

Scilab Textbook Companion for
Engineering Physics
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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

Optics

Scilab code Exa 1.1 To calculate intensity ratio of bright and dark fringes

```
1 //clc();
2 clear;
3 // To calculate the intensity ratio of bright and
   dark fringes
4 I1=1;
5 I2=25;
6 // Intensity is directly proportional to square of
   the amplitude
7 A1=sqrt(I1);
8 A2=sqrt(I2);
9 Imax=(A1+A2)^2;
10 Imin=(A1-A2)^2;
11 I=Imax/Imin;
12 printf("The intensity ratio of bright and dark
   fringes is %f",I);
```

Scilab code Exa 1.2 To determine the order that will be visible at a point

```

1 //clc ();
2 clear;
3 // To determine the order that will be visible at a
   point
4 n1=21;
5 lambda1=6000*10(-8);           // The 21st order
   maximum is observed for source of light in
   centimetres
6 lambda2=4500*10(-8);
7 n2=(n1*lambda1)/(lambda2);
8 printf("The order that will be visible if the source
   is replaced by 4500 Armstrong is %f",n2);

```

Scilab code Exa 1.3 To determine the slit separation in Youngs double slit experiment

```

1 //clc ();
2 clear;
3 // To determine the slit separation in Young's
   double slit experiment
4 lambda=5100*10(-8);           //A source of light in
   centimetres
5 D=200;           // Separation between screen
   and slit in centimetres
6 beeta=0.01;           // Overall separation from
   double slit in metres
7 d=(lambda*D)/beeta;
8 printf("The separation between slits if the source
   of light is incident from a narrow slit on a
   double slit is %f m",d);

```

Scilab code Exa 1.4 To determine the thickness of the mica sheet

```

1 //clc ();
2 clear;
3 // To determine the thickness of the mica sheet
4 mew=1.58; // Refractive index of mica sheet
5 d=0.1; // Seperation between slits in
    centimetres
6 x=0.2; // Fringe shifted by a distance in
    centimetres
7 D=50; // Distance of the screen from slits in
    centimetres
8 t=(x*d)/(D*(mew-1));
9 printf("The thickness of the mica sheet is %f cm",t)
    ;

```

Scilab code Exa 1.5 To determine the fringe width

```

1 //clc ();
2 clear;
3 // To determine the fringe width
4 lambda=5000*10(-8); //Wavelength of light
    in centimetres
5 D=50; // Distance between the slit and screen
    in centimetres
6 d=0.05; // Seperation between two slits in
    centimetres
7 beeta=(lambda*D)/d;
8 printf("the fringe width is %f cm",beeta);

```

Scilab code Exa 1.6 To determine the wavelength of source of light

```

1 //clc ();
2 clear;
3 // To determine the wavelength of source of light

```

```

4 beeta=0.30;          // fringe spacing in centimtres
5 d=0.04;             // distance between two slits in
                      centimtres
6 D=180;              // distance between the slit and
                      screen in centimetres
7 lambda=(beeta*d*10^8)/D;
8 printf("the wavelength of source of light is %f
          Armstrong",lambda);

```

Scilab code Exa 1.7 To calculate the wavelength of monochromatic light

```

1 //clc();
2 clear;
3 // To calculate the wavelength of monochromatic
  light
4 beeta=0.04;         // fringe width in centimetres
5 d=0.1;              // seperation between slits in
                      centimetres
6 D=80;               //distance between slits and screen
                      in centimetres
7 lambda=(d*beeta*10^8)/D;
8 printf("the wavelength of monochromatic light is %f
          Armstrong",lambda);

```

Scilab code Exa 1.8 To determine the fringe width

```

1 //clc();
2 clear;
3 // To determine the fringe width
4 lambda=5000*10^(-8); //wavelength of
                      monochromatic light in centimetres
5 d=0.05;             // seperation between two slits in
                      centimetres

```

```

6 D=50;           // distance between slit and screen
   in centimetres
7 beeta=(lambda*D)/d;
8 printf("the fringe width is %f cm",beeta);

```

Scilab code Exa 1.9 To determine the thickness of a soap film

```

1 //clc();
2 clear;
3 // To determine the thickness of a soap film
4 mew=1.33;           //refractive index of soap film
5 n=2;
6 lambda=7000*10(-8);           //wavelength of red light
   in centimetres
7 t=(((2*n)+1)*(lambda/2))/(2*mew);
8 printf("thickness of the soap film which gives
   constructive second order interference is %f cm",
   t);

```

Scilab code Exa 1.10 To determine the refractive index of the transparent sheet in Newtons ring experiment

```

1 //clc();
2 clear;
3 // To determine the refractive index of the
   transparent sheet in Newton's ring experiment
4 lambda=5460*10(-8);           //wavelength of light
   in centimetres
5 t=6.3*10(-4);           //thickness of the
   transparent material in centimetres
6 n=6;
7 mew=((n*lambda)/t)+1;

```

```
8 printf("the refractive index of the transparent
sheet when the central bright fringe is occupied
by the 6th bright fringe is mew=%f",mew);
```

Scilab code Exa 1.11 To determine the thickness of the glass plate

```
1 //clc();
2 clear;
3 // To determine the thickness of the glass plate
4 mew=1.56;           //refractive index of the glass
plate
5 lambda=5000*10^(-8); //wavelength of the light
in centimetres
6 n=16;
7 t=(n*lambda)/(mew-1);
8 printf("thickness of the glass plate in centimetres
when 16 fringes are displaced is %f cm",t);
```

