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

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August 10, 2013

[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: Engineering Physics

Author: P. V. Naik

Publisher: Pearson Publications (India)

Edition: 1

Year: 2004

ISBN: 8129705206

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

Acoustics

Scilab code Exa 1.1 To calculate the intensity

```
clc();
clear;
//To calculate intensity of sound

p=50;                        //sound waves with output
   power in W
r=4;                         //Distance in m
I=p/(4*%pi*r^2)              //Intensity in W/m^2
printf("Intensity of sound at a distance of 4m from
   the source is %f W/m^2",I);
```

Scilab code Exa 1.2 distance at which sound reduces to a level

```
clc();
clear;
//To determine the distance when intensity or power
   of source of sound changes
//Io=10^-12;                     //Initial intensity of
   sound
```

```
//d=50;                    //d=number of decibels given by 10log(Io/I1)
//Therefore I1=10^5Io=10^-7W/m^2
I1=10^(-7);
P=70;                      //Output power in W
r=sqrt(P/(4*(%pi)*I1))     //distance in m
printf("The distance at which sound reduces to a level of 50dB is %f m",r);
```

Scilab code Exa 1.3 Determination of total absorption in hall

```
clc();
clear;
//To find the total absorption in the hall
v=8000;                //volume of the hall
T=1.5;               //Reverberation time in seconds
A=(0.161*v)/T        //Total absorption time in m^2 sabine
printf("The total reverberation in the hall if reverberation time is 1.5s is %f m^2 sabine",A);
```

Scilab code Exa 1.4 average absorption coefficients of surface

```
clc();
clear;
//To determine the average absorption coefficients of surfaces
l=25;                              //length of the hall in m
b=20;                             //breadth of the hall in m
h=10;                            //height of the hall in m
```

```
V=l*b*h;                          //Volume of the hall
T=4;                              //Reverberation time in s
A=(0.161*V)/T ;                   //Total absorption time in m^2 sabine
b=A/(2*((l*b)+(b*h)+(l*h)))  //b is absorption co-efficient
printf("The average absorption co-efficients of surfaces is %f",b);
```

Scilab code Exa 1.5 determination of frequency of ultrasonic sound waves

```
clc();
clear;
//To determine the frequency of ultrasonic waves
Y=77*(10^10);                                   //Youngs modulus for quartz in dyne/cm^2
rho=2.6;                                        //density of quartz in g/cm^3
t=0.4;                                          //thickness in cm
f=((1/(2*t))*sqrt(Y/rho))*10^-3                 //frequency
printf("The frequency of ultrasonic waves produced when a quartz plate of thickness 4mm is used is %d kHz",f);
```

Scilab code Exa 1.6 To determine the thickness of crystal

```
clc();
clear;
//To determine the thickness of a crystal to produce ultrasonic waves
```

```
Y=81*(10^10);                                    //Young's modulus for barium titanate in dynes/cm^2
rho=5.51;                                        //density of barium titanate in g/cm^3
f=900;                                           //frequency of ultrasonic waves in kHZ
t=((1/(2*f))*sqrt(Y/rho))*10^-2          //thickness of crystal
printf("The thickness of the crystal to produce ultrasonic waves of frequency 900kHZ is %f mm",t);
```

Scilab code Exa 1.7 To calculate the output power

```
clc();
clear;//To calculate the output power of the sound source
r=3;                          //distance in m
I=0.86;                       //Intensity of sound source in W/m^2
P=4*(%pi)*r^2*I               //Power of the sound source
printf("The output power of the sound source  of intensity 0.86 W/m^2 at a distance of 3m is %f W",P);
```

Scilab code Exa 1.8 To calculate the output power

```
clc();
clear;
//To determine the output power of the sound source
d=60;                         //Number of decibels given by 10*log(I/I0)
```

```
I0=10^-12;                    //Initial intensity of
   sound
I=10^-6;                      //since 10log(I/I0)=60
r=200;                        //distance in m
P=4*(%pi)*r^2*I
printf("The output power of the sound source at a
   distance of 200m after the intensity reduces to a
    level of 60dB is %f W",P);
```

Scilab code Exa 1.9 To determine reverberation time

```
clc();
clear;
//To calculate the reverberation time
V=9250;                              //volume of the hall
   in m^3
A=900;                               //Total absorption in
   m^2 sabine
T=(0.161*V)/A                        //Reverberation time
   in s
printf("The reverberation time in a hall of 9250m^3
   and total absorption 900 m^2 sabine is %f s",T);
```

Scilab code Exa 1.10 To determine the thickness of crystal

```
clc();
clear;
//To determine the thickness of the crystal
f1=400;                                //Initial frequency
    in kHZ
f2=500;                               //New frequency
t1=3;                                 // initial thickness
    of the crystal
```

```
t2=(f1*t1)/f2                    //required thickness
printf("The required thickness of the crystal is %f mm",t2 );
```

Scilab code Exa 1.11 ratio of new to old frquencies

```
clc();
clear;
//Determining the ratio of new to old frequencies
t1=2;                          //Initial thickness in mm
t2=2.8;                        //New thickness in mm
F=t1/t2                        //ratio of new to old frequencies i.e f2/f1
printf("The ratio of new to old frequencies is %f",F);
```

Chapter 2

Crystal structures

Scilab code Exa 2.1 To determine lattice parameter

```
clc();
clear;
//To determine the lattice parameter
d=6.5*10^3;                    //density of silver
   bromide in Kg/m^3
m=187.8;                       //molecular weight of
   silver bromide
M=(4*m)/(6.022*10^26);         //mass of ion in unit
   cell in kg.There are 4molecules per unit cell as
   it is a fcc diatomic structure
//d=mass of ions in unit cell/volume of unit cell
//6.5*10^3=(1.25*10^-24)/a^3
a=((M/d)^(1/3))*10^10          //lattice parameter
printf("The lattice parameter is %f A",a);
```

Scilab code Exa 2.2 free volume per unit cell

```
clc();
```

```
clear;
//To determine the free volume per unit cell
r=2.3;                                        //atomic radius
a=(4*r)/sqrt(3);
fv=((a)^3-(2*(4/3)*%pi*r^3))*10^-30    //free volume in m^3
printf("The free volume per unit cell is %e m^3",fv);
```

Scilab code Exa 2.3 To determine ratio of vacancies

```
clc();
clear;
//To determine the ratio of vacancies
k=8.625*10^-5;                                //Boltzmann constant ineV/K
//n1000/n500=ln[n1000/n500]=Ev/1000k
Ev=1.08;                                      //average energy required to create a vacancy in eV
N=exp(Ev/(1000*k))                            //n1000/n500
printf("The ratio of vacancies is %f",N);
```

Scilab code Exa 2.4 ratio of number of vacancies to number of atoms

```
clc();
clear;
//To determine the ratio of the number of vacancies to the number of atoms
//n500=N*exp(-Ev/500k)
k=8.625*10^-5;                                //Boltzmann constant in eV/K
```

```
Ev=0.95;                                      //average
   energy required to create a vacancy
n=exp(-Ev/(500*k))                            //n500/N
printf("The ratio of number of vacancies to the
   number of atoms is %e ",n);
```

Scilab code Exa 2.5 spacing of 111 planes

```
clc();
clear;
//To determine spacing of (111) planes in a
   monoatomic fcc structure
h=1;
k=1;
l=1;
//d(hkl)=a/sqrt(h^2+k^2+l^2)where "a" is the lattice
    parameter
r=0.18;      //atomic radius in nm
d(111)=(2*sqrt(2)*r)/sqrt((h^2)+(k^2)+(l^2))
printf("The spacing of (111) planes in a monoatomic
   structure with atomic radius 0.18 nm is %f nm",d
   (111));
```

