Scilab Textbook Companion for College Physics(volume 2) by R. A. Serway and J. S. Faughn[1]

Created by
Byragoni Spandana
M.Sc
Physics
IIT-B
College Teacher
Na
Cross-Checked by
Lavitha Pereira

July 31, 2019

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: College Physics(volume 2)

Author: R. A. Serway and J. S. Faughn

Publisher: Thomson Learning, USA

Edition: 6

Year: 2003

ISBN: 0-03-035129-4

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 15

Electric Forces and Electric Fields

Scilab code Exa 15.1 Electric Force and Gravitational force

```
//Example 15.1
k_e=8.99*10^9
e=1.6*10^-19
r=5.3*10^-11
F_e= (k_e*e*e)/(r*r)
disp(F_e,"The attractive force in N= ")
G=6.67*10^-11
m_e=9.11*10^-31
m_p=1.67*10^-27
F_g=(G*m_e*m_p)/(r*r)
disp(F_g,"The gravitational force in N= ")
```

Scilab code Exa 15.2 Superposition Principle

```
//Example 15.2
clc
```

```

k_e=8.99*10^9 //N.m^2/c^2
q2=2*10^-9// in c
q3=5*10^-9// in c
r1=4//in m
F_23=(q2*q3*k_e)/(r1*r1)
disp(F_23,"The force in N= ")
q1=6*10^-9
r2=5//in m
F_13=(q1*q3*k_e)/(r2*r2)
disp(F_13,"The force in N= ")
```

Scilab code Exa 15.4 Electric force

```
//Example 15.4
q=1.6*10^-19//in c
E=2*10^4// in N/C
F=q*E
disp(F,"The magnitude of force in N= ")
```

Scilab code Exa 15.5 Fileld

```
//Example 15.5
clc
k_e=8.99*10^9 //N.m^2/c^2
q1=7*10^-6// in C
q2=5*10^-6//in C
r1=0.4
r2=0.5
E1=(k_e*q1)/(r1^2)
E2=(k_e*q2)/(r2^2)
Ex=(k_e*q2)/(r2^2)
disp(E1,"Magnitude of E1 in N/C")
```

```
disp(E2,"Magnitude of E2 in N/C")
disp(Ex,"Magnitude in x direction in N/C")
Ey=(3.93*10^5)+(-1.44*10^5)
disp(Ey,"Magnitude in y direction in N/C")
phi=atand(Ey/Ex)
disp(phi,"Angle in degree=")
//Answer given in book is wrong
```

Chapter 16

Electrical Energy and Capacitance

Scilab code Exa 16.1 `Field between 2 parallel plates`

```
//Example 16.1
//Given
clc
v_bminusv_a=-12
d=0.3*10^-2//in m
E=-(v_bminusv_a)/d
disp(E,"The value of E in v/m=")
```

Scilab code Exa 16.2 `Motion of proton`

```
//Example 16.2
clc
disp("solution a")
E=8*10^4//in V/m
d=0.5//in m
delta_V=-E*d
```

```
disp(delta_V,"Electric potential from A to B in V=")
disp("solution b")
q=1.6*10^-19//in C
delta_PE=q*delta_V
disp(delta_PE,"Change in electric potential in
   joules=")
m_p=1.67*10^-27//in kg
vf=sqrt((2*-delta_PE)/m_p)
disp(vf,"velocity in m/s=")
```

Scilab code Exa 16.3 Electric Potential

```
//Example 16.3
clc
k_e=8.99*10^9 //N.m^2/c^2
q1=5*10^-6// in C
q2=-2*10^-6//in C
r1=0.4
r2=0.5
V1=(k_e*q1)/(r1)
V2=(k_e*q2)/(r2)
disp("Solution a")
disp(V1,"Magnitude of V1 in v")
disp(V2,"Magnitude of V2 in v")
disp("solution b")
vp=V1+V2
disp(vp,"Magnitude of Vp in v")
q3=4*10^-6//in C
w=vp*q3
disp(w,"work done in Joule=")
```

Scilab code Exa 16.4 Parallel plate capacitor

```
//Example 16.4
clc
e0=8.85*10^-12//in c2/N.m2
A=2*10^-4//in m2
d=1*10^-3//in m
c=(e0*A)/d
disp(c,"Capacitance in farad=")
```

Scilab code Exa 16.5 parallel capacitors

```
//Example 16.5
c1=3*10^-6
c2=6*10^-6
c3=12*10^-6
c4=24*10^-6
delta_v=18
c_eq=c1+c2+c3+c4
disp(c_eq,"capacitance in farad=")
q=delta_v*c3
disp(q,"voltage between battery in c=")
```

Scilab code Exa 16.6 Capacitance

```
//Example 16.6
clc
c1=3*10^-6
c2=6*10^-6
c3=12*10^-6
c4=24*10^-6
delta_v=18
disp("solution a")
c_eq=1/((1/c1)+(1/c2)+(1/c3)+(1/c4))
disp(c_eq,"capacitance in farad=")
```

```
q=delta_v*c_eq
disp("solution b")
disp(q,"voltage between battery in c=")
```

Scilab code Exa 16.7 Equivalent capacitance

```
//Example 16.7
clc
c1=4*10^-6
c2=4*10^-6
disp("solution a")
c_eq=1/((1/c1)+(1/c2))
disp(c_eq,"capacitance in farad=")
```

Scilab code Exa 16.8 Voltage Energy and time

```
//Example 16.8
clc
Energy=1.2*10^3//in J
c=1.1*10^-4//in f
delta_v=sqrt((2*Energy)/c)
disp("solution a")
disp(delta_v,"Energy stored in volt")
disp("solution b")
Energy_deliverd=600//in j
delta_t=2.5*10^-3//in s
p=(Energy_deliverd)/delta_t
disp(p,"power in watt=")
```

Scilab code Exa 16.9 Paper filled capacitor

```
//Example 16.9
clc
k=3.7
e0=8.85*10^-12//in c2/N.m2
A=6*10^-4//in m2
d=1*10^-3//in m
c=(k*e0*A)/d
disp("solution a")
disp(c,"Capacitance in farad=")
disp("solution b")
E_max=16*10^6//in v/m
delta_v_max=E_max*d
disp(delta_v_max,"Voltage in volt")
Q_max=delta_v_max*c
disp(Q_max,"Maximum charge in columb=")
```