Scilab code Exa 1.12 To determine the thickness of the glass plate

```
1 //clc();
2 clear;
3 // To determine the thickness of the glass plate
4 lambda=6000*10^(-8); //wavelength of
parallel beam of light in centimetres
5 mew=1.5;           //refractive index of glass
plate
6 r=50;             //angle of refraction in
degrees
7 n=1;             //for least thickness
8 t=(n*lambda)/(2*mew*cosd(r));
```

```
9 printf("the least thickness of the glass plate in
centimetres which will appear dark by reflection
is %f cm",t);
```

Scilab code Exa 1.13 To calculate the thickness of the glass plate

```
1 //clc();
2 clear;
3 // To calculate the thickness of the glass plate
4 lambda=5000*10(-8); //wavelength of light
in centimetres
5 n=6; //shift of the central range
or the ratio between S and beeta
6 mew=1.5; //refractive index of glass
plate
7 t=(n*lambda)/(mew-1);
8 printf("the thickness of the glass plate when the
central fringe is shifted to the position of 6th
bright fringe is %f cm",t);
```

Scilab code Exa 1.14 To determine the refractive index of liquid in Newtons ring

```
1 //clc();
2 clear;
3 // To determine the refractive index of liquid in
Newton's ring
4 D8=1.42; //diameter of the 8th ring in
centimetres
5 D8new=1.25; //new diameter of the 8th ring in
centimetres
6 mew=(D82)/(D8new2);
```

```
7 printf("refractive index of the liquid when the
    liquid is introduced between the lens and glass
    plate is %f",mew);
```

Scilab code Exa 1.15 To determine the thickness of the thinnest film

```
1 //clc();
2 clear;
3 // To determine the thickness of the thinnest film
4 n=1;
5 lambda=6000*10(-8); //wavelength of yellow
    light in centimetres
6 mew=1.33; //refractive index of the film
7 r=0; //angle of refraction in
    degrees
8 t=(n*lambda)/(2*mew*cosd(r)*10(-2));
9 printf("thickness of the thinnest film in which
    destructive interference takes place is %f cm",t)
    ;
```

Scilab code Exa 1.16 To determine the radius of curvature of plano convex lens

```
1 //clc();
2 clear;
3 // To determine the radius of curvature of plano
    convex lens
4 lambda=6000*10(-8); //wavelength of light in
    centimetres
5 m=18;
6 n=8;
7 Dm=0.65; //diameter of 18th ring in
    centimetres
```



```

8 Dn=0.35;           //diameter of 8th ring in
   centimetres
9 R=(Dm^2-Dn^2)/(4*lambda*(m-n));
10 printf("Radius of curvature of the plano convex lens
   when the wavelength of light used is 6000
   Armstrong is %f cm",R)

```

Scilab code Exa 1.17 To determine the refractive index of the liquid

```

1 //clc();
2 clear;
3 // To determine the refractive index of the liquid
4 D12air=1.45;           //diameter of 12th ring in
   air medium
5 D12liq=1.25;           //diameter of 12th ring in
   liquid
6 mew=(D12air^2)/(D12liq^2);
7 printf("refractive index of the liquid when liquid
   is introduced between the lens and glass plate is
   %f",mew);

```

Scilab code Exa 1.18 To determine the diameter of a ring in Newtons rings experiment

```

1 //clc();
2 clear;
3 //To determine the diameter of a ring in Newton's
   rings experiment
4 D5=0.3;           //diameter of 5th ring in
   centimetres
5 D15=0.62;           //diameter of 15th ring in
   centimetres

```

```

6 //The principle used here is  $Dm^2 - Dn^2 = 4 * \lambda * R * (m - n)$ .
7 //the product  $\lambda * R$  is constant hence it can be
  eliminated.
8 aLHS= $D15^2 - D5^2$ ;
9 aRHS= $4 * (15 - 5)$ ; //By substituting the
  values of m and n in the principle equation
10 bRHS= $4 * (25 - 5)$ ; //By substituting the
  values of m and n in the principle equation
11 c=bRHS/aRHS;
12 D25=sqrt((c*aLHS)+ $D5^2$ );
13 printf("diameter of 25th ring is %f cm",D25);

```

Scilab code Exa 1.19 To determine the radius of curvature of convex lens

```

1 //clc();
2 clear;
3 //To determine the radius of curvature of convex
  lens
4 lambda= $5890 * 10^{-8}$ ; //wavelength in
  centimetres
5 m=15;
6 n=5;
7 Dm=0.590; //diameter of 15th ring in
  centimetres
8 Dn=0.336; //diameter of 5th ring in
  centimetres
9 R=(Dm-Dn)/(4*lambda*(m-n));
10 printf("radius of curvature of convex lens is %f cm"
  ,R);

```

Scilab code Exa 1.20 To determine the wavelength of the light used

```

1 //clc ();
2 clear;
3 //To determine the wavelength of the light used
4 R=70;           //radius of curvature of the lens in
   centimetres
5 n=10;
6 Dn=0.433       //diameter of 10th dark ring in
   centimetres
7 lambda=(Dn^2)/(4*R*n);
8 printf("the wavelength of the light used when a
   convex lens is exposed by a monochromatic light
   is %f cm",lambda);

```

Scilab code Exa 1.21 To determine the slit width

```

1 //clc ();
2 clear;
3 //To determine the slit width
4 theta=15;      //angle in degrees
5 lambda=6500*10^(-8); //wavelength in
   centimetres
6 n=1;
7 a=(n*lambda)/sind(theta);
8 printf("slit width illuminated by white light is %f
   cm",a);