Scilab code Exa 2.6 To calculate density of the structure

```
clc();
clear;
//To calculate the density of the structure
M=200;                                  //atomic weight
a=5;                                   //lattice
   parameter
Na=6.022*(10^26);
```

```
rho=(2*M)/(Na*(a*10^-10)^3)          //density of the structure
printf("The density of the bcc structure is %f kg/m^3",rho);
```

Scilab code Exa 2.7 To calculate atomic radius

```
clc();
clear;
//To determine the atomic radius
//Free volume=a^3-[(4/3)*pi*r^3];for sc,a=2r
//Therefore free volume =(2r)^3-[(4/3)*pi*r^3]
fv=30.48*10^-30;                           //free volume per unit cell
r=(fv/(8-(4/3)*%pi))^(1/3)*(10^10)         //atomic radius
printf("The atomic radius is %f A",r);
```

Scilab code Exa 2.8 To determine lattice parameter

```
clc();
clear;
//To detrmine the lattice parameter
//free volume=a^3-[2*(4/3)*pi*r^3]
//for bcc a=4r/3^(1/3)
fv=61.72*(10^-30);                         //free volume
a=-[fv/(1-%pi*sqrt(3))/8]^1/3*10^31          //lattice parameter
printf("The lattice parameter is %f A",a);
```

Scilab code Exa 2.9 Density of free electrons

```
clc();
clear;
//To determine the density of free electrons
rho=9000;                            //density in kg/m^3
w=65;                                //atomic weight
v=1;                                 //volume in m^3
n=(rho*v)/(w/(6.022*10^26));         //number of atoms
a=1.4;                               //average number of free electrons per atom
rhoe=n*a                             //density of free electrons per atom in electrons/m^3
printf("The density of free electrons is %e electrons/m^3",rhoe);
```

Scilab code Exa 2.10 To determine lattice parameter

```
clc();
clear;
//To determine the lattice parameter
h=1;
k=0;
l=1;
d101=0.5;                 //spacing of (101) plane
//d101=a/sqrt((h^2)+(k^2)+(l^2))
a=d101*sqrt(2)            //lattice parameter
printf("The lattice parameter is %f A",a);
```

Chapter 4

Interference

Scilab code Exa 4.1 Wavelengths absent in reflected light

```
clc();
clear;
//To determine the wavelengths absent in the
   reflected light
i=40;                                        //angle of
   incidence
mew=1.2;                                    //refractive
    index
r=asind(sin(i)/mew);
t=0.23;                                     //thickness
   of the film
lambda1=(2*mew*t*cosd(r))*10^3
lambda2=lambda1/2;
printf("The wavelength absent is %f nm",lambda1);
```

Scilab code Exa 4.2 To calculate thickness of air film

```
clc();
```

```
clear;
//To calculate the thickness of the air film
lambda1=400*10^-9;                    //wavelength 1
lambda2=600*10^-9;                    //wavelength 2
//2*t=n*lambda
n=150;                                //since 600*n=(n+75)400
t=((n*lambda2)/2)*10^6
printf("The thickness of the air film is %d micro meter",t);
```

Scilab code Exa 4.3 To calculate the bandwidth

```
clc();
clear;
//To calculate the bandwidth
lambda=600*10^-9;
mew=2;
teta=0.025;                                  //wedge-angle
x=(lambda/(2*mew*sind(teta)))*10^2           //bandwidth
printf("The bandwidth is %f cm",x);
```

Scilab code Exa 4.4 Refractive index of liquid

```
clc();
clear;
//To calculate the refractive index of liquid
xair=0.15;                          //bandwidth of air
xliq=0.115;                         //bandwidth of liquid
mewair=1;                           //refractive index of air
```

```
mewliq=(xair*mewair)/xliq        //refractive index of liquid
printf("The refractive index of liquid is %f",mewliq);
```

Scilab code Exa 4.5 Diameter of nineth dark ring

```
clc();
clear;
//To determine the diameter of the ninth dark ring
n=9;
lambda=589*10^-9;                    //wavelength of light used
R=0.95;                              //radius of curvature of lens
mew=1;
D=(sqrt((4*n*lambda*R)/mew))*10^2    //diameter of the ninth dark ring
printf("The diameter of the ninth dark ring is %f cm",D);
```

Scilab code Exa 4.6 Wavelength of light used

```
clc();
clear;
//To determine the wavelength of light used
x=0.055;                        //distance in fringe shift
n=200;                          //number of fringes
lambda=((2*x)/n)*10^6           //wavelength
printf("The wavelength of light used is %d nm",lambda);
```

Scilab code Exa 4.7 To determine thickness of the plate

```
clc();
clear;
//To determine the thickness of the plate
n=50;                              //number of fringes
lambda=500*10^-9;                  //wavelength of light used
mew=1.5;                           //refractive index of the plate
t=((n*lambda)/(2*(mew-1)))*10^6    //thickness of the plate
printf("The thickness of the plate is %d micro meter",t);
```

Scilab code Exa 4.8 Minimum thickness of film

```
clc();
clear;
//To determine the minimum thickness of the plate for normal incidence of light
lambda=550*10^-9;                  //wavelength
mew=1.38;                          //refractive index
t=(lambda/(4*mew))*10^9            //thickness
printf("The minimum thickness of the plate for normal incidence of light is %f nm",t);
```

Scilab code Exa 4.9 Thickness of the film

```
clc();
clear;
//To determine the thickness of the film
i=35;                                                       //angle of incidence
mew=1.4;                                                    //refractive index
r=asind(sin(i)/mew);
//2*mew*cos(r)=n*lambda
n=50;                                                      //n(459)=(n+1)450
lambda=459*10^-9;
t=(n*lambda/(2*mew*0.9122214))*10^6                        //thickness of the film
printf("The thickness of the film is %f micro meters",t);
```

Scilab code Exa 4.10 To calculate the wedge angle

```
clc();
clear;
//To calculate the wedge angle
lambda=500*10^-9;                                     //wavelength
x=0.07;                                               //observed band width
mew=1;                                                 //refractive index
teta=(asind(lambda/(2*mew*x)))*10^4                    //wedge angle
printf("The wedge angle is %f",teta);
```

Scilab code Exa 4.11 Refractive index of liquid

```
clc();
clear;
//To determine the refravtive index of liquid
dair=0.42;                    //diameter of certain rings
dliq=0.38;                    //diameter of rings when liquid is introduced
mew=dair^2/dliq^2             //refractive index of liquid
printf("The refravtive index of liquid is %f",mew);
```

Scilab code Exa 4.12 Wavelength of light used

```
clc();
clear;
//To determine the wavelength of light used
m=8;                                             //eigth ring
n=3;                                             //third ring
dm=0.4;                                          //diameter of the eigth ring
dn=0.2;                                          //diameter of the third ring
R=101;                                           //Radius of curvature
lambda=(((dm^2)-(dn^2))/(4*R*(m-n)))*10^5        //wavelength of light
printf("The wavelength of light used is %fcm",lambda)
```

Scilab code Exa 4.13 Wavelength with high transmission

```
clc();
clear;
//To determine the wavelength which has high
   transmission
mew=1.38;                //refractiveindex of magnesium
    floride
t=175;                   //thickness of coating of
   magnesium fluoride in nm
lambda=4*t*mew           //wavelength
printf("The wavelength which has high transmission
   is %f nm",lambda);
```