Chapter 17

Current and Resistance

Scilab code Exa 17.1 `Current in lightbulb`

```
//Example 17.1
clc
disp("solution a")
delta_q=1.67//in c
delta_t=2//in s
I=delta_q/delta_t
disp(I,"Current in amp=")
disp("solution b")
N=5.22*10^18
N_q=(1.6*10^-19)*N

disp(N_q,"Number of electrons in C")
```

Scilab code Exa 17.2 `Drift speed`

```
//Example 17.2
clc
M=63.5//IN G
```

```
rho=8.95
v=M/rho
electrons=6.02*10^23
n=(electrons*10^6)/v
I=10//in c/s
q=1.60*10^-19//in c
A=3*10^-6//in m2
vd=(I)/(n*q*A)
disp("Solution a")
disp(vd,"The drift speed in m/s=")
k_b=1.38*10^-23
T=293
m=9.11*10^-31
v_rms=sqrt((3*k_b*T)/m)
disp(v_rms,"Drift speed of electron in m/s=")
```

Scilab code Exa 17.3 Resistance of steam iron

```
//Example 17.3
clc
delta_v=120
I=6.4
R=(delta_v)/I
disp(R,"The resistance in ohm=")
```

Scilab code Exa 17.4 resistance

```
//Example 17.4
clc
r=0.321*10^-3
A=%pi*(r*r)
disp("Solution a")
disp(A,"Area in m^2=")
```

```
rho=1.5*10^-6//in ohm=m
l=rho/A
disp(l,"Resistance in ohm/m=")
disp("solution b")
Delta_v=10
I=(Delta_v)/l
disp(I,"The current in Amps=")
```

Scilab code Exa 17.5 Platinum resistance

```
//Example 17.5
clc
R=76.8
Ro=50
alpha=3.92*10^-3
t=(R-Ro)/(alpha*Ro)
T=t+20
disp(T,"Temperature in C=")
```

Scilab code Exa 17.6 Power converted

```
//Example 17.6
clc
delta_v=50
R=8
I=(delta_v)/R
disp(I,"The current in A=")
P=I*I*R
disp(P,"Power in watt=")
```

Scilab code Exa 17.7 Light

```
//Example 17.7
clc
I=20//in A
delta_v=120
p_bulb=75//inwatt
p_total=I*delta_v
N=p_total/p_bulb
disp(N,"Number of bulbs=")
```

Scilab code Exa 17.8 Cost of operating bulb

```
//Example 17.8
clc
p=0.10//in w
t=24//in h
Energy=p*t
disp(Energy,"Energy in kwh=")
cost=Energy*0.12
disp(cost,"Cost in dollars=")
```

Chapter 18

Direct Current Circuits

Scilab code Exa 18.1 Four resistors in series

```
//Example 18.1
clc
R1=2
R2=4
R3=5
R4=7
R_eq=R1+R2+R3+R4
v=6//in v
disp("Solution a")
disp(R_eq,"Equivalent resistance in ohm=")
disp("Solution b")
I=v/R_eq
disp(I,"Current in Amps=")
```

Scilab code Exa 18.2 Parallel resistance

```
//Example18.2
clc
```

```
delta_V=18//in volt
R1=3//in ohm
R2=6//in ohm
R3=9//in ohm
I1=delta_V/R1
I2=delta_V/R2
I3=delta_V/R3
disp("solution a")
disp(I1,"Current in amps=")
disp(I2,"Current in amps=")
disp(I3,"Current in amps=")
P1=(I1^2)*R1
P2=(I2^2)*R2
P3=(I3^2)*R3
disp("solution B")
disp(P1,"Power in watt=")
disp(P2,"Power in watt=")
disp(P3,"Power in watt=")
```

Scilab code Exa 18.3 Equivalent resistance

```
//Example18.3
delta_Vac=42//in volt
R_eq=14//in ohm
I=delta_Vac/R_eq
disp("solution b")
disp(I,"Current in amps=")
```

Scilab code Exa 18.4 Kirchoff law

```
//example18.4
//formula used x=inv(a)*b
clc
```

```
I=[1 -1 -1;-4 0 -9;0 -5 9]
V=[0;6;0]
X=inv(I)
a=X*V

disp("Current value I1,I2,I3 in amps=")
disp(a)
```

Scilab code Exa 18.5 Application of kirchoff law

```
//example18.5
//prob
//formula used x=inv(a)*b
clc
I=[8 2 0;-3 2 0;1 1 -1]
V=[10;-12;0]
X=inv(I)
disp(X)
a=X*V

disp("Current value I1,I2,I3 in amps=")
disp(a)
```

Scilab code Exa 18.6 Charging capacitor

```
//Example 18.6
clc
R=8*10^5//in ohms
C=5*10^-6//in Farad
t=R*C
disp(t,"Constant of the circuit in s=")

Q=C*12
```

```
disp(Q,"Charge in columb=")
q=0.632*Q
disp(q,"Charge in columb when capacitance 63.2%=")
```

Scilab code Exa 18.7 Discharging of capacitance

```
//Example18.7
x=log(4)
disp(x)
disp(x,"time in s is =R*C*")
```

Chapter 19

Magnetism

Scilab code Exa 19.1 Magnetic fueld

```
//Example 19.1
clc
q=1.6*10^-19//in columb
v=1*10^5//in m/s
B=55*10^-6//in T
F=q*v*B* 0.8660
disp(F,"The force in Newton=")
```

Scilab code Exa 19.2 Magnetic field

```
//Example 19.2
q=1.6*10^-19//in columb
v=8*10^6//in m/s
B=2.5//in T
F=q*v*B* 0.8660
disp(F,"The force in Newton=")
m=1.67*10^-27
a=F/m
disp(a,"Acceleration in m/s^2=")
```

Scilab code Exa 19.3 Current in magnetic field

```
//Example 19.3
clc
l=36//in m
I=22//in A
B=0.50*10^-4//in T
F=B*I*l
disp(F,"The maximaum force in Newton=")
```