```

Scilab code Exa 1.22 To determine the wavelength of light

```

1 //clc ();
2 clear;
3 //To determine the wavelength of light
4 theta=15;      //first diffraction maxima in
   degrees

```

```

5 a=2.5*10^(-6);           //slit width in metres
6 lambda=(a*sind(theta)*10^10)/1.43;
7 printf("wavelength of light is %f Armstrong",lambda)
  ;

```

Scilab code Exa 1.23 To determine the wavelength of spectral line

```

1 //clc();
2 clear;
3 //To determine the wavelength of spectral line
4 n=2;
5 N=4250;           //grating in lines per centimetre
6 theta=30;        //angle in degrees
7 e=1/N;
8 lambda=(e*sind(theta)*10^8)/n;
9 printf("wavelength of the spectral line when a plane
   transmission grating is illuminated with a
   sodium light is %f Armstrong",lambda);

```

Scilab code Exa 1.24 To determine the angular separation

```

1 //clc();
2 clear;
3 //To determine the angular separation
4 lambda=600*10^(-9);           //wavelength of light
   in metres
5 a=1*10^(-6);           //slit width in metres
6 n=1;
7 theta=asind((n*lambda)/a);
8 printf("the angular separation between the first
   order minima and central maxima of either side is
   %f degrees",theta);

```

Scilab code Exa 1.25 To determine the visible number of orders

```
1 //clc();
2 clear;
3 //To determine the visible number of orders
4 N=10520;           //grating lines in lines per
   centimetre
5 theta=90;         //angle in degrees
6 lambda=5*10(-5); //wavelength of light in
   centimetres
7 e=1/N;
8 n=(e*sind(theta))/lambda;
9 printf("the number of orders visible in grating
   spectra is %f",n);
```

Scilab code Exa 1.26 To determine the slit width

```
1 //clc();
2 clear;
3 //To determine the slit width
4 x=4.2*10(-3); //distance between central max
   to first max in metres
5 D=0.6; //distance between screen and
   slit in metres
6 lambda=6000*10(-10); //wavelength of light
   in metres
7 d=(D*lambda)/x;
8 printf("the slit width in a single slit diffraction
   pattern is %f m",d);
```

Scilab code Exa 1.27 To calculate the possible order of spectra

```
1 //clc();
2 clear;
3 //To calculate the possible order of spectra
4 N=5.905*10^3;           //grating lines in lines per
   centimetre
5 lambda=6000*10^(-8);   //wavelength of light in
   centimetres
6 d=1/N;
7 m=d/lambda;
8 printf("the possible order of spectra with a plane
   transmission grating is %f",m);
```

Scilab code Exa 1.28 To determine the wavelength of light in Fraulhofer double slit diffraction

```
1 //clc();
2 clear;
3 //To determine the wavelength of light in Fraulhofer
   double slit diffraction
4 D=150;                 //distance between slit and
   screen in centimetres
5 d=0.03;                //seperation between slits in
   centimetres
6 beeta=0.3;            //fringe seperation in
   centimetres
7 lambda=(beeta*d*10^8)/D;
8 printf("wavelength of light if fringe seperation is
   0.3 cm is %f Armstrong",lambda);
```

Chapter 2

Ultrasonics

Scilab code Exa 2.1 To determine the fundamental frequency of crystal

```
1 //clc();
2 clear;
3 //To determine the fundamental frequency of crystal
4 t=0.002;           //thickness of the crystal in
                    metres
5 V=5750;           //velocity of sound waves in
                    metres per sec
6 new=V*10(-6)/(2*t);
7 printf("fundamental frequency of the piezo electric
        crystal is %f MHz",new);
```

Scilab code Exa 2.2 To determine the frequency of the fundamental note

```
1 //clc();
2 clear;
3 //To determine the frequency of the fundamental note
4 l=3*10(-3);       //vibrating length in metres
5 Y=8*10(10);       //Youngs modulus in N/m2
```

```

6 rho=2.5*10^3;           //density of crystal in kg/cm
    ^3
7 new=(sqrt(Y/rho))/(2*1);
8 printf("the frequency of the fundamental note
    emitted by piezo-electric crystal is %f Hz",new);

```

Scilab code Exa 2.3 To determine the natural frequency of ultrasonic waves

```

1 //clc();
2 clear;
3 //To determine the natural frequency of ultrasonic
    waves
4 l=5.5*10^(-3);         //thickness of quartz plate
    in metres
5 Y=8.0*10^10;          //youngs modulus of quartz
    in N/m^2
6 rho=2.65*10^3;        //density in kg/m^3
7 new=(sqrt(Y/rho))*10^(-3)/(2*1);
8 printf("natural frequency of ultrasonic waves is %f
    KHz",new);

```

Scilab code Exa 2.4 To determine the natural frequency of iron

```

1 //clc();
2 clear;
3 //To determine the natural frequency of iron
4 l=40*10^(-3);         //length of pure iron rod in
    metres
5 rho=7.25*10^3;        //density of pure iron in kg
    /m^3
6 Y=115*10^9;          //youngs modulus in N/m^2
7 new=(sqrt(Y/rho))*10^(-3)/(2*1);