Chapter 5

Diffraction

Scilab code Exa 5.1 To determine the width of the slit

```
clc();
clear;
//To determine the width of the slit
n=1;
lambda=600*10^-9;                        //wavelength
teta=35;                                 //angle at which
   first minimum falls
d=((n*lambda)/sind(35))*10^6       //width of the
   slit
printf("The width of the slit is %f micro m",d);
```

Scilab code Exa 5.2 To determine central band

```
clc();
clear;
//To determine the width of a central band
D=0.95;                                 //distance of the
   screen from the slit
```

```
lambda=589*10^-9;                  //wavelength in m
d=0.5*10^-3;                       //width of the slit
y=((2*D*lambda)/d)*10^3            //width of a central band
printf("The width of the central band is %f mm",y);
```

Scilab code Exa 5.3 To determine width of slit

```
clc();
clear;
//To determine the slit width
D=1.1;                             //distance of the screen from the slit
lambda=589*10^-9;                  //wavelength in m
y=4.5*10^-3;                       //distance of first minimum on either side of central maximum
d=((D*lambda)/y)*10^3              //slit width
printf("The slit width is %f mm",d);
```

Scilab code Exa 5.4 Distance between central maximum and fourth dark fringe

```
clc();
clear;
//To determine the distance between centres of central maximum and the fourth dark fringe
n=4;
lambda=589.6*10^-9;                //wavelength
D=0.95;                            //distance of the screen from the slit
w=0.28*10^-3;                      //width of the slit
d=((n*lambda*D)/w)*10^3
```

```
printf("The distance between centres of central maximum and the fourth dark fringe is %f mm",d);
```

Scilab code Exa 5.5 Ratio of intensities of central and secondary maximum

```
clc();
clear;
//To calculate the ratio of intensities of central & second secondary maximum
s=5*%pi/2;                              //secondary maximum
I=(sin(s)/s)^2                          //I2/I0
printf("Ratio of intensities of central & second secondary maximum is %f",I);
```

Scilab code Exa 5.6 Minimum number of lines per cm

```
clc();
clear;
//To calculate the minimum number of lines per cm
lambda=450*10^-9;                       //wavelength
n=2;
dlambda=1*10^-9;                        //difference in wavelength
N=lambda/(n*dlambda)                    //minimum number of lines per cm
printf("The minimum number of lines per cm is %d",N);
```

Scilab code Exa 5.7 Angle at which first minimum will be observed

```
clc();
clear;
//To calculate the angle at which first minimum will be observed
n=1;
lambda=650*10^-9;                                //wavelength
d=2*10^-6;                                       //widthof hte slit
teta=asind((n*lambda)/d)                         //angle at which first minimum will be observed
printf("The angle at which first minimum will be observed is %f",teta);
```

Scilab code Exa 5.8 To determine width of the slit

```
clc();
clear;
//To determine the slit width
lambda=600*10^-9;                                   //wavelength
y=2*10^-3;                                          //width of the central band
D=1;                                                //distance of the screen from the slit
d=((2*D*lambda)/y)*10^3                             //slit width
printf("The slit width is %f mm",d);
```

Scilab code Exa 5.9 Wavelength of light used

```
clc();
```

```
clear;
//To determine the wavelength of light used
y=6*10^-3;                          //first minimum is
    observed
d=90*10^-6;                         //slit width
D=0.98;                             //distance of the
    screen from the slit
lambda=((y*d)/D)*10^9                // wavelength
printf("The wavelength of light used is %f nm",
    lambda);
```

Scilab code Exa 5.10 Wavelength of spectral line

```
clc();
clear;
//To calculate the wavelength of second spectral
    line
n=1;
lambda1=450*10^-7;                        //wavelength of
     first spectral line
d=1/5000;
teta1=asind((n*lambda1)/d);
teta2=teta1+2.97;
lambda2=((d*sind(teta2))/n)*10^7      //wavelength of
    second spectral line
printf("The wavelength of second spectral line is %f
     nm",lambda2);
```

Scilab code Exa 5.11 Minimum grating element required

```
clc();
clear;
```

```
//To determine the minimum grating element required
   to observe the entire third order spectrum
n=3;
lambda=700*10^-9;                    //wavelength
teta=90;
d=((n*lambda)/sin(teta))*10^6   //grating element
printf("The minimum grating element required to
   observe the entire third order spectrum is %f m",
   d);
```

Chapter 6

Polarisation

Scilab code Exa 6.1 To determine angle of refraction

```
clc();
clear;
//To determine the angle of refraction
mew=1.63;                  //refractive index of the
    glass plate
//tan ip=mew
ip=atand(mew);           //ip=polarising angle
//ip+r=90
r=90-ip                  //r=angle of refraction
printf("The angle of refraction is %f",r);
```

Scilab code Exa 6.2 Percentage of incident unpolarised light

```
clc();
clear;
//To determine the percentage of incident
    unpolarized light
//I=I0(cos^2(teta))
```

```
teta=50;                    //angle made between two principle planes
I=(cosd(50))^2;             //incident unpolarized light
//percentage of incident unpolarised light is (I/I0)*100 where I0 is incident polarised light .
I=(cosd(50))^2*100          //percentage of incident unpolarized light
printf("The percentage of incident unpolarized light is %f ",I);
```

Scilab code Exa 6.3 Angle between planes

```
clc();
clear;
//To determine the angle between planes of transmission of analyser and polariser
//I=I0*cos^2(teta)
//cos^2(teta)=I/I0
a=0.08;                    //a=I/I0;where I=incident unpolarized light & I0=incident polarized light
teta=acosd(sqrt(a))        //angle between planes of transmission of analyser and polariser
printf("The angle between the planes of transmission of analyser & polariser is +(or)- %f",teta);
```

Scilab code Exa 6.4 Intensities of ordinary and extraordinary light

```
clc();
clear;
//To compare the intensities of ordinary & extraordinary light
//IE=A^2(cos^2(teta));IO=A^2(sin^2(teta))
//I0/IE=tan^2(teta)
```

```
teta=40;                          //angle made between incident beam & optic axis
a=tand(40)^2                      //I0/IE
printf("I0/IE=%f",a);
```

Scilab code Exa 6.5 Thickness of quarter wave plate

```
clc();
clear;
//To determine the thickness of a quarter-wave plate
lambda=589;                        //wavelength of light in nm
mew0=1.54;                         //refractive index for ordinary wave
mewE=1.55;                         //refractive index for extraordinary wave
t=lambda/(4*(mewE-mew0))*10^-3     //thickness in micro meters
printf("The thickness of a quarter-wave plate is %f micro meters",t);
```

Scilab code Exa 6.6 To determine the refractive index

```
clc();
clear;
//To determine the refractive index of material surface
ip=52;                             //angle of polarization
mew=tand(ip)                       //refractive index of the material surface
printf("The refractive index of the material surface is %f",mew);
```

Scilab code Exa 6.7 To calculate the refractive index

```
clc();
clear;
//To determine the refractive index of quartz
r=33;                                   //angle of refraction
ip=90-r;                                //polarising angle
mew=tand(ip)                            //refractive index of quartz
printf("The refractive index of quartz is %f",mew);
```