Scilab code Exa 19.4 Torque

```
//Example 19.4
clc
A=%pi*(0.5)*0.5//in m
I=2//in A
B=0.50//in T
T=B*I*A*0.5
disp(T,"The Torque in N-m=")
```

Scilab code Exa 19.5 Uniform magnetic field

```
//Example 19.5
clc
q=1.6*10^-19
B=.35
r=14*10^-2//in m
m=1.67*10^-27//kg
v=(q*B*r)/m
```

```
disp(v,"Velocity in m/s=")
```

Scilab code Exa 19.6 Mass spectometer

```
//Example 19.6
clc
q=1.6*10^-19
B=.10//in T
v=1*10^6//in m/s
r=14*10^-2//in m
m1=1.67*10^-27//in kg
m2=3.34*10^-27//in kg
r1=(m1*v)/(q*B)
r2=(m2*v)/(q*B)
x=(2*r2)-(2*r1)
disp(r1,"Radius of lighter istope in m=")
disp(r2,"Radius of heavier istope in m=")
disp(x,"Distance of seperation in m=")
```

Scilab code Exa 19.7 Magnetic field of long wire

```
//Example 19.7
clc
Uo=(4*%pi*10^-7)
I=5//in A
r=4*10^-3
B=(Uo*I)/(2*%pi*r)
disp(B,"Magnetic field in T=")
q=1.6*10^-19
v=1.5*10^3//in m/s
F=q*v*B
disp(F,"Force in Newton=")
```

Scilab code Exa 19.8 Levitating wire

```
//Example 19.8
clc
mo=4*%pi*10^-7//Tm/A
d=0.1//in m
x=1*10^-4//F/l
I=sqrt((x*2*%pi*d)/mo)
disp(I,"Current in A=")
```

Scilab code Exa 19.9 Magnetic field

```
//Example 19.9
clc
N=100//turns
l=.1//in m
n=N/l//in turns/m
mo=4*%pi*10^-7//Tm/A
I=.5//in A
B=n*I*mo
q=1.6*10^-19//in c
v=375//in m/s
F=q*v*(B/2)

disp(B,"Magnetic field in T=")
disp(F,"Force in N=")
```

Chapter 20

Induced Voltages and Inductance

Scilab code Exa 20.1 Magnetic flux

```
//Example 20.1
clc;
B=.5//in T
A=3.24*10^-4//in m^2
Flux=B*A
N=25
delta_t=.8
disp(Flux,"Magnetic flux in T.m^2=")
e=(N*Flux)/(delta_t)
disp(e,"Induced emf in volt=")
```

Scilab code Exa 20.2 Induced emf

```
//Ex20_2
B=.6*10^-4//in T
l=30
```

```
v=250//in m/s
e=B*l*v
disp(e,"Induced emf in volt=")
```

Scilab code Exa 20.3 Energy and force

```
//example20.3
clc
B=.25//in T
l=.5
v=2//in m/s
e=B*l*v
disp("Solution a")
disp(e,"Induced emf in volt=")
R=.5//in ohm
I=e/R

disp("Solution b")
disp(I,"Current in A=")
delta_v=.25
P=I*delta_v
disp("Solution c")
disp(P,"Power in watt=")
t=1//in s
w=P*t
disp(w,"Energy delivered in J=")
// Answer give for J in textbook is wrong
d=v*t
F=w/d
disp("Solution d")
disp(F,"Force in N=")
```

Scilab code Exa 20.5 Current and emf

```
//Example 20.5
clc;
f=60//in Hz
w=2*%pi*f
N=8
A=.09//in m^2
B=.5//in T
emf=N*A*B*w
disp("Solution a")
disp(emf,"Induced emf in volt=")
R=12//in ohm
I=emf/R
disp("Solution b")
disp(I,"Current in A=")

disp("Solution c")
disp("Emf in Volt 136*sinwt=")
```

Scilab code Exa 20.6 Induced current in a motor

```
//Example 20.6
clc
emf=120//in Volt
R=10//in Ohm
e_back=70
I=emf/R
disp("Solution a")
disp(I,"Maximum Current  in A=")
disp("Solution b")
I=(emf-e_back)/R;
disp(I,"Current  in A=")
```

Scilab code Exa 20.8 Inductance and emf

```
//Ex20.8
clc;
uo=4*%pi*10^-7//in m/A
N=300
A=4*10^-4//in m^2
l=25*10^-2
L=(uo*N*N*A)/l
disp("Solution a")
disp(L,"Inductance in H=")
delta_I=-5
delta_t=1
e=(-L*delta_I)/(delta_t)


disp("Solution b")
disp(e,"Emf in Volt=")
```

Scilab code Exa 20.9 `Time constant and current`

```
//Ex20.9
clc;
L=30*10^-3//in Henry
R=6//in Ohm
tou=L/R
disp("Solution a")
disp(tou,"Time constant ij s=")

e=12
I=(0.632*e)/R


disp("Solution b")
disp(I,"Current in Amps=")
```

Chapter 21

Alternating current circuits and electromagnetics

Scilab code Exa 21.1 current and voltage

```
//Example 21.1
clc;
V_max=200//in V
V_rms=(V_max)/sqrt(2)
R=100//in ohm
I_rms=V_rms/R
disp(V_rms,"Voltage in V=")
disp(I_rms,"Current in Amps=")
```

Scilab code Exa 21.2 current

```
//Example 21.2
clc;
C=8*10^-6
X_c=1/(377*C)
disp(X_c,"Resistance in ohm=")
```

```
I_rms=150/X_c
disp(I_rms,"Current in Amps=")
```

Scilab code Exa 21.3 Resistance and current

```
//Example 21.3
clc;
L=25*10^-3//In H
w=377
X_L=w*L//In ohm
disp(X_L,"Resistance in ohm=")
I_rms=150/X_L//In A
disp(I_rms,"Current in Amps=")
```

Scilab code Exa 21.4 Inductance capacitance and resistance

```
//Example 21.4
clc;
R=250//in ohm
Xc=758//in ohm
Xl=226//in Ohm
X=Xl-Xc
V_max=150//in Volt
Z=sqrt(R^2+X^2)
I=V_max/Z
q=atand(X/R)
disp(Z,"Impedence in ohm")
disp(I,"Current in Amps")
disp(q,"Angle in degree=")
V_R=I*R
V_C=I*Xc
V_L=I*Xl
disp(V_R,"Voltage at Resistance in Volt")
```

```
disp(V_L,"Voltage at Inductance in Volt")
disp(V_C,"Voltage at Capacitance in Volt")
```