```



```
8 printf("the natural frequency of pure iron is %f KHz
",new);
```

Scilab code Exa 2.5 To determine the capacitance

```
1 //clc();
2 clear;
3 //To determine the capacitance
4 new=10^6; //frequency of ultrasonics in
    Hz
5 L=1; //Inductance in Henry
6 A=4*(%pi^2)*(new^2)*L;
7 C=10^12/A;
8 printf("the capacitance to produce ultrasonic waves
    is %f PF",C);
```

Scilab code Exa 2.6 To determine the fundamental frequency

```
1 //clc();
2 clear;
3 //To determine the fundamental frequency
4 l=3*10^(-3); //vibrating length of piezo
    electric crystal in metres
5 rho=3.5*10^3; //density of piezo electric
    crystal in kg/m^3
6 Y=8*10^10; //youngs modulus in N/m^2
7 new=((10^-3)*(sqrt(Y/rho))*10^(-3))/(2*l);
8 printf("the fundamental frequency is %f Hz",new);
```

Scilab code Exa 2.7 To determine the fundamental frequency

```
1 //clc();
2 clear;
3 //To determine the fundamental frequency
4 t=0.001; //thickness of the crystal in
    metres
5 rho=2650; //density of quartz in kg/m3
6 Y=7.9*1010; //youngs modulus in N/m2
7 V=sqrt(Y/rho);
8 printf("the fundamental frequency is %f m/s",V);
9 //For fundamental mode of vibration, the thickness
    must be equal to lambda/2
10 lambda=2*t;
11 new=V/lambda;
12 printf("the fundamental frequency is %f Hz",new);
```

Chapter 3

Acoustics of buildings

Scilab code Exa 3.1 To determine the total absorption in the hall

```
1 //clc();
2 clear;
3 //To determine the total absorption in the hall
4 V=7500; //Volume of cinema hall in m^3
5 T=1.5; //Reverberation time in seconds
6 A=(0.165*V)/T;
7 printf("total absorption in hall is %f O.W.U or
   Sabine",A);
```

Scilab code Exa 3.2 To determine reverberation time of hall

```
1 //clc();
2 clear;
3 //To determine reverberation time of hall
4 V=1500; //Volume of hall in m^3
5 S=120; //Seating capacity
6 S1=112; //Area of plastered wall in m^2
7 C1=0.03; //Coefficient of absorption of
   plastered wall in O.W.U
```

```

8 S2=130; //Area of wooden floor in m^2
9 C2=0.06; //Coefficient of absorption of
  wooden floor in O.W.U
10 S3=20; //Area of wooden door in m^2
11 C3=0.06; //Coefficient of absorption of
  wooden door in O.W.U
12 S4=170; //Area of plastered ceiling in
  m^2
13 C4=0.04; //Coefficient of absorption of
  plastered ceiling in O.W.U
14 S5=100; //Area of cushioned chairs in m
  ^2
15 C5=1.0; //Coefficient of absorption of
  cushioned chairs in O.W.U
16 S6=120; //Area of audience in m^2
17 C6=4.7; //Coefficient of absorption of
  audience in O.W.U
18 A1=S1*C1; //Absorption due to plastered
  wall
19 A2=S2*C2; //Absorption due to wooden
  floor
20 A3=S3*C3; //Absorption due to wooden door
21 A4=S4*C4; //Absorption due to plastered
  ceiling
22 A5=S5*C5; //Absorption due to cushioned
  chairs
23 A6=S6*C6; //Absorption due to 120 persons
24 A=A1+A2+A3+A4+A5;
25 T1=(0.165*V)/A;
26 printf("Reverberation time when hall is empty is %f
  sec",T1);
27 T2=(0.165*V)/(A6+A);
28 printf("Reverberation time when hall is with full
  capacity of audience is %f sec",T2);
29 A7=100*C6; //Absorption due to 100 persons
30 T3=(0.165*V)/(A7+A);
31 printf("Reverberation time when hall is with
  audience occupying only cushioned seats is %f sec

```

```
”,T3);
```

Scilab code Exa 3.3 To determine average absorbing power of surfaces

```
1 //clc();
2 clear;
3 //To determine average absorbing power of surfaces
4 V=120000; //Volume of hall in m^3
5 T=1.5; //Reverberation time in sec
6 S=25000; //Total sound absorbing surface in
   m^2
7 a=(0.165*V)/(T*S);
8 printf("average absorbing power of surface is %f O.W
   .U or sabine",a);
```

Scilab code Exa 3.4 To determine the effect on reverberation time

```
1 //clc();
2 clear;
3 //To determine the effect on reverberation time
4 V=2265; //volume of hall in m^3
5 A=92.9; //Total absorption in m^2
6 T1=(0.165*V)/A;
7 //when one audien fill the hall then total
   absorption will be 2*A
8 T2=(0.165*V)/(2*A);
9 printf("T1=%f sec",T1);
10 printf("when one audien fill the hall then total
   absorption is %f sec",T2);
11 printf("thus reverberation time is reduced to one-
   half of its initial value");
```

Scilab code Exa 3.5 To determine reverberation time of the hall

```
1 //clc ();
2 clear;
3 //To determine reverberation time of the hall
4 V=1000;           //volume of hall in m^3
5 A1=400;           //area of wall in m^2
6 A2=100;           //area of floor in m^2
7 A3=100;           //area of ceiling in m^2
8 N=0.02;           //number of cushion chairs of
   wall
9 a1=0.01;          //absorption coefficient of
   ceiling
10 a2=0.05;          //absorption coefficient of floor
11 a3=1.0;           //absorption coefficient of each
   cushion chair
12 T=(0.165*V)/((A1*N)+(A2*a1)+(A2*a2)+(A3*a3))
13 printf("reverberation time of the hall is %f sec",T)
   ;
```

