copper strip in metre
w=2*10^-2 //width of copper strip in meter
//calculation
Vxy=i*B/(n*e*h)
disp(Vxy,"Hall potential difference aross strip in
    volt is")
```

Scilab code Exa 33.6 Orbital radius Cyclotron frequency and Period of revolution

```
//chapter 33
//example6
clc
//given
m=9.1*10^-31 // in kg
v=1.9*10^6 //in m/sec
q=1.6*10^-19 //charge in coul
B=1.0*10^-4 //in wb/m2
//calculations
//(A)
r=m*v/(q*B)
disp(r,"(A)  Orbit radius in meter is")
//(B)
f=q*B/(2*%pi*m)
disp(f,"(B)  Cyclotron frequency in rev/sec is")
//(C)
T=1/f
```

```
disp(T,"(C)  Period of revolution in sec is")
```

Scilab code Exa 33.7 Magnetic induction and Deuteron energy

```
//chapter 33
//example7
clc
//given
f0=12*10^6 //cyclotron frequency in cycles/sec
r=21//dee radius in inches
R=r*0.0254 //dee radius in meter
q=1.6*10^-19 //charge in coul
m=3.3*10^-27 //in kg
//(A)
B=2*%pi*f0*m/q
disp(B,"(A)  Magnetic induction needed to accelerate
    deuterons in wb/m2 is")
//(B)
K=((q^2*B^2*R^2)/(2*m))
disp(K,"(B)  Deuteron energy in joule is")
K1=K*(1/(1.6*10^-19))
disp(K1,"   Deuteron energy in ev is")
```

Chapter 34

AMPERES LAW

Scilab code Exa 34.3 Distance

```
//chapter 34
//example3
clc
//given
i1=100 //in amp
i2=20 //in amp
W=0.073 //weight of second wire W=F/l in nt/m
u0=4*%pi*10^-7 //in weber/amp-m
//calculations
d=u0*i1*i2/(2*%pi*W)
disp(d,"seperation between two wires in metres")
```

Scilab code Exa 34.5 Magnetic field and Magnetic flux

```
//chapter 34
//example5
clc
//given
```

```
l=1.0 //length of solenoid in meter
d=3*10^-2 //diameter of solenoid in meter
n=5*850 //number of layers and turns of wire
u0=4*%pi*10^-7 //in weber/amp-m
i0=5.0 //current in amp
//(A)
B=u0*i0*n
disp(B,"Magnetic field at center in wb/m2 is")
//(B)
A=%pi*(d/2)^2
Q=B*A
disp(Q,"Magnetic flux at the center of the solenoid
    in weber is")
```

Scilab code Exa 34.9 Magnetic field and Magnetic dipole moment

```
//chapter 34
//example9
clc
//given
e=1.6*10^-19 //in coul
R=5.1*10^-11 //radius of th enucleus in meter
f=6.8*10^15 //frequency with which elecron
    circulates in rev/sec
u0=4*%pi*10^-7 //in weber/amp-m
x=0 //x is any point on the orbit , since at center x
    =0
//(A)
i=e*f
B=u0*i*R^2*0.5/((R^2+x^2)^(3/2))
disp(B,"(A)  Magnetic field at the center of the
    orbit in wb/m2")
N=1 //no.of turns
A=%pi*R^2
U=N*i*A
```

```
disp(U,"(B) Equivalent magnetic dipole moment in
    amp-m2 is ")
```

Chapter 35

FARADAYS LAW

Scilab code Exa 35.1 Induced EMF

```
//chapter 35
//example1
clc
//given
l=1.0 //length of solenoid in meter
r=3*10^-2 //radius of solenoid in meter
n=200*10^2 //number of turns in solenoid per meter
u0=4*%pi*10^-7 //in weber/amp-m
i=1.5 //current in amp
N=100 //no.of turns in a close packed coil placed at
    the center of solenoid
d=2*10^-2 //diameter of coil in meter
delta_T=0.050 //in sec
//(A)
B=u0*i*n
disp(B,"Magnetic field at center in wb/m2 is")
//(B)
A=%pi*(d/2)^2
Q=B*A
disp(Q,"Magnetic flux at the center of the solenoid
    in weber is")
```

```
delta_Q=Q-(-Q)
E=-(N*delta_Q/delta_T)
disp(E,"Induced EMF in volts is ")
```

Scilab code Exa 35.7 Induced elelctric field and EMF