Scilab code Exa 21.5 Power

```
//Example 21.5
clc;
V_max=150//in V
V_rms=(V_max)/sqrt(2)
I_max=.255//in ohm
I_rms=I_max/sqrt(2)
cos=.426
P=V_rms*I_rms*cos
disp(V_rms,"Voltage in V=")
disp(I_rms,"Current in Amps=")
disp(P,"Power in watt=")
```

Scilab code Exa 21.6 capacitance

```
//Example21.6
L=20*10^-3//in H
C=1/(25*10^6*L)
disp(C,"Capacitance in Farad=")
```

Scilab code Exa 21.7 Percentage power loss

```
//example 21.7
clc
I1=100
v1=4*10^3
```

```
v2=2.40*10^5
I2=(I1*v1)/v2
R=30//in ohm
p_lost=I2*I2*R
P_output=I1*v1
p_per=(p_lost*100/P_output)
disp("Solution a")
disp(p_per,"Percentage of power lost=")
P_lost=I1*I1*R
per=(P_lost*100)/(4*10^5)
disp("Solution B")
disp(per,"Percentage of power lost=")
```

Scilab code Exa 21.8 Power

```
//Example 21.8
P=1000*8*20
disp(P,"Power  in watt")
```

Chapter 22

Relection and refraction of light

Scilab code Exa 22.2 Angle of refraction

```
//Example 22.2
clc
n1=1
n2=1.52
x=sind(30)
theta_2=asind((n1*x)/n2)
disp(theta_2,"Angle in degree=")
```

Scilab code Exa 22.3 Wavelength

```
//Example22.3
clc
disp("Solution a")
c=3*10^8// Constant in m/s
n=1.458
v=c/n
disp(v,"Velocity in m/s=")
disp("Solution b")
```

```
lambda_o=589//in nm
lambda_n=lambda_o/n
disp(lambda_n,"Wavelength in Fused quartz in nm=")
```

Scilab code Exa 22.5 Angle

```
//Example 22.5
clc
x=699//in micrometer(w-a)
t=1200 //in micrometer
b=x/2
theta_2=atand(b/t)
disp(theta_2,"Angle in degree=")
y=sind(theta_2)
n1=1
n2=1.55
theta_1=asind((n2*y)/n1)
disp(theta_1,"Angle in degree=")
```

Scilab code Exa 22.6 Angle

```
//Example 22.6
clc
n1=1.33
n2=1
x=asind(n2/n1)

disp(x,"Angle in degree(theta_c)=")
```

Chapter 23

Mirrors and Lenses

Scilab code Exa 23.1 Calculation of height

```
//Example 23.1
AC= 1.8-.1//in m
AD=.5*AC
CF=.10///in m
X=.5*CF//in m
FA=1.8//in m
d=FA-AD-X
disp(d,"The hight in m=")
```

Scilab code Exa 23.2 calculation of height

```
//23.2
p=25//in cm
f=10//in cm
x=(1/f)-(1/p)
q=1/x
p=25
M=-(q/p)
```

```
disp("part a")
disp(M,"The magnification when object is at 25cm=")
p=5//in cm
f=10//in cm
x=(1/f)-(1/p)
q=1/x
p=5
M=-(q/p)
disp("part c")
disp(M,"The magnification when object is at 5cm=")
```

Scilab code Exa 23.3 Magnification

```
//23.3
p=20//in cm
f=-8//in cm
x=(1/f)-(1/p)
q=1/x
p=25
M=-(q/p)
disp("part a")
disp(q,"The position of final image in cm=")
disp("part b")
disp(M,"The magnification=")
```

Scilab code Exa 23.4 focal length

```
//23.4
clc
p=40//in cm
q=-(2*p)

x=(1/p)-(1/q)
```

```
f=1/x
disp(f,"The focal length in cm=")
//Answer given in book is wrong
```

Scilab code Exa 23.5 `Position of image`

```
//23.5
p=20//in cm
n1=1.5//in cm
n2=1//in cm
R=-30//in cm
x=(n2-n1)/R
y=n1/p
s=x-y
q=1/s
disp(q,"The position of final image in cm=")
M=(n1*q)/(n2*p)
disp(M,"The magnification when object in cm")
h=2//in cm
h1=-M*h
disp(h1,"The Position of image in cm=")
```

Scilab code Exa 23.7 `converge`

```
//23.3
p=30//in cm
f=10//in cm
x=(1/f)-(1/p)
q=1/x

M=-(q/p)
disp("part a")
disp(q,"The position of final image in cm=")
```

```
disp(M,"The magnification=")
p=5//in cm
f=10//in cm
x=(1/f)-(1/p)
q=1/x
M=-(q/p)
disp("part b")
disp(q,"The position of final image in cm=")
disp(M,"The magnification=")
```

Scilab code Exa 23.8 `lenses`

```
//23.8
p=30//in cm
f=-10//in cm
x=(1/f)-(1/p)
q=1/x

M=-(q/p)
disp("part a")
disp(q,"The position of final image in cm=")
disp(M,"The magnification=")
p=10//in cm
f=-10//in cm
x=(1/f)-(1/p)
q=1/x
M=-(q/p)
disp("part b")
disp(q,"The position of final image in cm=")
disp(M,"The magnification=")
p=5//in cm
f=-10//in cm
x=(1/f)-(1/p)
q=1/x
M=-(q/p)
```

```
disp("part c")
disp(q,"The position of final image in cm=")
disp(M,"The magnification=")
```

Scilab code Exa 23.9 `lenses in row`

```
//23.9
p=30//in cm
f=10//in cm
x=(1/f)-(1/p)
q=1/x

M1=-(q/p)

p=5//in cm
f=20//in cm
x=(1/f)-(1/p)
q=1/x

M2=-(q/p)


M=M1*M2
disp(M,"The magnification=")
```