Chapter 4

Magnetic properties

Scilab code Exa 4.1 To determine the change in magnetic moment

```
1 //clc();
2 clear;
3 //To determine the change in magnetic moment
4 r=0.052*(10^-9); //radius of orbit in m
5 B=1; //magnetic field of
   induction in Web/m^2
6 e=1.6*(10^-19); //electron charge in C
7 m=9.1*(10^-31); //mass of electron in kg
8 A=(e^2)*(r^2)*B;
9 dmew=A/(4*m);
10 printf("change in magnetic moment is");
11 disp(dmew);
12
13 //answer in book is wrong
```

Scilab code Exa 4.2 To determine intensity of magnetisation and magnetic flux density

```

1 //clc();
2 clear;
3 //To determine intensity of magnetisation and
   magnetic flux density
4 ki=-0.5*10^-5;           //magnetic susceptibility
5 H=9.9*10^4;             //magnetic field of
   intensity in Amp/m
6 I=ki*H;
7 mew0=(4*pi*10^-7);     //mew0 in H/m
8 B=mew0*H*(1+ki);
9 printf("intensity of magnetisation is %f amp/m",I);
10 printf("magnetic flux density is %f wb/m^2",B);
11
12 //answer in book is wrong

```

Scilab code Exa 4.3 To determine relative permeability of a ferromagnetic material

```

1 //clc();
2 clear;
3 //To determine relative permeability of a
   ferromagnetic material
4 H=220;                 //magnetic field strength in amp/m
5 I=3300;                //magnetisation in amp/m
6 mewr=1+(I/H);
7 printf("relative permeability is %f",mewr);

```

Scilab code Exa 4.4 To determine magnetic induction and dipole moment

```

1 //clc();
2 clear;
3 //To determine magnetic induction and dipole moment

```



```

4 r=6.1*10^-11;           //radius of hydrogen atom in
    m
5 new=8.8*10^15;         //frequency in revolution
    per sec
6 e=1.6*10^-19;         //electron charge in C
7 i=e*new;
8 mew0=(4*pi*10^-7);     //mew0 in H/m
9 B=(mew0*i)/(2*r);
10 mew=i*pi*(r^2);
11 printf("magnetic induction at the centre is %f Web/m
    ^2",B);
12 printf("dipole moment in amp m^2 is");
13 disp(mew);

```

Scilab code Exa 4.5 To determine average number of Bohr magnetons

```

1 //clc();
2 clear;
3 //To determine average number of Bohr magnetons
4 Is=1.96*10^6;          //saturation magnetisation in
    amp/m
5 a=3;                   //cube edge of iron
6 A0=3*10^-10;           //A0 in m
7 mewB=9.27*10^-24;      //bohr magneton in amp/m^2
8 N=2/(A0^a);
9 mewbar=Is/N;
10 mewAB=mewbar/mewB;
11 printf("average number of bohr magnetons is %f Bohr
    magneton/atom",mewAB);

```

Scilab code Exa 4.6 To determine magnetic force and relative permeability of material

```

1 //clc ();
2 clear;
3 //To determine magnetic force and relative
  permeability of material
4 I=3000;           //magnetisation in amp/m
5 B=0.005;         //flux density in weber/m^2
6 mew0=(4*pi*10^-7); //mew0 in H/m
7 H=(B/mew0)-I;
8 mewr=(I/H)+1;
9 printf("magnetizing force is %f amp/m",H);
10 printf("relative permeability is %f",mewr);

```

Scilab code Exa 4.7 To determine permeability

```

1 //clc ();
2 clear;
3 //To determine permeability
4 H=1800;           //magnetizing field in amp/m
5 phi=3*10^-5;     //magnetic flux in wb
6 A=0.2*10^-4;     //cross-sectional area in m^2;
7 B=phi/A;
8 mew=B/H;
9 printf("permeability is %f Henry/m",mew);
10
11 //answer in book is wrong

```

Scilab code Exa 4.8 To determine the magnetic dipole moment and torque

```

1 //clc ();
2 clear;
3 //To determine the magnetic dipole moment and torque
4 r=0.04;          //radius of circular loop in m
5 i=1;             //current in A

```

```

6 B=10^-3;           //magnetic flux density in Wb/m^2
7 theta=45;         //angle in degrees
8 A=%pi*(r^2);
9 mew=i*A;
10 tow=i*B*cosd(theta);
11 //disp(mew);
12 //disp(tow);
13 printf("magnetic dipole moment is %f amp m^2",mew);
14 printf("torque on the coil is %f Nm",tow);

```

Scilab code Exa 4.9 To determine the hysteresis loss per cycle

```

1 //clc();
2 clear;
3 //To determine the hysteresis loss per cycle
4 A=100;           //area of hysteresis loop in m^2
5 B=0.01;         //flux density in Wb/m^2
6 H=40;           //magnetic field in amp/m
7 M=7650;         //atomic weight in kg/m^3
8 L=A*B*H;
9 printf("hysteresis loss per cycle is %f J/m^3",L);

```

Scilab code Exa 4.10 To determine hysteresis power loss in watt per cubic meter and in watt per kg

```

1 //clc();
2 clear;
3 //To determine hysteresis power loss in watt per
  cubic meter and in watt per kg
4 HC=200;         //hysteresis loss per cycle in J/m
  ^3
5 A=7650;         //atomic weight in kg/m^3
6 M=100;         //magnetisation cycles per sec