```
//chapter 35
//example7
clc
//given
//refer to fig 35-16
B=2 //magnetic field in wb/m2
l=10*10^-2 //in m
v=1.0 //in m/sec
q=1.6*10^-19 //charge in coul
disp("Let S be the frame of reference fixed w.r.t
    the magnet and Z be the frame of reference w.r.t
    the loop")
//(A)
E=v*B
disp(E,"(A)  Induced electric field in volt/m
    observed by Z")
//(B)
F=q*v*B
disp(F,"(B)  Force acting on charge carrier in nt w.
    r.t S is")
F1=q*E
disp(F1,"      Force acting on charge carrier in nt w
    .r.t Z is")
//(C)
emf1=B*l*v
disp(emf1,"(C)  Induced emf in volt observed by S is
    ")
emf2=E*l
disp(emf2,"Induced emf in volt observed by Z is")
```

Chapter 36

INDUCTANCE

Scilab code Exa 36.1 Inductance of a toroid

```
//chapter 36
//example1
clc
//given
u0=4*%pi*10^-7//in weber/amp-m   Mu-not=u0
N=10^3//no.of turns
a=5*10^-2//im meter
b=10*10^-2 //in meter
h=1*10^-2// in metre
L=(u0*N^2*h)/(2*%pi)*log(b/a)
disp(L,"Inductance of a toroid of recyangular cross
   section in henry is")
```

Scilab code Exa 36.2 Time

```
//chapter 36
//example2
clc
```

```
//given
L=50 //inductance in henry
R=30 //resistance in ohms
t0=log(2)*(L/R)
disp(t0,"Time taken for the current to reach one-
    half of its final equilibrium in sec is")
```

Scilab code Exa 36.3 MAximum Current and Energy stored

```
//chapter 36
//example3
clc
//given
L=5 //inductance in henry
V=100 //emf in volts
R=20 //resistance in ohms
i=V/R
disp(i,"Maximum current in amp is")
U=(L*i^2)/2
disp(U,"Energy stored in the magnetic field in
    joules is")
```

Scilab code Exa 36.4 Rate at which energy is stored and delivered and appeared

```
//chapter 36
//example4
clc
//given
L=3//inductance in henry
R=10 //resistance in ohm
V=3 //emf in volts
t=0.30//in sec
```

```
T=0.30 //inductive time constant in sec
//(a)
i=(V/R)*(1-exp(-t/T))
P1=V*i
disp(P1,"The rate at which energy is delivred by the
    battery in watt is")
//(b)
P2=i^2*R
disp(P2,"The rate at which energy appears as Joule
    heat in the resistor in watt is")
//(c)
disp("Let D=di/dt")
D=(V/L)*exp(-t/T)// in amp/sec
P3=L*i*D
disp(P3,"The desired rate at which energy is being
    stored in the magnetic field in watt is")
```

Scilab code Exa 36.6 Energy

```
//chapter 36
//example6
clc
//given
epsilon0=8.9*10^-12//in coul2/nt-m2
E=10^5//elelctric field in volts/meter
B=1 //magnetic field in weber/meter2
u0=4*%pi*10^-7//in weber/amp-m  Mu-not=u0
a=0.1 //side of the cube in meter
V0=a^3 //volume of the cube in meter3
//(a)
U1=epsilon0*E^2*V0/2 //in elelctric field
disp(U1,"(a)Energy required to set up in the given
    cube on edge in electric field in joules is")
//(b)
U2=(B^2/(2*u0))*V0
```

```
disp(U2,"(b)Energy required to set up in the given
    cube on edge in magnetic field in joules is")
```

Chapter 37

MAGNETIC PROPERTIES OF MATTER

Scilab code Exa 37.2 Orbital dipole moment

```
//chapter 37
//example2
clc
//given
e=1.6*10^-19 //in coul
r=5.1*10^-11 //radius of hydrogen atom in meter
m=9.1*10^-31// mass of electron in kg
epsilon0=8.9*10^-12 //in coul2/nt-m2
p=((e^2)/4)*sqrt(r/(%pi*epsilon0*m))
disp(p,"Orbital dipole moment in amp-m2 is")
```

Scilab code Exa 37.4 Change in magnetic moment

```
//chapter 37
//example4
clc
```

```
//given
e=1.6*10^-19 //in coul
r=5.1*10^-11 //radius of hydrogen atom in meter
m=9.1*10^-31// mass of electron in kg
epsilon0=8.9*10^-12 //in coul2/nt-m2
B=2 //in wb/m2
delta_p=(e^2*B*r^2)/(4*m)
disp(delta_p,"Change in Orbital dipole moment in amp
    -m2 is + 0r -")
```

Scilab code Exa 37.5 Precession frequency