Scilab code Exa 6.8 Angle made by the plane of vibration of the incident light with the optic axis

```
clc();
clear;
//To determine the angle made by plane of vibration of the incident light with optic axis
//IE=A^2*cos^2(teta);IO=A^2*sin^2(teta)
//I0/IE=tan^2(teta)=0.65
a=0.65;                                 //ratio of intensities of ordinary & extraordinary light
teta=atand(sqrt(a))                     //angle made by plane of vibration of the incident light with optic axis
printf("The angle made by the plane of vibration of incident light with the optic axis is %f",teta);
```

Scilab code Exa 6.9 Phase difference between O and E rays

```
clc();
clear;
//To determine the phase difference between between
   O &E rays
mew0=1.544;

   //refractive index of ordinary waves
mewE=1.553;

   //refractive index of extraordinary waves
lambda=550;

   //wavelength in nm
t=9;
delta=((2*180)/(lambda*(10^-9)))*(mewE-mew0)*t
   *(10^-6)                          //mewE>mew0
printf("The phase difference between O and E rays is
    %f degrees",delta);
```

Scilab code Exa 6.10 Wavelength of light incident on quartz plate

```
clc();
clear;
//To determine the wavelength of light incident on a
    quartz plate
delta=50;

   //phase difference
mewE=1.544;

   //refractive index of extraordinary waves
mew0=1.553;
```

```
//refractive index of ordinary waves
t=8;
//thickness in nm
lambda=((2*180)/delta)*(mew0-mewE)*t*10^-6*10^9
                        //mew0>mewE
printf("The wavelength of light incident is %f nm",
   lambda);
```

Chapter 7

Motion of charged particle

Scilab code Exa 7.1 Kinetic energy and speed of electron

```
clc();
clear;
//To calculate the kinetic energy and speed of the electron
e=1.6*10^-19;                                    //charge of the electron
V=18;                                            //potential difference in kV
K=e*V*10^3                                       //Kinetic energy in J
m=9.1*10^-31;                                    //mass of the electron
v=sqrt((2*e*V*10^3)/m)*10^-7                     //speed of electron in m/s
printf("The kinetic energy of electron is %e J and speed of the electron is %f m/s",K,v);
```

Scilab code Exa 7.2 Vector displacement of electron

```
clc();
clear;
//To determine the vertical displacement of electron
m=9.1*10^-31;                                  //mass of electron
vx=4*10^6;                                     //velocity along x-axis
E=1500;                                        //electric field strength
l=0.07;                                        //length in y-axis
q=1.6*10^-19;                                  //charge of electron
y=(-q*E*(l^2))/(2*m*(vx^2))*10^2               //vertical displacement of electron
printf("The vertical displacement of electron when it leaves the electric field is %f cm",y);
```

Scilab code Exa 7.3 Time required for the proton to reach maximum height

```
clc();
clear;
//To determine the time required for the proton to reach the maximum height in electric field
u=5*10^5;                          //velocity in m/s
m=1.67*10^-27;                     //mass of proton
q=1.6*10^-19;
E=500;                             //electric field
t=((u*m*sind(42))/(q*E))*10^6
printf("The time required for the proton to reach the maximum height in electric field is %f micro sec",t);
```

Scilab code Exa 7.4 Orbital speed of proton

```
clc();
clear;
//To determine the orbital speed of proton
m=1.67*10^-27;                          //mass of proton
q=1.6*10^-19;
B=0.36;                                 //magnetic field in T
R=0.2;                                  //radius in m
v=((q*B*R)/m)*10^-6                     //orbital speed of proton
printf("The orbital speed of proton is %f m/s",v);
```

Scilab code Exa 7.5 Pitch of the helix

```
clc();
clear;
//To calculate the pitch of the helix and radius of trajectory
v=2*10^6;                             //speed in m/s
teta=30;                              //angle at which proton enters  at the origin of coordinate system
B=0.3;                                //magnetic field in iT
vp=v*sind(teta);                      //v(perpendicular component)
vpa=v*cosd(teta);                     //v(parallel component)
m=1.67*10^-27;                        //mass of proton
q=1.6*10^-19;
p=(vpa*2*%pi*m)/(q*B)                //pitch of the helix described by the proton
R=((m*vp)/(q*B))*10^2                //radius of the trajectory
```

```
printf("the pitch of the helix is %f m and radius of
    trajectory is %f cm",p,R)
```

Scilab code Exa 7.6 To calculate the displacement produced

```
clc();
clear;
//To determine the displacement produced ,the angle
   made by the beam with the axis ,velocity of
   electrons
V=25;                                            //
   deflecting voltage
l=0.03;                                          //
   length of deflecting planes in m
d=0.75;                                         //
   distance between 2 deflecting plates
Va=800;                                         //final
   anode voltage
D=0.2;                                         //
   distance between the screen and the plates
y=(((V*l)/(2*d*Va))*(D+(l/2)))*10^4            //
   displacement produced
a=((V*l)/(2*d*Va))*10^2;
alpha=atand(a)                                  //angle
   made by the beam with the axis
e=1.6*10^-19;
m=9.1*10^-31;                                    //mass
   of electron
v=((sqrt((2*e*Va)/m))/cosd(alpha))              //
   velocity of electron
printf("the displacement produced is %f cm,the angle
    made by the beam with the axis is %f,velocity of
    electrons is %e m/s",y,alpha,v);
```

Scilab code Exa 7.7 Displacement of electron beam spot on the screen

```
clc();
clear;
//To determine the displacement of the electron beam
    spot on the screen
e=1.6*10^-19;
B=5*10^-5;                                    //magnetic
   field in Wb/m^2
l=0.04;                                       //length of
   magnetic fiekd along the axis
m=9.1*10^-31;                                 //mass of
   electron
D=0.25;                                       //distance of
   the screen from the field
Va=600;                                       //final anode
   voltage
y=(((e*B*l)/m)*sqrt(m/(2*e*Va))*(D+(l/2)))*10^2
printf("the displacement of the electron beam spot
   on the screen is %f cm",y);
```

Scilab code Exa 7.8 Separation on the photographic plate

```
clc();
clear;
//To calculate the seperation on photographic plate
E=2.5*10^4;                                   //electric
   field
B=0.18;                                       //magnetic
   field
v=E/B;                                        //velocity of
   particles
```

```
B1=0.22;                                          //magnetic field in the main chamber
m2=13;                                            //mass number of carbon
m1=12;                                            //mass number of carbon
e=1.6*10^-9;
s=((2*v*(m2-m1)*1.67*10^-27)/(e*B1))*10^12
printf("the seperation on photographic plate is %f cm",s);
```

Scilab code Exa 7.9 Intensity of electric field

```
clc();
clear;
//To determine the intensity of electric field
v=5.6*10^6;                                     //speed of the electron
m=9.1*10^-31;                                   //mass of electron
e=1.6*10^-19;
s=0.03;                                         //distance travelled
E=(m*(v)^2)/(2*e*s)                             //intensity of electric field
printf("The intensity of electric field is %f N/C",E);
```

Scilab code Exa 7.10 Charge to mass ratio of the particle

```
clc();
clear;
//To determine the charge to mass ratio
```

```
v=5*10^7;
B=0.4;                              //magnetic field
r=0.711*10^-3;                      //radius of the circle
Q=v/(B*r)                          //Q=q/m
printf("The charge to mass ratio is %e",Q);
```

Scilab code Exa 7.11 Magnetic field required to bend a beam

```
clc();
clear;
//To determine the magnetic field
m=9.1*10^-31;                                //mass of electron
v=3*10^7;                                    //speed of electron
R=0.05;                                      //radius of the circle
q=1.6*10^-31;
B=((m*v)/(q*R))*10^-9                        // magnetic field
printf("The magnetic field to bend a beam is %f mT",B);
```