```

```
7 L=HC*M;
8 P=L/A;
9 printf(" hysteresis power loss per second is %f watt/
    m^3",L);
10 printf("power loss is %f watt/kg",P);
```

Chapter 5

Superconductivity

Scilab code Exa 5.1 To determine magnitude of critical magnetic field

```
1 //clc();
2 clear;
3 //To determine magnitude of critical magnetic
  field
4 Tc=7.2;           //critical temperature in K
5 H0=6.5*10^3;     //critical magnetic field in A/m
6 T=5;             //temperature in K
7 A=1-(T/Tc)^2;
8 Hc=H0*A;
9 printf("magnitude is %f A/m",Hc);
```

Scilab code Exa 5.2 To determine the value of critical field

```
1 //clc();
2 clear;
3 //To determine the value of critical field
4 H0=3.2*10^3;     //critical magnetic field in A/m
5 Tc=3.5;          //critical temperature in K
```

```

6 T=2.5; //temperature in K
7 A=1-(T/Tc)^2;
8 Hc=H0*A;
9 printf("value of critical field is %f A/m",Hc);

```

Scilab code Exa 5.3 To determine transition temperature

```

1 //clc();
2 clear;
3 //To determine transition temperature
4 Hc=5*10^3; //critical magnetic field in A/m
5 H0=2*10^4; //critical field in A/m
6 T=6; //temperature in K
7 A=sqrt(1-(Hc/H0));
8 Tc=T/A;
9 printf("transition temperature is %f K",Tc);

```

Scilab code Exa 5.4 To determine critical current value

```

1 //clc();
2 clear;
3 //To determine critical current value
4 Hc=2*10^3; //critical magnetic field in A/
   m
5 r=0.02; //radius of ring in m
6 Ic=2*pi*r*Hc;
7 printf("critical current value is %f Amp",Ic);

```

Scilab code Exa 5.5 To determine isotopic mass

```

1 //clc ();
2 clear;
3 //To determine isotopic mass
4 M1=199.5;           //isotopic mass in a.m.u
5 T1=5;              //first critical temperature in K
6 T2=5.1;           //second critical temperature in K
7 M2=M1*(T1/T2)^2;
8 printf("isotopic mass at 5.1 K is %f a.m.u",M2);

```

Scilab code Exa 5.6 To determine critical current for a wire

```

1 //clc ();
2 clear;
3 //To determine critical current for a wire
4 d=3*10^-3;        //diameter of wire in m
5 r=d/2;
6 Tc=8;            //critical temperature in K
7 H0=5*10^4;      //magnetic field in A/m
8 T=5;            //temperature in K
9 A=1-(T/Tc)^2;
10 Hc=H0*A;
11 printf("magnitude is %f A/m",Hc);
12 Ic=2*pi*r*Hc;
13 printf("critical current is %f Amp",Ic);

```

Scilab code Exa 5.7 To determine critical temperature

```

1 //clc ();
2 clear;
3 //To determine critical temperature
4 M1=199.5;         //isotopic mass in a.m.u
5 M2=203.4;        //isotopic mass in a.m.u
6 Tc1=4.185;       //first critical temperature

```

```
7 Tc2=Tc1*sqrt(M1/M2);
8 printf("critical temperature is %f K",Tc2);
```

Scilab code Exa 5.8 To determine generating EM waves frequency

```
1 //clc();
2 clear;
3 //To determine generating EM waves frequency
4 V=8.50*10^-6; //voltage of Josephson
   junction in V
5 e=1.6*10^-19; //charge of electron in C
6 h=6.626*10^-24; //plank constant
7 new=(2*e*V)/h;
8 printf("EM waves frequency is %f Hz",new);
9
10 //answer in book is wrong
```

Scilab code Exa 5.9 To determine critical temperature

```
1 //clc();
2 clear;
3 //To determine critical temperature
4 Tc1=5; //first critical temperature in K
5 P1=1; //first pressure in mm
6 P2=6; //second pressure in mm
7 Tc2=Tc1*(P2/P1);
8 printf("critical temperature is %f K",Tc2);
```

Scilab code Exa 5.10 To determine the maximum critical temperature


```
1 //clc ();
2 clear;
3 //To determine the maximum critical temperature
4 Tc=8.7;           //first critical temperature in K
5 Hc=6*10^5;       //critical magnetic field in A/m
                   at Tc
6 H0=3*10^6;       //critical magnetic field in A/m
                   at 0K
7 A=1-(Hc/H0);
8 T=Tc*sqrt(A);
9 printf("maximum critical temperature is %f K",T);
```

Chapter 6

Crystal structure and X ray diffraction

Scilab code Exa 6.1 To determine density

```
1 //clc();
2 clear;
3 //To determine density
4 n=8; //number of atoms per unit cell
5 a=5.6*10^-10; //lattice constant in m
6 M=710.59; //atomic weight of Germanium in
   a.m.u
7 N=6.02*10^26; //avagadro number in kg/mol
8 rho=(n*M)/(N*a^3);
9 printf("density in kg/m^3 is ");
10 disp(rho);
```

Scilab code Exa 6.2 To determine the lattice constant

```
1 //clc();
2 clear;
```

```

3 //To determine the lattice constant
4 n=2; //number of atoms per unit cell
5 M=55.85; //atomic weight in a.m.u
6 N=6.02*10^26; //avagadro number in kg/mol
7 rho=7860; //density in kg/m^3;
8 a=((n*M)/(N*rho))^(1/3);
9 printf("lattice constant in m is ");
10 disp(a);
11
12 //answer in book is wrong