```
//chapter 37
//example5
clc
//given
u=1.4*10^-26 //in amp-m2
B=0.50 //wb/m2
Lp=0.53*10^-34 //in joule-sec
fp=u*B/(2*%pi*Lp)
disp(fp,"Precession frequency of phoyon in given
    magnetic field in cps is")
```

Scilab code Exa 37.6 Magnetic field strength Magnetisation Effective magnetising current and Permeability

```
//chapter 37
//example6
clc
//given
n=10*10^2 //turns/m
i=2 //in amp
B=1.0 //in wb/m
```

```
u0=4*%pi*10^-7 //in wb/amp-m
//(A)
H=n*i
disp(H,"(A)  Magnetic field strength in amp/m is")
//(B)
M=(B-u0*H)/u0
disp("(B)  Magnetisation is Zero when core is
   removed")
disp(M,"  Magnetisation when th ecore is replaced in
    amp/m")
//(C)
disp("(C)  Effective magnetizing current i=i(M,0)=M
   *(2*%pi*r0/N0)=M/n")
i=M/n
disp(i,"  Effective magnetizing current in amp is")
//D
Km=B/(u0*H)
disp(Km,"(D)  Permeability ")
```

Chapter 38

ELECTROMAGNETIC OSCILLATIONS

Scilab code Exa 38.1 Current

```
//Example 1
//Chapter 38
clc()
V_o=50// in volts
C=1*10^-6 //in farad
L=10*10^-3
i_m=V_o*(sqrt(C/L))
disp(i_m,"Max current in amps")
```

Scilab code Exa 38.2 Angular frequency

```
//chapter 38
//Example 2
clc
//given
L=10*(10^-3)// in henry
```

```
C=(10)^-6 //in farad
w=sqrt(1/(L*C))
disp(" Angular frequency in radians/sec=")
disp(w)
```

Scilab code Exa 38.3 Angular frequency and time

```
//chapter 38
//Example 3
clc


//given
L=10*(10^-3)// in henry
C=(10)^-6 //in farad
R=0.1 //in ohm
w=sqrt(1/(L*C))
disp(" Angular frequency in radians/sec=")
disp(w)
t=(2*L*log(2))/R
disp(" time in sec=")
disp(t)
```

Scilab code Exa 38.5 Magnetic field

```
//chapter 38
//Example 5
clc
//given
m_0=(4*%pi*10^-7)//in weber
e_0=(8.9*10^-12)
R=5*10^-2//meters
dEbydT=10^12
```

```
B=(0.5*m_0*e_0*R*dEbydT)
disp(" magnetic field in weber/m^2=")
disp(B)
```

Scilab code Exa 38.6 Calculation of current

```
//chapter 38
//Example 6
clc
//given
m_0=(4*%pi*10^-7)//in weber
e_0=(8.9*10^-12)
R=5*10^-2//meters
dEbydT=10^12
i_d=(e_0*%pi*R*R*dEbydT)
disp(" current in amp=")
disp(i_d)
```

Chapter 39

ELECTROMAGNETIC WAVES

Scilab code Exa 39.6 Magnitude of electric and magnetic field

```
//Example 6
//chapter 39
clc()
r=1//in m
p=10^3//
m=4*%pi*10^-7//weber/amp-m
c=3*10^8
x=2*%pi
E_m=(1/r)*(sqrt((p*m*c)/x))
disp(E_m,"The value of E in volts/meter=")
B=E_m/c
disp(B,"B in weber/meter^2")
```

Chapter 40

NATURE AND PROPOGATION OF LIGHT

Scilab code Exa 40.1 Force and energy reflected

```
//chapter 40
//Example 1
clc()
u=(10)*(1.0)*3600// in Joules
c=3*10^8// in m/sec
t=3600//in sec
disp("solution (a)")
disp(u,"energy reflected from mirror in joule=")
p=(2*u)/c
disp(p,"momentum after i hr illumination in kg-m/sec
    =")
disp("solution (b)")
f=p/t
disp(f,"force in newton=")
```

Scilab code Exa 40.2 Angular speed

```
//chapter 40
// example 2
clc()
theta=1/1440
c=3*10^8// in m/sec
l=8630 //in m
w=(c*theta)/(2*l)
disp(w,"Angular speed in rev/sec= ")
```

Scilab code Exa 40.3 Calculation of c