Scilab code Exa 7.12 To determine the magnetic field

```
clc();
clear;
//To determine the magnetic field
m=9.1*10^-31;                           //mass of electron
q=1.6*10^-19;
t=8*10^-9;                              //time in ns
B=(2*%pi*m*500)/(q*t)                   //magnetic field
printf("The magnetic field is %f T",B);
```

Scilab code Exa 7.13 To determine the magnetic field

```
clc();
clear;
//To determine the magnetic field
v=9.15*10^7;                          //cyclotron
   frequency of proton
m=1.67*10^-27;                        //mass of proton
q=1.6*10^-19;
B=(2*%pi*v*m)/q                       // magnetic field
printf("The magnetic field is %f T",B);
```

Chapter 8

Magnetic Materials and Specroscopy

Scilab code Exa 8.1 To determine temperatue

```
clc();
clear;
//calculating temperatue when average thermal energy
    of an atom is equal to it's magnetic energy.
//The given condition is (mew*B)=3/2(kT)
mew=0.9*10^-23;                //magnetic dipole moment
B=0.72;                        //magnetic field applied
    in T
k=1.38*10^-23;
T=(2*mew*B)/(3*k)             //T=temperature in Kelvin
printf("The temperature at which the avg.thermal
   energy of an atom is equal to its magnetic energy
    is%f K",T);
```

Scilab code Exa 8.2 Magnetisation of paramagnetic salt

```
clc();
clear;

//Calculating the magnetisation of paramagnetic salt

//(C=mew0*M*T)/B.
//Therefore M=(C*B)/(mew0*T)
C=2*10^-3;                //C is curies constant
B=0.4;                    //applied magnetic field T
mew0=4*%pi*10^-7;
T=300;                    //temperature in kelvin
M=(C*B)/(mew0*T)         //M is magnetisation
printf("%f A/m",M);
```

Scilab code Exa 8.3 Zeeman shift in wave length

```
clc();
clear;

//To measure Zeeman shift in wave length

//Zeeman shift in frequency is delta V=eB/4*Pi*m.
//v=c/lambda  and dv=-cB(lambda)^2=mod[(c*d*lambda)/
   lambda^2]
//Therefore delta lambda=(lambda^2*delta v)/c=eB(
   lambda^2)/4*pi*m*c
e=1.6*10^-19;
B=0.35;                        //magnetic field
lambda=500*10^-9;              //wavelength in m
m=9.1*(10^-31);
c=3*(10^8)*10^-9;              //speed of light
deltalambda=(e*B*(lambda)^2)/(4*(%pi)*m*c)
printf("Zeeman shift in wave length is %f nm",
   deltalambda);
```

Scilab code Exa 8.4 To determine temperature

```
clc();
clear;
//Determining temperature when magnetisation,curies
   constant,magnetic field are given

//T=(C*B)/(mew0*B)
C=2.1*10^-3;              //C is curie's constant
B=0.38;                   //magnetic field
mew0=4*(%pi)*10^-7;     //molecular magnetic moment
M=2.15;                   //magnetisation in A/m
T=(C*B)/(mew0*M)        //temperature in kelvin
printf("Temperature is %f K",T);
```

Scilab code Exa 8.5 Magnetisation of paramagnetic salt

```
clc();
clear;

//To measure magnetisation of paramagnetic salt


//(M1*T1)=(M2*T2).Therefore M2=(M1*T1)/T2
M1=2;                     //Initial magnetisation in A/m
T1=305;                   //Initial temperature in K
T2=321;
M2=(M1*T1)/T2             //M2 is magnetisation at 321K
printf("Magnetisation at 321 K is %f A/m",M2);
```

Scilab code Exa 8.6 To calculate the magnetic field

```
clc();
clear;

//To calculate the magnetic field

mew0=4*(%pi)*10^-7;          //molecular magnetic
    moment
M=4;                         //magnetisation in A/m
T=310;                       //temperature in K
C=1.9*10^-3;                //Curie's constant
B=(mew0*M*T)/C             //magnetic field in T
printf("Magnetic field is %f T",B);
```

Scilab code Exa 8.7 To calculate the magnetic field

```
clc();
clear;

//To calculate the magnetic field
//e/m is gyromagnetic ratio.
deltalambda=0.01*10^-9;                          //
    Zeeman shift
c=3*10^8;                                       //
    speed of light in  vacuum in m/s
lambda=600*(10)^-9;                             //
    wavelength in m
e=1.6*10^-19;
m=9.1*10^-31;
B=(deltalambda*4*(%pi)*m*c)/(e*(lambda)^2)     //
    uniform magnetic field
printf("Magnetic field is %f T",B);
```

Scilab code Exa 8.8 To determine e m ratio

```
clc();
clear;
// To determine e/m ratio
//e/m=(deltalambda*4*pi*c)/(B*(lambda)^2)
deltalambda=0.01*10^-9;                                    //Zeeman shift
c=3*(10^8);                                               //speed of light in vacuum in m/s
B=0.78;                                                   //magnetic field
lambda=550*(10^-9);                                       //wavelength in nm
Y=(deltalambda*4*(%pi)*3*(10^8))/(B*(lambda)^2)   //e/m ratio
printf("e/m =%e",Y);
```

Chapter 9

Quantum Theory

Scilab code Exa 9.1 Power radiated by the filament

```
clc();
clear;
//To calculate the power radiated by the filament
r=0.05;                                    //radius of the wire in mm
l=4;                                       //length of the wire in cm
A=2*%pi*r*l*10^-5;                         //in m^2
//According to Stephen-Boltzmann law R=e*s*(T^4)
//P=R*A
e=1;
T=3000;                                    //temperature in K
s=5.6703*10^-8;                            //s is stepfan's constant
p=s*(T)^4*A*e
printf("The power radiated by the filament is %f W",p);
```

Scilab code Exa 9.2 To calculate the number of photons

```
clc();
clear;
//To calculate the number of photons that reach the surface of the earth per square cm per second
h=6.626*10^-34;                                        //plancks constant
c=3*10^8;                                              //speed of light
lambda=550;                                            //wavelength in nm
E=(h*c)/(lambda*10^-9);                                 //energy of photon in J
Es=0.1/E                                               //number of photons per square cm per second
printf("The number of photons that reach the surface of the earth per square cm per second are %e ",Es);
```

Scilab code Exa 9.3 Maximum kinetic energy of photoelectron

```
clc();
clear;
//To determine the maximum kinetic energy of photoelectron
h=6.626*10^-34;                                        //plancks constant
c=3*10^8;                                              //speed of light
lambda=300*10^-9;                                      //wavelength
E=(h*c)/lambda                                       //energy of photon
phi=(2.2*1.6*(10^-19))-1.94;
```

```
Kmax=E-phi                                        //maximum kinetic energy
printf("The maximum kinetic energy  is %f eV",Kmax);
```

Scilab code Exa 9.4 To determine the potential difference

```
clc();
clear;
//To calcuate the potential difference
h=6.626*10^-34;                                  //plancks constant
c=3*10^8;                                        //speed of light
lambda=175*10^-9;                                //wavelength of light
w=5;                                             //work function of nickel
E=(h*c)/(lambda*1.6*10^-19);                     //Energy of 200 nm photon
//From photoelectric equation E-w is the potential difference
p=E-w                                            //potential difference required to stop the fastest electron
printf("The potential difference that should be applied to stop fastest photoelectron emitted by the surface is %f eV",p);
```