Chapter 24

Wave Optics

Scilab code Exa 24.1 To find wavelength of light and distance between adjacent bri

```
//Chapter 24
clc
//Example 1
//given
L=1.2 // Seperation between screen and double−slit in meter
d=3*10^-5 //distance between the two slits
m=2 //second order bright fringe
Y=4.5*10^-2 //distance of second order bright fringe from centerline
//wavelength of light
lambda=(Y*d)/(m*L)
disp(lambda,"(A)  wavelength of light in meters")
//distance between adjacent bright fringes
//delta_Y=Y(m+1)−Ym
delta_Y=lambda*L/d
disp(delta_Y,"(B)  Distance between adjacent fringes in meters")
```

Scilab code Exa 24.2 `Thickness of soap bubble`

```
errcatch(-1,"stop");mode(2);//Chapter 24
clc
//Example 2
//given
n=1.33 //refractive index of soap bubble
lambda=602 //wavelength of light in nm
//for constructive interference we have 2nt=lambda/2
t=lambda/(4*n)
disp(t,"Minimum thickness of soap bubble film in nm
    is")
```

Scilab code Exa 24.3 `Thickness of film`

```
//Chapter 24
clc
//Example 3
//given
n=1.45 //refractive index of silicon monoxide
lambda=552 //wavelength of light in nm
//for destructive interference we have condition for
    minimn thickness 2t=lambda/2n
t=lambda/(4*n)
disp(t,"Minimum thickness of  film in nm is")
```

Scilab code Exa 24.5 `Pit depth in a CD`

```
//Chapter 24
clc
//Example 5
//given
```

```
n=1.6 //refractive index of plastic transparent
    layer
lambda=780 //wavelength of laser light in nm
//for destructive interference we have condition for
     minimn thickness 2t=lambda/2n
t=lambda/(4*n)
disp(t,"Pit depth in a CD in nm is")
```

Scilab code Exa 24.6 Position of dark fringe and width of central bright fringe

```
//Chapter 24
clc
//Example 6
//given
lambda=580*10^-9 //wavelength of incident light in
    meter
a=0.30*10^-3 //slit width in meter
L=2 //distance of screen from slit in meters
//The first dark fringe corresponds to m=+1 or -1
m=1
sin_theta=m*lambda/a
//From fig 24.16 tan_theta=y/L and since theta is
    very small we have sin_theta=tan_theta hence
    sin_theta=y/L
y=L*sin_theta
disp(y," Position of first dark fringe in meters is"
    )
```

Scilab code Exa 24.7 Angle of monochromatic light

```
//Chapter 24
clc
//Example 7
```

```
//given
lambda=632.8 //wavelength of monochromatic light
   from helium-neon laser in meter
a=6000 //lines in diffraction grating per cm
d=10^7/a//slit seperation in nm
//for the first order maximum we have m=1
sin_theta1=lambda/d
theta1=asind(sin_theta1)
disp(theta1,"Angle in degrees at which first order
   maxima is observed is ")
//for the second order maximum we have m=2
sin_theta2=2*lambda/d
theta2=asind(sin_theta2)
disp(theta2,"Angle in degrees at which second order
   maxima is observed is ")
disp("for higher order number of diffraction the the
    solutions are non realistic")
```

Chapter 25

Optical Instruments

Scilab code Exa 25.1 focal length

```
//Chapter 25
clc
//Example 1
//given
q=-50 // Near point of an eye in cm
p=25 //object location in cm
//a) focal length calculation
//Using Thin Lens equation 1/f=((1/p)+(1/q))
f=p*q/(p+q)
disp(f,"a) focal length f in cm is")
//b) power of the lens
f1=50*10^-2// focal length in meters
P=1/f1
disp(P,"Power of the lens in diopters is")
```

Scilab code Exa 25.3 Angular Magnification of lens

```
//Chapter 25
```

```
clc
//Example 3
//given
f=10 // focal length in cm
//a)Maximum angular magnification
M_max=1+(25/f)
disp(M_max,"a) Maximum angular magnification of the
    lens is")
m=25/f
disp(m,"Angular Magnification of lens when eye is
    relaxed is")
```

Scilab code Exa 25.4 Magnification

```
//Chapter 25
clc
//Example 4
//given
//interchangeable objectives
f1=2 // focal length in cm
f2=0.2 //focal length in cm
//data of two eye pieces
f3=5 //focal length in cm
f4=2.5 //focal length in cm
L=18 // length of microscope
//Calculation of magnification for four combinations
     of lens
//magnification of compound microscope  m =-(L/fo)
    *(25cm/fe) where fo is shortest  focal length
    compared to fe
//combination of two long focal lengths
m1=-(L/f1)*(25/f3)
disp(m1,"Magnification of microscope with two long
    focal lengths")
//combination of 20 mm objective  and 2.5 cm
```

```
eyepiece
m2=-(L/f1)*(25/f4)
disp(m2,"Magnification of microscope with a combination of 20 mm objective  and 2.5 cm eyepiece is ")
//combination of 2 mm objective  and 5 cm eyepiece
m3=-(L/f2)*(25/f3)
disp(m3,"Magnification of microscope with a combination of 20 mm objective  and 2.5 cm eyepiece is ")
//combination of two short focal lengths
m4=-(L/f2)*(25/f4)
disp(m4,"Possible magnification of microscope with two short focal lengths")
```

Scilab code Exa 25.5 Angular Magnification of telescope

```
//Chapter 25
clc
//Example 5
//given
d=8 //diameter of objective mirror of reflecting telescope in inches
fo=1500 //focal length of objective mirror of reflecting telescope in mm
fe=18 //focal length of eyepiece
m=fo/fe
disp(m,"Angular magnification of the telescope is")
```

Scilab code Exa 25.6 Limiting angle of Resolution

```
//Chapter 25
clc
```

```
//Example 6
//given
l=589*10^-9 //Wavelength of sodium light m
d=90*10^-2 //diameter of the aperture in m
L=400*10^-9 //Wavelength of desirable Visble light
n=1.33 //refractive index of water
//a) Calculation of limiting angle of resolution
//Limiting angle of resolution of the circular
    aperture is Theta_min=1.22*(l/d)
Theta_min1=1.22*(l/d)
disp(Theta_min1,"a) Limiting angle of resolution in
    radians is")
//b) Calculation of maximum limit of resolution for
    the microscope
Theta_min2=1.22*(L/d)
disp(Theta_min2," b) Maximum limit of resolution for
     the microscope in radians")
//c)Effect of water b/w the object and objective on
    resolving power of microscope
lw=l/n
Theta_min3=1.22*(lw/d)
disp(Theta_min3,"c) Limiting angle of resolution for
     the microscope when water filled the space b/w
    the object and objective in radians is")
```