```
//chapter 40
//example 3
clc()
l=15.6//in cm
n=8
lambda_g=(2*l)/n
disp(lambda_g,"lambda_g in cm=")
lambda=3.15//in cm
f=9.5*10^9//cycles/sec
c=lambda*f
disp(c,"value of c in m/sec=")
```

Scilab code Exa 40.4 Percentage error

```
//Example 4
//chapter 4
clc()
v_1=25000//miles/hr
u=25000//miles/hr
c=6.7*10^8// miles/hr
x=1+((v_1*u)/(c)^2)

```

```
v=(v_1+u)/x
disp(v,"Speed of light in miles/hour=")
```

Chapter 41

REFLECTION AND REFRACTION PLANE WAVES AND PLANE SURFACESREFLECTION AND REFRACTION PLANE WAVES AND PLANE SURFACES

Scilab code Exa 41.1 angel between two refracted beam

```
//example_2
//chapter 41
theta_1=30
n_qa=1.4702
theta2=asind(sind(theta_1)/n_qa)
disp("For 4000 A beam, theta_2 in degree=")
disp(theta2)

```

```
theta_1=30
n_qa=1.4624
theta2=asind(sind(theta_1)/n_qa)
disp("For 5000 A beam, theta_2 in degree=")
disp(theta2)
```

Scilab code Exa 41.4 Index of glass

```
//example 4
// chapter 41
clc()
disp("Index reflection=")
n=1/sind(45)
disp(n)
```

Scilab code Exa 41.5 Angel

```
//Example 4
//Chapter 41
clc()
n2=1.33
n1=1.50
theta_c=asind(n2/n1)
disp(theta_c,"Angle theta_c in degree=")
disp("Actual angle of indices =45 is less than
   theta_ c, so there \n is no internal angle
   reflection")
disp("angle of refraction=")
x=n1/n2
theta_2=asind(x*sind(45))
disp(theta_2,"theta_2 in degree=")
```

Chapter 42

REFLECTION AND REFRACTION SPHERICAL WAVES AND SPHERICAL SURFACES

Scilab code Exa 42.4 Location of image

```
//example_4
//chapter 42
clc()
n1=1
n2=2
o=20//in cm
r=10//in cm
disp("x=n2/i")
x=((n2-n1)/r)-(n1/o)
disp(x)
i=n2/x
disp(i,"The value of i in cm=")
```

Scilab code Exa 42.5 Location of image

```
//example_5
//chapter 42
clc()
n1=2
n2=1
o=15//in cm
r=-10//in cm
disp("x=n2/i")
x=((n2-n1)/r)-(n1/o)
disp(x)
i=n2/x
disp(i,"The value of i in cm=")
```

Scilab code Exa 42.7 Location of image

```
//Example 7
//chapter 42
clc()
n=1.65
r_1=40//in cm
r_2=-40//in cm
disp("x=1/f in cm=")
x=(n-1)*((1/r_1)-(1/r_2))
disp(x)
disp("f=1/x")
f=1/x
disp(f,"f in cm=")
```

Scilab code Exa 42.8 Location of image

```
//Example 8
```

```
//chapter 42
clc()
o=9//in c
f=24//in cm
x=(1/f)-(1/o)
disp("x=1/i in cm=")
disp(x)
i=1/x
disp("i in cm=")
disp(i)
disp("lateral magnification =")
m=-(i/o)
disp(m)
```

Chapter 43

INTERFERENCE

Scilab code Exa 43.1 Angular position of first minimum

```
//Example
//chapter 43
//given
m=1
lambda=546*10^-9
d=0.10*10^-3//in m
sin_theta=((m-0.5)*lambda)/(d)
disp(sin_theta,"sin theta =")
theta=asind(sin_theta)
disp(theta,"angle in degree=")
```

Scilab code Exa 43.2 Linear distance

```
//Example 2
//chapter 43
delta=546*10^-9//in meter
D=20*10^-2//in meter
d=0.10*10^-3///in meter
```

```
delta_y=(delta*D)/d
disp(delta_y,"Linear distence in meter=")
```

Scilab code Exa 43.4 Refraction

```
//Example 4
//chapter 43
d=3200//in A
n=1.33
for m=1:2
    lambda_max=(2*d*n)/(m+0.5)
    lambda_min=(8500/m)
    disp(m, "when m=")
    disp(lambda_max,"lambda_max=")
    disp(lambda_min,"lambda_min=")
end
```

Scilab code Exa 43.5 Refraction