Scilab code Exa 9.5 Shortest wavelength of X rays

```
clc();
clear;
//To calculate the shortest wavelength of X-rays produced by the machine
```

```
h=6.626*10^-34;                                    //plancks constant
c=3*10^8;                                          //speed of light
e=1.6*10^-19;
V=50;                                              //accelerating voltage in kV
lambdamin=((h*c)/(e*V*10^3) )*10^9
printf("The shortest wavelength of X-rays roduced by the machine is %f nm",lambdamin);
```

Scilab code Exa 9.6 To calculate wavelength of line

```
clc();
clear;
//To determine the wavelength
lambda1=0.708;                                 //wavelength of a certain line in an X-ray spectrum
Z1=42;                                         //atomic number
Z2=24;
a=1;                                           //screening constant
lambda2=(lambda1*(Z1-a)^2)/((Z2-a)^2)
printf("The wavelength of same line in target of Z=24 is %f A",lambda2);
```

Scilab code Exa 9.7 Distance between atomic planes

```
clc();
clear;
//To calculate the distance between atomic planes
//From Bragg's law 2*d*sin(teta)=n*lambda
```

```
n=1;
lambda=0.32;                            //wavelength in nm
teta=28;                                //angle at which first order Bragg's reflection is observed
d=lambda/(2*sind(28))
printf("The distance between atomic planes is %f nm",d);
```

Scilab code Exa 9.8 Wavelength of X rays

```
clc();
clear;
//To calculate the wavelength of X-rays in the incident beam
h=6.626*10^-34;                            //plancks constant
teta=50;
m=9.1*10^-31;                              //mass of electron
c=3*10^8;                                  //speed of light
deltalambda=(h/(m*c))*(1-cosd(50))*10^12
lambdafin=2.5;                             //wavelength of scattered X-rays
lambdainit=lambdafin-deltalambda
printf("The wavelength of X-rays in the incident beam is %f pm",lambdainit);
```

Scilab code Exa 9.9 To determine the power of laser

```
clc();
clear;
```

```
//To determine the power of the laser
h=6.626*10^-34;                              //plancks constant
c=3*10^8;                                    //speed of light
lambda=500;                                  //wavelength of laser
E=(h*c)/lambda;                              //Energy of 500 nm photon
N=2.52*10^16;                                //number of photons in a 20ms pulse
p=((E*N)/(20*10^-3))*10^9
printf("The power of the laser is %f W",p);
```

Scilab code Exa 9.10 Work function of the surface

```
clc();
clear;
//To calculate the work function of the surface
h=6,626*10^-34;                                        //plancks constant
c=3*10^8;                                              //speed of light
lambda=350;                                            //threshold wavelength
W=((h*c)/(lambda*10^-9*1.6*10^-19))*10^-34              //work function of the surface
printf("The workfunction of the surface is %f eV",W);
```

Scilab code Exa 9.11 To calculate the accelerating voltage

```
clc();
clear;
//To calculate the accelerating voltage
h=6.626*10^-34;                                   //plancks constant
c=3*10^8;                                         //speed of light
e=1.6*10^-19;
lambdamin=0.02*10^-9;                             //minimum wavelength in nm
V=((h*c)/(lambdamin*e))*10^-3                     //accelerating voltage
printf("The accelerating voltage needed to produce minimum wavelength of 0.02 nm is %f kV",V);
```

Scilab code Exa 9.12 Angle of second order Braggs reflections

```
clc();
clear;
//To determine the angle of second order bragg's reflections
//According to Bragg's eq.2*d*sin(teta)=n*lambda
n=2;                                  //since second order Bragg's eq.
d=5;                                  //since d=5(lambda)
lambda=1;
a=(n*lambda)/(2*5*lambda);
teta=asind(a)                        //angle of second order Braggs reflections
printf("The angle of second order Braggs reflection is %f",teta);
```

Scilab code Exa 9.13 Accelerating voltage applied

```
clc();
clear;
//To determine the accelerating voltage applied
h=6.626*10^-34;                                    //plancks
    constant
c=3*10^8;                                          //speed of
    light
lambda=0.03;                                       //wavelength
     in nm
E=(h*c)/(lambda*10^-9);                            //energy of
    photon
TE=((E*100)/80);                                   //Total
    energy.E=80% of TE in J
TE=TE/(16.0017*10^-17)                                     //
    Total energy in kV
printf("The electron must have been accelerated
    through a potential difference of %f kV",TE);
```

Chapter 10

Quantum Mechanics

Scilab code Exa 10.1 To calculate de Broglie wavelength

```
clc();
clear;
//To calculate the de Broglie wavelength
v=10^7;                         //speed of electron in
    m/s
h=6.626*10^-34;                 //plancks constant
m=9.1*10^-31;                   //mass of electron
lambda=h/(m*v)                  //de Broglie
   wavelength in m
printf("The de Broglie wavelength is %e",lambda);
```

Scilab code Exa 10.2 To determine the kinetic energy

```
clc();
clear;
//To determine the kinetic energy of proton &
   electron
h=6.626*10^-34;                           //plancks
   constant
```

```
lambda=0.3;                                    //de Broglie wavelength
p=h/(lambda*10^-9);                                    //uncertainity in determining momentum in kg.m/s
//For electron
me=9.1*10^-31;                                  //mass of electron
K1=p^2/(2*me);                                   //kinetic energy of electron in J
//For proton
mp=1.672*10^-27;                                //mass of proton
K2=p^2/(2*mp)                                    //kinetic energy of proton in J
printf("The kinetic energy of electron is %e J and kinetic energy of proton is %e J",K1,K2);
```

Scilab code Exa 10.3 To calculate the kinetic energy

```
clc();
clear;
//To determine the kinetic energy
//K=p^2/(lambda^2*2*m) where K is kinetic energy
h=6.626*10^-34;                                  //plancks constant
lambda=10^-14;                                   //de Broglie wavelength
m=9.1*10^-31;                                    //mass of electron
K=(h^2/((lambda^2)*2*m*1.6*10^-19))*10^-9
printf("The kinetic energy is %f Gev",K);
//It is not possible to confine the electron to a nucleus.The experimental observations show that even electrons assosciated with unstable atoms never have energy more than a fraction of MeV
```

Scilab code Exa 10.4 Uncertainity in determining the position

```
clc();
clear;
//To determine the uncertainity in determining the
   position of this electron
m=9.1*10^-31;                              //mass of
   electron
v=6*10^3;                                  //speed of
   electron
p=m*v;                                     //uncertainity
    in momentum in kg.m/s
h=6.626*10^-34;                            //plancks
   constant
deltap=0.00005*p;                          //uncertainity
    in p is 0.00005 of p
deltax=(h/(4*%pi*deltap))*10^3            //uncertainity
   in position
printf("The uncertainity in position is %f mm",
   deltax);
```

Scilab code Exa 10.5 First 2 energy levels of a particle

```
clc();
clear;
//To determine the first two energy levels using
   particle-in-a-box model
L=3*10^-5;
                                                  //
   diameter of the sphere
```

```
h=6.626*10^-34;                                              //plancks constant
m=1.67*10^-27;                                               //mass of the particle
n=1;
E1=((h^2)*(n^2))/(8*m*(L^2)*1.6*10^-19)*10^12          //first energy level
E2=E1*2^2                                                    //second energy level
printf("The first energy level is %f Mev",E1);
printf("The second energy level is %f Mev",E2);
```