Scilab code Exa 25.8 Resolving Power

```
//Chapter 25
clc
//Example 8
//given
f1=1000// focal length of objective of telescope A
    in mm
f2=1250// focal length of objective of telescope B
    in mm
```

```
f3=6// focal length of eyepiece of telescope A in mm
f4=25// focal length of eyepiece of telescope Bin mm
//C) Calculation of magnification of the telescope
m_A=f1/f3
m_B=f2/f4
disp(m_A,"Magnification of telescope A is")
disp(m_B,"Magnification of telescope B is")
```

Scilab code Exa 25.9 Resolving Power of grating

```
//Chapter 25
clc
//Example 8
//given
L1=589 // wavelength of first bright line in sodium
   spectrum in nm
L2=589.59 // wavelength of second bright line in
   sodium spectrum in nm
m=2 // order of the spectrum
delta_L=L2-L1
R=L1/delta_L
disp(R,"a) Resolving poer of grating inorder to
   distinguish the wavelengths is")
N=R/m
printf("No.of lines of the grating illuminated to
   resolve the lines in the second order spectrum
   are %d",N)
```

Chapter 26

Relativity

Scilab code Exa 26.1 `Time period`

```
//Chapter 26
clc
//Example1
//given
Tp=3 //proper time in sec
c=3*10^8 //velocity of light in m/sec
v=0.95*c
gamma=1/sqrt(1-(v^2/c^2))
T=gamma*Tp
disp(T,"Period of the pendulum w.r.t to observer is"
   )
```

Scilab code Exa 26.2 `Length of spaceship with respect to observer`

```
//Chapter 26
clc
//Example2
//given
```

```
Lp=120 // length of space ship in meters
c=3*10^8 //velocity of light in m/sec
v=0.99*c
gamma=1/sqrt(1-(v^2/c^2))
L=Lp/gamma
disp(L,"Length of spaceship measured by moving
    observer in meters is")
```

Scilab code Exa 26.3 Distance from spaceship to ground

```
//Chapter 26
clc
//Example3
//given
Lp=435 // length of space ship in meters
c=3*10^8 //velocity of light in m/sec
v=0.970*c
gamma=1/sqrt(1-(v^2/c^2))
L=Lp/gamma
disp(L,"Distance from spaceship to the groung
    measured by an observer in spaceship in meters is
    ")
```

Scilab code Exa 26.4 shape of spaceship

```
//Chapter 26
clc
//Example4
//given
c=3*10^8 //velocity of light in m/sec
//when the spaceship is at rest
x=52 // diatance in x direction  in meters
y=25 //measurement in y direction
```

```
v=0.95*c
//when the spaceship moves to an observer at rest
   only x dimension looks contracted
gamma=1/sqrt(1-(v^2/c^2))
L=x/gamma
disp(L,"The observer sees the horizontal dimension
   of the spaceship gets contracted to a length in
   meters of")
```

Scilab code Exa 26.5 Relativistic Momentum

```
//Chapter 26
clc
//Example5
//given
c=3*10^8 //velocity of light in m/sec
m=9.11*10^-31 //mass of electron in kg
v=0.75*c
gamma=1/sqrt(1-(v^2/c^2))
//relativistic momentum
p=m*v*gamma
disp(p,"relativistic momentum in kg.m/s is")
//classical approach
P=m*v
disp(P,"classical momentum in kg.m/s is")
Z=(p-P)*100/P
printf("the relativistic result is %d percent
   greater than classical result",Z)
```

Scilab code Exa 26.6 speed of light beam

```
//clc
//Example6
```

```
//given
c=3*10^8 //velocity of light in m/sec
Vmo=0.80*c // velocity of motocycle w.r.t stationary
    observer
Vlm=c // velocity of motocycle w.r.t motorcycle
//velocity of light w.r.t stationary observer
Vlo=(Vlm+Vmo)/(1+(Vlm*Vmo)/c^2)
disp(Vlo,"velocity of light w.r.t stationary
   observer in m/sec")
```

Scilab code Exa 26.7 Energy released

```
//Chapter 26
clc
//Example7
//given
c=3*10^8 //velocity of light in m/sec
m=0.50 //mass of baseball in kg
E=m*c^2
disp(E,"The energy equivalent of baseball in joules
   is")
```

Scilab code Exa 26.8 Total energy and kinetic energy of electron

```
//Chapter 26
clc
//Example 8
//given
c=3*10^8 //velocity of light in m/sec
m=0.511 //rest energy of electron in Mev
v=0.85*c
gamma=1/sqrt(1-(v^2/c^2))
E=(m)*gamma
```

```
disp(E,"total energy of an electron in Mev")
K=E-m
disp(K,"Kinetic energy of electron in Mev is")
```

Scilab code Exa 26.9 Conversion of mass to KE

```
//Chapter 26
clc
//Example 9
//given
m_n=1.008665 //mass of neutron in amu
m_U=235.043924 //atomic mass of uranium in amu
m_Ba=140.903496 //atomic mass of barium in amu
m_Kr=91.907720 //atomic mass of krypton in amu
c=3*10^8 // velocity of light in m/s
//a) Kinetic energy released in fission of uranium
KE_final_=((m_n+m_U)-(m_Ba+m_Kr+(3*m_n)))*c^2
//1 amu = 931.494 Mev/c^2
KE_final=KE_final_*931.494/c^2
disp(KE_final,"a) Kinetic energy released in fission in Mev is")
//b) velocities of barium and krypton
//E=mc2/sqrt(1-v2/c2)
KE_Ba=KE_final
m_Ba_=m_Ba*931.494/c^2 // mass of barium in Mev
E_Ba=KE_Ba+m_Ba_*c^2
V_Ba=(sqrt(1-(((m_Ba_*c^2)^2)/E_Ba^2)))*c
disp(V_Ba,"Speed of Barium fragment in Mev is")
KE_Kr=KE_final
m_Kr_=m_Kr*931.494/c^2 // mass of krypton in Mev
E_Kr=KE_Kr+m_Kr_*c^2
V_Kr=(sqrt(1-((m_Kr_*c^2)^2)/E_Kr^2))*c
disp(V_Kr," Speed of krypton fragment in Mev is")
//The difference in answer is because of round off
```