```
//Example 5
//chapter 43
clc()
lambda=5000//in A
n=1.38
for m=0:3
    disp(m,"when m=")
    d=((m+0.5)*lambda)/(2*n)
    disp(d,"d in A=")
end
```

Chapter 44

DIFFRACTION

Scilab code Exa 44.1 Calculation of wavelength

```
//example 1
//chapter 44
clc()
m=1
lambda=6500//in A

a=(m*lambda)/sind(30)
disp(a,"a in A=")
```

Scilab code Exa 44.2 Calculation of wavelength

```
//Example 2
//Chapter 44
lambda=6500
lambda_1=lambda/1.5
disp(lambda_1,"wavelength in A=")
```

Scilab code Exa 44.5 Current

```
//chapter 44
//Example 5
clc
//given
m_0=(4*%pi*10^-7)//in weber
e_0=(8.9*10^-12)
R=5*10^-2//meters
dEbydT=10^12
i_d=(e_0*%pi*R*R*dEbydT)
disp(" current in amp=")
disp(i_d)
```

Scilab code Exa 44.7 delta y

```
//chapter 44
//example 7
//given
clc()

lambda=480*10^-9//in m
d=0.10*10^-3//in m
D=50*10^-2// in m
a=0.02*10^-3
delta_y=(lambda*D)/d
disp("solution (a)")
disp(delta_y,"D in m=")
```

Chapter 45

GRATING AND SPECTRA

Scilab code Exa 45.1 calculation of angel

```
//example 1
//chapter 45
clc()
m=1
lambda=4000//in A
d=31700//in A
theta=asind((m*lambda)/d)
disp(theta,"The first order diffraction pattern in
    degree=")
```

Scilab code Exa 45.2 Calculation of angel theta

```
//chapter 45
//example 2
//given
clc()
m=1
lambda=5890//in A
```

```
d=25400//in A
theta=asind((m*lambda)/d)
disp("solution (a)")
disp(theta,"The first order diffraction pattern in
    degree=")
disp("solution (b)")
//given
del_lambda=5.9//in A
delta_theta=(m*(del_lambda))/(d*cosd(theta))
disp(delta_theta,"Angle of seperation in degree=")
```

Scilab code Exa 45.3 Calculation of sodium doublet

```
//Example 3
//chapter 45
//Given
lambda=5890//A
m=3
delta_lambda=(5895.9-5890.0)//in A
R=lambda/(delta_lambda)
disp(R,"Resolving power=")
N=(R/m)
disp(N,"Number of rulings needed is=")
```

Scilab code Exa 45.4 Calculation of dispersion

```
//Example 4
//Chapter 45
clc()
m=3
m1=5
lambda=5460//in A
d=31700//in A
```

```
theta=asind((m*lambda)/d)
disp(theta,"The first order diffraction pattern in
   degree=")
D=m/(d* cosd(theta))
disp("Solution (a)")
disp(D,"The dispersion in radian/A=")
disp("Solution (b)")
N=8000
lambda=5460
R=N*m1
delta_lambda=lambda/R
disp(delta_lambda,"Wave length difference in A=")
```

Scilab code Exa 45.5 Calculation of angels

```
//Example 5
//chapter 45
clc()
a_o=5.63//A
d=a_o/sqrt(5)
lambda=1.10//in A
disp(d,"Interplanar spacing d in A=")

disp("diffracted beam occurs when m=1,m=2 and m=3")
disp("when m1=1, theta in degree=")
m1=1
x=(m1*lambda)/(2*d)
theta_1=asind(x)
disp(theta_1)
disp("when m1=2, theta in degree=")
m2=2
x=(m2*lambda)/(2*d)
theta_2=asind(x)
disp(theta_2)
disp("when m1=3, theta in degree=")
```

```
m3=3
x=(m3*lambda)/(2*d)
theta_3=asind(x)
disp(theta_3)
```

Chapter 46

POLARIZATION

Scilab code Exa 46.1 Calculation of theta

```
//example 1
//chapter 46
theta=acosd(1/sqrt(2))
disp(180-theta,"Polarization angle theta=")
```

Scilab code Exa 46.2 Angle of refraction

```
//example 2
// Chapter 46
theta_p= atand(1.5)
disp(theta_p,"theta_p in degrees")
sin_theta_r= sind(theta_p)/1.5
theta_r=asind(sin_theta_r)
disp(theta_r,"angle of refraction fron snells law in
    degrees=")
```

Scilab code Exa 46.3 Thickness of slab