Scilab code Exa 10.6 Ground state and first excited state energy

```
clc();
clear;
//To determine ground state & first excited state energy
h=6.626*10^-34;                             //plancks constant
a=2*10^12;                                  //angular frequency in rad/s
E0=(0.5*(h/(2*%pi*1.6*10^-19))*a)*10^3     //ground state energy
E1=(1.5*(h/(2*%pi*1.6*10^-19))*a)*10^3     //first excited state energy
printf("The ground state energy is %f Mev and first excited state energy is %f Mev",E0,E1);
```

Scilab code Exa 10.7 To determine kinetic energy of electron

```
clc();
clear;
//To determine the kinetic energy of electron
h=6.626*10^-34;                                   //plancks constant
E=85;                                             //Energy in keV
c=3*10^8;                                         //speed of light
lambda=(h*c)/(E*10^3*(1.6*10^-19));              //de Broglie wavelength
m=9.1*10^-31;                                     //mass of electron
K=((h^2)/((lambda^2)*2*m*1.6*10^-9))*10^7 //kinetic energy of electron
printf("The kinetic enery of the electron is %f keV",K);
```

Scilab code Exa 10.8 To determine velocity of electron

```
clc();
clear;
//To determine velocity of an electron
lambda=0.08;                //de Briglie wavelength
m=9.1*10^-31;               //mass of electron
h=6.626*10^-34;                                           //plancks constant
v=h/(m*lambda*10^-9)                                     //velocity of the electron
printf("The velocity of the electron is %f m/s",v);
```

Scilab code Exa 10.9 To determine the potential difference

```
clc();
clear;
//To determine the potential diference
h=6.626*10^-34;                    //plancks constant
lambda=589*10^-9;                  //wavelength in m
m=9.1*10^-31;                      //mass of electron
e=1.6*10^-19;
V=((h^2)/((lambda^2)*2*m*e))*10^6  //potential diference
printf("The potential difference through which an electron should be accelerated to have a wavelength of 589 nm is %f microV ",V);
```

Scilab code Exa 10.10 Uncertainity in velocity of electron

```
clc();
clear;
//To determine uncertainity in velocity
deltax=0.92*10^-9;                        //uncertainity in position
m=9.1*10^-31;                             //mass of electron
h=6.626*10^-34;                           //plancks constant
deltav=h/(4*%pi*m*deltax)                //uncertainity in velocity
printf("The uncertainity in velocity is %f m/s",deltav);
```

Scilab code Exa 10.11 Length of the box for a proton

```
clc();
clear;
//To determine the length of a box
h=6.626*10^-34;                                          //
   plancks constant
n=3;                                                     //
   for second excited state
m=1.67*10^-27;                                           //
   mass of proton
E=0.5;                                                    //
   energy in Mev
L=((h*n)/sqrt(8*m*E*10^6*1.6*10^-19))*10^15              //
   length of the box
printf("The length of the box for proton in its
   second excited state is %f fm ",L);
```

Chapter 11

Nuclear Radiations and Detectors

Scilab code Exa 11.1 To calculate the radius of Li

```
clc();
clear;
//To calculate the radius of Li(mass no.7)
r0=1.2;                  //in fm
A=7;                     //mass number
//r=r0*(A)^1/3
r=r0*(A)^(1/3)
printf("The radius of Li with mass number 7 is %f fm
   ",r);
```

Scilab code Exa 11.2 Binding energy per nucleon

```
clc();
clear;
//To determine the binding energy per nucleon of U
   with mass no. 235
```

```
M=235.043945;             //atomic mass of uranium
Z=92;                     //atomic number of uranium
mp=1.007825;                                    //mass of proton
N=143;                                          //no.of neutrons
mn=1.008665;                                    //mass of neutron
A=235;                                          //number of nucleons
B=[[(Z*mp)+(N*mn)-(M)]/A]*931.5                 //Binding energy in MeV
printf("The binding energy per nucleon is %f MeV",B);
```

Scilab code Exa 11.3 minimum energy required to remove a neutron from nucleus

```
clc();
clear;
//To calculate the minimum energy required to remove a neutron from Ca(A=43;Z=20)
//After removing one neutron from Ca(A=43;Z=20) it becomes Ca(A=42;Z=20)
M=41.958622;                  //mass of Ca(A=42;Z=20)
mn=1.008665;                  //mass of neutrom
C=M+mn;
E=42.95877;                   //mass of Ca(A=43;Z=20)
D=C-E;
B=D*931.5                     //Binding energy of neutron
printf("The binding energy of neutron is %f MeV",B);
```

Scilab code Exa 11.4 To determine the Q value of the reaction

```
clc();
clear;
//To determine the Q-value
mBe=9.012182;                    //Atomic mass of
   beryllium in u
mHe=4.002603;                   //Atomic mass of helium
mn=1.008665;                    //mass of neutron
mC=12.000000;                   //Atomic mass of carbon
Q=(mBe+mHe-mn-mC)*931.5         //Q is called energy
   balance of the reaction
printf("The Q-value is %f MeV",Q);
```

Scilab code Exa 11.5 Q value of the reaction and energy of each alpha particle

```
clc();
clear;
//To determine the Q-value
mLi=7.016004;                   //mass of Lithium(A=7)
mH=1.007825;                    //mass of Hydrogen(A=1)
mHe=4.002603;                   //mass of helium(A=4)
Q=[mLi+mH-2*(mHe)]*931.5         //Q is the energy
   balance of the reaction
p=0.5;                          //energy of proton in
   MeV
//The energy of 2 alpha particles is equal to the Q-
   value + energy of proton.
Ealpha=(Q+p)/2                  //energy of each alpha
   particle
printf("The Q-value of the reaction is %f MeV and
   energy of each alpha particle is %f MeV",Q,Ealpha
   )
```

Scilab code Exa 11.6 To calculate the energy released

```
clc();
clear;
//To determine the amount of energy released
wt=1000;                                    //weight in gm
A=235;                                      //mass number of
    uranium
N=[6.02*(10^23)/A]*wt;                      //no.of nuclei in
    1kg of uranium
Q=208;                                      //energy-balance
    of the reaction
E=N*Q;                                      //Energy released
    in MeV
//1MeV=4.45*10^-20kWh
E=E*4.45*(10^-20)
printf("The energy released is %f kWh",E);
```

Scilab code Exa 11.7 power output of a nuclear reactor

```
clc();
clear;
//To determine the power output of a nuclear reactor
wt=5000;                                   //weight in gm
A=235;                                     //mass number of
    uranium
N=(6.02*(10^23)/A)*wt;                     //number of nuclei
    in 5 Kg
Ef=208;                                    //Energy released
    per fission in MeV
E=N*Ef;                                    //Energy in MeV
E=E*1.6*(10^-13);                           //Energy in J
```

```
T=24*60*60;                              //time
P=E/T                                    //power
printf("The power output of a nuclear reactor is %f MW",P);
```

Scilab code Exa 11.8 Amount of U required

```
clc();
clear;
//To calculate the amount of Uranium(A=235) required
A=235;                                   //mass number of uranium
p=1000;                                  //amount of electric power produced
e=0.32;                                  //energy conversion efficiency of the plant
I=p/e;                                   //Input nuclear energy in MW
f=200;                                   //fission energy per event in MeV
TE=I*(10^6)*3600*24*365;                 //total energy in J
EF=f*(10^6)*1.6*(10^-19);                //Energy released per fission event in J
N=TE/EF;                                 //Number of nuclei required
M=(N*A)/[6.02*(10^23)]*10^-3             //corresponding mass in kg
printf("The amount of uranium required is %f kg",M);
```