Chapter 27

Quantum Physics

Scilab code Exa 27.1 `Wavelength of radiation`

```
//chapter27
clc
//Example 1
//given
T=35 //Temperature of the skin in celsius
T1=T+273 //Temperature in kelvin
//From Wien's displacement law
Lambda_max=(0.2898*10^-2)/T1
disp(Lambda_max,"Wavelength at which radiation
   emitted from the skin reaches its peak in meters
   is")
```

Scilab code Exa 27.2 `Calculation of Energy and Quantum number`

```
//Chapter 27
clc
//Example 2
//given
```

```
m=2 // mass of the object in Kg
k=25 //force constant of spring in N/m
A=0.4 //Amplitude of Simple harmonic oscillation by
    spring in meters
h=6.63*10^-34//js
//a) Total energy and frequency of SHO calculation
E=(1/2)*k*A^2
f=(1/(2*%pi))*sqrt(k/m)
disp(E,"a) Total energy of Simple harmonic
    oscillator with given amplitude in Joules is")
disp(f,"   Frequency of oscillation in Hertz is")
//b) Calculation of quantum number for the system
n=E/(h*f)
disp(n,"b) Quantum number for the given macroscopic
    system is")
//c) Calculation of energy carried away in a quantum
     charge
delta_E=h*f
disp(delta_E,"c) Energy carried away by a one-
    quantum charge in joules is")
```

Scilab code Exa 27.3 Energy of photon

```
clc
//Example 3
//given
f=6*10^14 //frequency of yellow light in hertz
h=6.63*10^-34 //plancks constant J.s
E=h*f
disp(E,"Energy carried by a photon with the given
    frequency in Joules is")
```

Scilab code Exa 27.4 Energy and wavelength of photon

```
//Chapter 27
clc
//Example 4
//given
l=0.3*10^-6 //wavelength of light  in meters
W=2.46 //work function for sodium in ev
c=3*10^8 //velocity of light in m/s
h=6.63*10^-34//js
//a) Maximum KE of the ejected photoelectrons
E=(h*c/l)/(1.6*10^-19) //energy of each photon of th
    eilluminating light beam in ev
KE_max=E-W
disp(KE_max,"a) Maximum Kinetic energy of th
    eejected photoelectrons in ev is")
//b) Cut off wavelength for sodium
W1=W*1.6*10^-19
lc=h*c/W1
disp(lc,"b) Cut off wavelength for sodium in meters
    is")
```

Scilab code Exa 27.5 `minimum wavelength`

```
//Chapter 27
clc
//Example 5
//given
V=10^5 //potential difference in Volts
h=6.63*10^-34 // plancks constant in J.s
c=3*10^8// velocity of light in m/s
e=1.6*10^-19// elelctronic charge in coulombs
L_min=(h*c)/(e*V)
disp(L_min,"Minimum wavelength produced in meters is
    ")
```

Scilab code Exa 27.6 Grazing angle

```
//Chapter 27
clc
//Example 6
//given
d=0.314 //spacing between certain planes in a crystal of calcite in nm
l=0.070 //wavelength of X-rays in nm
m=1// first order of interference
theta1=asind((m*l)/(2*d))
disp(theta1,"Grazing angle at first order of interference in degree is")
m=3 //third order of interference
theta2=asind((m*l)/(2*d))
disp(theta2,"Grazing angle at third order of interference in degree is")
```

Scilab code Exa 27.7 Compton scattering

```
//Chapter 27
clc
//Example 7
//given
Lo=0.200000 //wavelength of X-rays in nm
h=6.63*10^-34 //in J.s
m_e=9.11*10^-31 // in Kg
c=3*10^8 //in m/s
theta=45 //in degrees
//wavelength is represented by d
delta_L=(h/(m_e*c))*(1-cosd(theta))
L=delta_L+Lo
```

```
printf("Wavelength of the scattered X-rays at the
    given angle in %f nm is",L)

//Answer given in textbook is wrong
```

Scilab code Exa 27.8 de Broglie wavelength

```
//Chapter 27
clc
//Example 8
//given
h=6.63*10^-34 //in J.s
m_e=9.11*10^-31 // in Kg
v=1*10^7 //in m/s
lambda=h/(m_e*v)
disp(lambda,"de Broglie wavelength for an electron
    in meters is")
```

Scilab code Exa 27.9 de broglie wavelength of ball

```
//Chapter 27
clc
//Example 9
//given
h=6.63*10^-34 //in J.s
m=0.145 // in Kg
v=40 //in m/s
lambda=h/(m*v)
disp(lambda,"de Broglie wavelength of the ball in
    meters is")
```

Scilab code Exa 27.10 `uncertainity of the position of electron`

```
//Chapter 27
clc
//Example 10
//given
h=6.63*10^-34//js
v=5*10^3 //speed of the electron in m/s
m_e=9.11*10^-31 // mass of electron in Kg
p=m_e*v
delta_p=0.00300*p
//Uncertainity principle states delta_x*delta_p >=h
   /(4*%pi)
delta_x=h/(4*%pi*delta_p)
disp(delta_x,"Uncertainity in position of electron
   in Meters is ")
```

Scilab code Exa 27.11 `Uncertainity in energy of excited state`

```
//Chapter 27
clc
//Example 11
//given
h=6.63*10^-34 // plancks constant in J.s
delta_t=1.00*10^-8 // Average time that an ellectron
    exists in the excited states in sec
delta_E=h/(4*%pi*delta_t)
disp(delta_E," Minimum uncertainity in energy of the
    excited states in Joules is")
```

Chapter 28

Atomic Physics

Scilab code Exa 28.1 wavelength and frequency

```
//Chapter 28
clc
//Example 1
//given
RH=1.097*10^7 //Rydberg constant in per meter
lambda=4/(3*RH)
c=3*10^8 // m/sec
f=c/lambda
disp(lambda,"Wavelength of the emitted photon in
   meters")
disp(f,"frequency of the emitted photon in meters")
```