```

Scilab code Exa 6.3 To determine the lattice constant

```

1 //clc();
2 clear;
3 //To determine the lattice constant
4 n=2; //number of atoms per unit cell
5 M=6.94; //atomic weight in a.m.u
6 N=6.02*10^26; //avagadro number in kg/mol
7 rho=530; //density in kg/m^3;
8 a0=((n*M)/(N*rho))^(1/3);
9 a=a0*10^10;
10 printf("lattice constant in Armstrong is ");
11 disp(a);

```

Scilab code Exa 6.4 To calculate the number of atoms per unit cell

```

1 //clc();
2 clear;
3 //To calculate the number of atoms per unit cell
4 a=2.9*10^-10; //lattice parameter in m
5 M=55.85; //molecular weight in kg/m^3
6 N=6.02*10^26; //avagadro number in kg/mol

```

```

7 rho=7870;           //density in kg/m^3;
8 n=(rho*N*(a^3))/M;
9 printf("number of atoms is ");
10 disp(n);

```

Scilab code Exa 6.5 To calculate the density

```

1 //clc();
2 clear;
3 //To calculate the density
4 r=0.1278*10^-9;    //atomic radius in m
5 n=4;               //number of atoms per unit
   volume
6 M=63.5;           //atomic weight in a.m.u
7 N=6.02*10^26;    //avagadro number in kg/mol
8 a=sqrt(8)*r;
9 rho=(n*M)/(N*(a^3));
10 printf("density in kg/m^3 is ");
11 disp(rho);

```

Scilab code Exa 6.6 To calculate the percentage of volume change

```

1 //clc();
2 clear;
3 //To calculate the percentage of volume change
4 T=910;           //temperature in C
5 r1=1.258;        //initial atomic radius in Armstrong
6 r2=1.292;        //latter atomic radius in Armstrong
7 a1=(4*r1)/sqrt(3); //lattice constant in BCC
   structure
8 Vu1=a1^3;        //volume of unit cell of BCC
9 n1=2;
10 V1=Vu1/n1;

```

```

11 disp(V1);
12 a2=2*sqrt(2)*r2;    //lattice constant in FCC
    structure
13 Vu2=a2^3;    //volume of unit cell of FCC
14 n2=4;
15 V2=Vu2/n2;
16 disp(V2);
17 PV=(V1-V2)*100/V2;
18 printf("percentage volume change is")
19 disp(PV);

```

Scilab code Exa 6.7 To calculate the maximum radius of sphere

```

1 //clc();
2 clear;
3 //To calculate the maximum radius of sphere
4 //for FCC structure a=(4*r)/sqrt(2)
5 //R=(a/2)-r
6 //hence R=0.414*r on simplification

```

Scilab code Exa 6.8 To calculate the distance between two adjacent atoms

```

1 //clc();
2 clear;
3 //To calculate the distance between two adjacent
    atoms
4 MW=23+35.5;    //Molecular weight of NaCl
5 N=6.023*10^23;
6 M=MW/N;    //mass of NaCl molecule in gm
7 m=2.18;    //mass of unit volume of NaCl in gm
8 Nm=m/M;
9 disp(Nm);
10 Na=2*Nm;    //number of atoms per unit volume

```

```

11 V=1;           //volume of unit cube in cm^3
12 //V=n^3*a^3
13 //n^3=Na
14 a=(1/Na)^(1/3);
15 printf("distance between two adjacent atoms in cm is
        ")
16 disp(a);

```

Scilab code Exa 6.9 To calculate the wavelength of X rays and maximum order of diffraction

```

1 //clc();
2 clear;
3 //To calculate the wavelength of X-rays and maximum
  order of diffraction
4 d=0.282*10^-9;           //lattice spacing in m
5 theta1=8.58333;         //glancing angle in degrees
6 n1=1;
7 lambda=(2*d*sind(theta1))/n1;
8 printf("wavelength in Armstrong is ");
9 disp(lambda);
10 theta=90;               //bragg's angle for maximum order
  of diffraction
11 n=(2*d*sind(theta))/lambda;
12 printf("maximum order of diffraction possible is ");
13 disp(n);

```

Scilab code Exa 6.10 To calculate the angle at which third order reflection can occur

```

1 //clc();
2 clear;

```

```

3 //To calculate the angle at which third order
  reflection can occur
4 n=3;          //diffraction order
5 lambda=0.79*10^-10;    //wavelength in m
6 d=3.04*10^-10;    //spacing in m
7 theta=asind((n*lambda)/(2*d));
8 printf("bragg's angle in degrees is");
9 disp(theta);

```

Scilab code Exa 6.11 To calculate the glancing angle

```

1 //clc();
2 clear;
3 //To calculate the glancing angle
4 lambda=0.071*10^-9;    //wavelength in m
5 //miller indices of diffraction plane
6 h=1;
7 k=1;
8 l=0;
9 a=0.28*10^-9;    //lattice constant in m
10 n=2;
11 d=a/sqrt((h^2)+(k^2)+(l^2));
12 disp(d);
13 theta=asind((n*lambda)/(2*d));
14 printf("glancing angle in degrees is");
15 disp(theta);

```

Scilab code Exa 6.12 To calculate the space of the reflecting plane and volume

```

1 //clc();
2 clear;