```
//Example 3
//chapter 46
// from the equation
lambda=5890//A
n_e=1.553
n_o=1.544
s=(n_e)-(n_o)
x=(lambda)/(4*s)
//textbook answer is wrong
disp(x,"The value of x in m=")
```

Chapter 47

LIGHT AND QUANTUM PHYSICS

Scilab code Exa 47.1 velocity

```
//Chapter 47
//Example1
k=20//in nt/m
m=1//in kg
//solution
v=(sqrt((k)/(m)))*(1/(2*%pi))

disp("velocity in cycles/s" )
disp(v)
```

Scilab code Exa 47.2 Time calculation

```
//Example 2
//chapter 47
P=(10^(-3))*(3*10^(-18))/(300)
disp(P,"Power in j-sec")
```

```
s=1.6*(10^(-19))
t=(5*s)/P
disp(t,"time reqired in sec =")
one_sec=0.000277778// hr
in_hour=one_sec*t
disp(in_hour,"time required in hour")
```

Scilab code Exa 47.3 Work function for sodium

```
//Example_3
//Chapter 47
h=6.63*10^(-34)// in joule/sec
v=4.39*10^(14)// cycles/sec
E_o=h*(v)
disp(E_o,"Energy in joule=")
```

Scilab code Exa 47.4 Kinetic energy to be imparten on recoiling electron

```
//Example 4
disp("solution a")
h=(6.63)*10^-34
m=9.11*10^-31
c=3*10^8
delta_h=(h/(m*c))*(1-cos(90))
disp(delta_h,"compton shift in meter")
disp("solution b")
delta=1*10^-10
k=(h*c*delta_h)/(delta*(delta+delta_h))

disp(k,"Kinetic energy in joules")
```

Scilab code Exa 47.5 Binding energy of hydrogen atom

```
//example5
m=9.11*10^-31//in kg
e=8.85*10^-12// in coul^2/nt-m^2
h=6.63*10^-34//in j-sec
E=(-m*(e^4))/(8*(e^2)*(h^2))
disp(E,"Binding energy of hydrogen in joule")
```

Chapter 48

WAVES AND PROPOGATION

Scilab code Exa 1.1 Wavelength of particle

```
//Chapter 48
//Example1
k=100*(1.6*(10^-19))
m=9.1*(10^-31)
//solution
v=sqrt(((2*k)/(m)))

disp("velocity in m/s" )
disp(v)
h=6.6*(10^-34)
p=5.4*(10^-34)
lambda=h/p
disp("wavelength in A")
disp(lambda)
```

Scilab code Exa 48.1 velocity and angular wavelength

```
//Chapter 48
//Example1
k=100*(1.6*(10^-19))
m=9.1*(10^-31)
//solution
v=sqrt(((2*k)/(m)))

disp("velocity in m/s" )
disp(v)
h=6.6*(10^-34)
p=5.4*(10^-34)
lambda=h/p
disp("wavelength in A")
disp(lambda)
```

Scilab code Exa 48.2 Quantized energy

```
//Example 2
//given data
n=1
h=(6.6)*10^-34 //j/sec
m=9.1*(10^-31)//in kg
l=1*(10^-9)//in m
//Solution
E=(n^2)*((h^2)/(8*m*(l^2)))
disp("Energy in Joule=")
disp(E)
```

Scilab code Exa 48.3 Quantum number

```
//Example3
//given
m=10^-9//in kg
```

```
v=10^-6//in m/s
l=10^-4//in m
h=(6.6)*(10^-34)//j/s
E=(0.5)*m*(v^2)

disp("Energy in joule=")
disp(E)

n=(l/h)*(sqrt(8*m*E))
disp("Quantum number=")
disp(n)
```

Scilab code Exa 48.5 Position of electron

```
//Example 5
//given
m=9.1*(10^-31)//in kg
v=300//in m/s
h=6.6*(10^-34)// in j-s
p=m*v
disp("The electrom momentum in kg-m/s=")
disp(p)
delta_p=(0.0001)*p

disp("delta_p in kg-m/s=")
disp(delta_p)

delta_x=(h/delta_p)
disp("Minimum uncertainaity in m=")
disp(delta_x)
```

Scilab code Exa 48.6 Position of electron

```
//Example_6
m=0.05// in kg
v=300 //m/s
delta_p=m*v
disp("Momentum in kg-m/s=")
disp(delta_p)
delta_x=(6.6*10^-34)/delta_p
disp("delta_x in meter=")
disp(delta_x)
```