Scilab code Exa 28.2 wavelength and energy emitted by the photon

```
//Chapter 28
clc
//Example 2
//given
```

```
RH=1.097*10^7 //Rydberg constant in per meter
h=6.626*10^-34 //plancks constant in j.s
c=3*10^8 // velocity of light in m/s
nf=2 //quantum number
ni=3// quantum number
//assuming k=1/lambda
k=RH*((1/nf^2-1/ni^2))
lambda=1/k
disp(lambda, "longest wavelength that photon emmited
    in meters is")
E_photon=h*c/lambda
disp(E_photon,"Energy emmited by the photon in
   Joules is")
```

Scilab code Exa 28.3 energy and radiation

```
//Chapter 28
clc
//Example 3
//given
Z=2 //atomic number of helium
n=1 //principal quantum number
E=-Z^2*13.6/n^2
disp(E,"a) Energy of the atom in ground state in eV
   is")
r=(n^2/Z)*0.0529//in nm
disp(r,"b) Radius of the ground state orbit in nm is
   ")
```

Scilab code Exa 28.4 energy of the states

```
//Chapter 28
clc
```

```
//Example 4
//given
n=2// principal quantum number
E=-13.6/n^2
disp(E,"Energy of the states with quantum number 2
   in ev is")
```

Scilab code Exa 28.6 Energy of the characteristic X ray

```
//Chapter 28
clc
//Example 6
//given
Z=74 //atomic number of tungsten
Eo=13.6 //ground state enenrgy in ev
E_K=-(Z-1)^2*(13.6) //Energy of the electron in K
   shell
n=3
Z_eff=Z-n^2
E3=Eo/n^2
E_M=-Z_eff^2*E3
E=E_M-E_K
disp(E,"Energy of the characteristic emiited from
   tungsten target when electron drops from M shell
   to K shell in ev is")
//Difference in answer is because of roundoff
```

Chapter 29

Nuclear Physics

Scilab code Exa 29.1 Nuclear Density

```
mode(2);//Chapter 29
clc
//Example 1
//given
m=1.67*10^-27 //mass of nucleus in kg
ro=1.2*10^-15 //in meter
p=(3*m)/(4*%pi*(ro)^3)
disp(p,"Nuclear density in kg/m3 is")
```

Scilab code Exa 29.2 Binding Energy

```
//Chapter 29
clc
//Example 2
//given
mp=1.007825 //in u
mn=1.008665 //in u
md=2.014102 //in u
```

```
u=931.494 //Mev
M=mp+mn
delta_m=(M-md) //in u
E=delta_m*u
disp(E,"Binding energy of Deuteron in Mev is")
```

Scilab code Exa 29.3 Decay rate

```
//Chapter 29
clc
//Example 3
//given
No=3*10^16 //no.of radioactive nuclei present at t=0
t_half=1.6*10^3 //years
T_half=t_half*3.16*10^7 //in sec
d=0.693/T_half
R_o=d*No // decays/s
Ci=3.7*10^10
Ro=R_o/Ci
disp(Ro,"Activity or decay rate at t=0 in Ci is")
```

Scilab code Exa 29.4 activity of radon

```
//Chapter 29
clc
//Example 4
//given
T_half=3.83 //half life time of Radon in days
No=4*10^8 //Initial No .of Radon atoms
lambda=0.693/T_half // in days
t=12
N=No*exp(-(lambda*t))
disp(N,"a) No.of atoms remaining after 12 days is")
```

```
lambda_=lambda/(8.64*10^4)
R=lambda_*No
disp(R,"Initial activity of the radon sample in
    decay/sec is")
```

Scilab code Exa 29.5 Energy liberated

```
//Chapter 29
clc
//Example 5
//given
m_d=222.017571 //mass of daughter nuclei in atomic
    units
m_alpha=4.002602 //mass of alpha particle in atomic
    units
M_p=226.025402 //mass of parent nuclei in atomic
    units
m=m_d+m_alpha
delta_m=(M_p-m)
E=delta_m*931.494
disp(E,"Energy liberated in Mev is")
```

Scilab code Exa 29.6 energy released in beta decay

```
//Chapter 29
clc
//Example 6
//given
M_C=14.003242 //mass of carbon in atomic mass units
M_N=14.003074 //mass of nitogen in atomic mass units
delta_M=M_C-M_N
E=delta_M*(931.494)
disp(E,"Energy released in beta decay in Mev is")
```

Scilab code Exa 29.7 age of teh skeleton

```
//Chapter 29
clc
//Example 7
//given
T_half=3.01*10^9 //half life time in min
lambda=0.693/T_half
R=200 // in decay/min
R0_=15 //decay rate in decay/min.g
m=50 //weight of carbon
R0=R0_*m //in decay/min
t1=-(log(R/R0)/lambda) //im min
t=t1/525949
disp(t,"Age of the skeleton in years is")
```

Chapter 30

Nuclear Energy and Elementary Particles

Scilab code Exa 30.2 total energy released

```
//Chapter 30
clc
//Example 2
//given
Q=208 //disintegration energy per event in Mev
m=1*10^3 //mass of uranium
A=235 //mass number or uranium in g/mol
a=6.02*10^23 //avagadro number nuclei/mol
N=(a/A)*m //nuclei
E=N*Q
P=E*4.45*10^-20
disp(E,"Disintegration energy in Mev is")
disp(P,"or in KWh")
```

Scilab code Exa 30.3 deuterium deuterium reaction

```
errcatch(-1,"stop");mode(2);//Chapter 30
clc
//Example 3
//given
m1=2.014102 // mass of deuterium in atomic mass unit
m2=3.016049 //mass of tritium in atomic mass unit
m3=1.007825 // mass of hydrogen in atomic mass unit
//referring to the deuterium-deuterium reaction
//mass before reaction
M1=2*m1
//mass after reaction
M2=m2+m3
//excessive mass
m=M1-M2
//converting mass into energy
//1 u = 931.494 Mev
E=m*931.494
disp(E," Energy release in deuterium-deuterium
   reaction in Mev is")

exit();
```