Scilab code Exa 11.9 Frequency of oscillator to be used

```
clc();
```

```
clear;
//To determine the frequency of oscillator to be used to accelerate protons
q=1.6*(10*10^-19);                              //charge of the particle
B=1;                                            //magnetic field in T
m=1.67*(10^-27);                                //mass of proton in kg
omega=(q*B)/m;                                  //angular frequency in radians/s
v=[omega/(2*%pi)]*10^-8;                        //in MHz
r=0.5;                                          //radius in m
s=omega*r;                                      //speed of proton in m/s
K=[m*(s^2)]*(1/2)*6.27*10^10                    //kinetic energy of protons emerging from cyclotron
printf("The frequency of oscillator to accelerate protons is %f radians/s ,speed of proton is %f m/s and the kinetic energy of protons emerging from the cyclotron is %f MeV",omega,s,K);
```

Scilab code Exa 11.10 To calculate the radius

```
clc();
clear;
//To calculate radius
rho=1.83*(10^17);                                              //average density of carbon nucleus in kg/m^3
m=12;                                                          //mass in u
//rho=m/[(4/3)*pi*r]. Therefore r=[m/[(4/3)*pi*rho]]^(1/3)
```

```
r=[m*1.66*(10^-27)/((4/3)*%pi*rho)]^(1/3)*10^15
            //radius in fm
printf("The radius is %f fm",r);
```

Scilab code Exa 11.11 To calculate the cyclotron frequency

```
clc();
clear;
//To calculate cyclotron frequency of of electron
q=1.6*(10^-19);                    //charge of the
   particle
B=5;                               //magnetic field in
    T
m=9.1*(10^-31);                    //mass of electron
   in kg
v=(q*B)/(2*%pi*m)                  //cyclotron
   frequency in Hz
printf("cyclotron frequency of of electron is %e Hz"
   ,v);
```

Scilab code Exa 11.12 To determine the magnetic field

```
clc();
clear;
//To determine the magnetic field
k=1.5;
   //maximum kinetic energy in MeV
m=1.67*10^-27;                                    //
   mass of proton in kg
q=1.6*(10^-19);                                   //
   charge of particle
r=0.35;                                           //
   radius in m
```

```
//k=[(q^2)*(B^2)*(r^2)]/(2*m).Therefore B=[sqrt(k*2*m)]/q*r
B=sqrt(k*10^6*1.6*10^-19*2*m)/(q*r)                    //magnetic field in T
printf("The mgnetic field is %f T",B);
```

Scilab code Exa 11.13 To determine the magnetic field

```
clc();
clear;
//To calculate magnetic field
m=1.67*(10^-27);                    //mass of proton
q=1.6*10^-19;                    //charge of particle
v=25;                    //cyclotron frequency in MHz
//v=(q*B)/(2*pi*m).Therefore B=(v*2*pi*m)/q
B=(v*10^6*2*%pi*m)/q
printf("The required magnetic field is %f T",B);
```

Scilab code Exa 11.14 Charge to mass ratio for proton

```
clc();
clear;
//To determine the charge to mass ratio for proton
v=20;                                   //cyclotron frequency in MHz
B=1.3;                                  //magnetic field in T
//d=q/m=(2*pi*v)/B
d=(2*%pi*v*10^6)/B                      //charge to mass ratio of proton
```

```
printf("q/m=%f C/kg",d);
```

Chapter 13

Optical Fibre

Scilab code Exa 13.1 Numerical aperture of a fibre

```
clc();
clear;
//To calculate the numerical aperture
n1=1.49;                         //refractive index of
   core
n2=1.46;                         //refractive index of
   cladding
//NA=sqrt((n1^2)-(n2^2))
NA=sqrt((n1^2)-(n2^2))           //Numerical aperture
printf("The numerical aperture is %f",NA);
```

Scilab code Exa 13.2 To determine the acceptance angle

```
clc();
clear;
//To determine acceptance angle
NA=0.5;                                    //numerical
   aperture of fibre
```

```
n0=1;                                   //refractive index of the medium (air) from which ray enters the fibre
//NA=n0*sin(i)where i is the acceptance angle.
i=asind(NA/n0)                          //acceptance angle in degrees
printf("The acceptance angle is %d degrees",i);
```

Scilab code Exa 13.3 Number of guided modes

```
clc();
clear;
//To determine the number of guided modes
NA=0.25;                                //numerical apperture
lambda=0.75;                            //wavelength in micro metres
a=25;                                   //core radius i.e 50/2=25
f=(2*%pi*a*NA)/lambda;                  //normalised frequency
Ng=(f^2)/2                              //number of guided modes
printf("The number of guided modes is %f",Ng);
```

Scilab code Exa 13.4 Signal attenuation per kilometer

```
clc();
clear;
//To determine the signal attenuationnper kilometer
pi=100;                                 //mean optical power launched in micro meter
```

```
po=5;                                    //mean optical power at fibre output
S=10*log10(pi/po);                       //signal attenuation un dB
l=6;                                     //length in km
Sk=S/l                                   //signal ayyenuation per kilometer
printf("The signal attenuation per kilometer is %f dB/km",Sk);
```

Scilab code Exa 13.5 Numerical aperture for the optical fibre

```
clc();
clear;
//To determine the numerical apperture
ns=2.89;                                 //sum of refractive indices of core & cladding
nd=0.03;                                 //difference of refractive indices of core & cladding
NA=sqrt(ns*nd)                           //numerical apperture
printf("The numerical apperture for the optical fibre is %f",NA);
```

Scilab code Exa 13.6 Number of guided modes

```
clc();
clear;
//To determine the number of guided modes
NA=0.28;                                       //numerical aperture
a=30;                                          //core radius
```

```
lambda=0.8;                                    //wavelength in micro meter
f=(2*%pi*a*NA)/lambda;                         //normalised frequency
Ng=f^2/2                                       //number of guided modes
printf("The number of guided modes is %f",Ng);
```

Scilab code Exa 13.7 To determine the mean optical power

```
clc();
clear;
//To calculate the mean optical power launched into a fibre
S=2;                     //signal attenuation per km
l=1;                     //length in km.Since l=1 S=2
//S=10*log(pi/p0)(or)pi/p0=10^(S/10)
p0=20;                   //mean optical power at fibre output
pi=p0*10^(S/10)          //mean optical power launched into fibre
printf("The mean optical power launched into a fibre of length of 1km is %f micri W",pi);
```

Scilab code Exa 13.8 To determine the mean optical power

```
clc();
clear;
//To determine pi/p0
S=2.3;                    //Signal attenuation per km
l=4;                      //length in km
```

```
S=S*l;                          //signal attenuation for 4 km in dB
//S=10*log(pi/po)(or)pi/po=10^(S/10)
P=10^(S/10)                     //mean optical power launched into fibre(pi)/mean optical power at fibre output (po)
printf("pi/po=%f",P);
```

Scilab code Exa 13.9 To calculate signal attenuation

```
clc();
clear;
//To determine signal attenuation
//given condition:po=pi/4where p0=mean optical power at fibre output,pi=mean optical power launched into fibre
//S=10*log(pi/po)
S=10*log10(1/(1/4))             //signal attenuation in dB
printf("Signal attenuation when po=pi/4 is %f dB",S);
```