```

```

3 //To calculate the space of the reflecting plane and
  volume
4 lambda=3*10^-10;      //wavelength in m
5 h=1;
6 k=0;
7 l=0;
8 theta=40;           //glancing angle in degrees
9 n=1;               //diffraction order
10 d=(n*lambda)/(2*sind(theta));
11 printf("space of the reflecting plane in m is");
12 disp(d);
13 x=sqrt(h^2+k^2+l^2);
14 a=d*x;
15 V=a^3;
16 printf("volume of unit cell in m^3 is");
17 disp(V);

```

Scilab code Exa 6.13 To calculate miller indices of reflecting planes

```

1 //clc();
2 clear;
3 //To calculate miller indices of reflecting planes
4 lambda=0.82;      //wavelength in Angstrom
5 theta=75.86;     //glancing angle in
  degrees
6 n=1;           //diffraction order
7 a=3;          //lattice constant in Angstrom
8 d=(n*lambda)/(2*sind(theta));
9 disp(d);
10 //but d!=a
11 //answer in book is wrong

```

Scilab code Exa 6.14 To calculate the inter planar spacing of reflection planes

```
1 //clc();
2 clear;
3 //To calculate the inter planar spacing of
  reflection planes
4 KE=3.76*10^-17;           //kinetic energy of electron
  in J
5 n=1;
6 //theta=9.12'.25"
7 theta=9.20694;          //by converting to degrees
8 h=6.625*10^-34;
9 m=9.1*10^-31;
10 a=sqrt(2*m*KE);
11 lambda=h/a;
12 lambda=lambda*10^10;    //converting from metres to
  angstrom
13 disp(lambda);
14 d=(n*lambda)/(2*sind(theta));
15 printf("inter planar spacing in Angstrom is");
16 disp(d);
```

Scilab code Exa 6.15 To calculate the wavelength and energy of X ray beam

```
1 //clc();
2 clear;
3 //To calculate the wavelength and energy of X-ray
  beam
4 theta=27.5;             //diffraction angle in degrees
5 n=1;                    //diffracted order
6 h=1;
7 k=1;
8 l=1;
```

```

 9 H=6.625*10^-34;           //plancks constant
10 c=3*10^10;               //velocity of light
11 a=5.63*10^-10;          //lattice constant in m
12 d=a/(sqrt(h^2+k^2+l^2));
13 lambda=(2*d*sind(theta))/n;
14 printf("wavelength in metres is");
15 disp(lambda);
16 E=(H*c)/lambda;
17 E=E/(1.6*10^-19);        //converting from J to eV
18 printf("energy of X-ray beam in eV is");
19 disp(E);
20
21 //answer in book is wrong

```

Scilab code Exa 6.16 To calculate the spacing of the crystal

```

1 //clc();
2 clear;
3 //To calculate the spacing of the crystal
4 V=854;           //accelerated voltage in V
5 theta=56;       //glancing angle in degrees
6 n=1;
7 h=6.625*10^-34;
8 m=9.1*10^-31;
9 e=1.6*10^-19;
10 lambda=h/(sqrt(2*m*e*V));
11 disp(lambda);   //wavelength in m
12 d=(n*lambda)/(2*sind(theta));
13 printf("spacing of crystal in metres is");
14 disp(d);

```

Scilab code Exa 6.17 To calculate the lattice parameter of lead

```

1 //clc();
2 clear;
3 //To calculate the lattice parameter of lead
4 lambda=1.5*10^-10;
5 h=2;
6 k=0;
7 l=2;
8 theta=34; //bragg angle in degrees
9 n=1;
10 d=(n*lambda)/(2*sind(theta));
11 disp(d);
12 a=d*(sqrt(h^2+k^2+l^2));
13 a=a*10^10; //converting from metres into
    angstrom
14 printf("lattice parameter in angstrom is");
15 disp(a);

```

Scilab code Exa 6.18 To calculate braggs angle for first order of reflection

```

1 //clc();
2 clear;
3 //To calculate braggs angle for first order of
    reflection
4 V=5000; //potential difference in V
5 n=1;
6 h=1;
7 k=1;
8 l=1;
9 d=0.204*10^-9; //inter planar spacing in m
10 H=6.625*10^-34; //plancks constant in J
11 m=9.1*10^-31;
12 e=1.6*10^-19;
13 lambda=H/(sqrt(2*m*e*V));
14 disp(lambda);
15 a=(n*lambda)/(2*d);

```

```
16 theta=asind(a);  
17 printf("bragg angle in degrees is");  
18 disp(theta);
```

Chapter 7

Laser

Scilab code Exa 7.1 To determine matter wave energy

```
1 //clc();
2 clear;
3 //To determine matter wave energy
4 V=3*10^3;           //velocity of matter wave in m/s
5 lambda=600*10^-9;  //wavelength in m
6 h=6.6*10^-34;      //planck's constant in Js
7 E=(h*V)/lambda;
8 printf("matter wave energy in J is");
9 disp(E);
10
11 //answer in book is wrong
```

Scilab code Exa 7.2 To calculate wavelength of emitted photons

```
1 //clc();
2 clear;
3 //To calculate wavelength of emitted photons
4 Eg=3*1.6*10^-19;   //energy gap in J
```

```

5 C=3*10^8;           //velocity of photon in m/s
6 h=6.6*10^-34;      //plank's constant in Js
7 lambda=(h*C)/Eg;
8 printf("wavelength of emitted photons in m is");
9 disp(lambda);
10 lambda=lambda*10^9; //converting into nm
11 printf("wavelength of emitted photons in nm is");
12 disp(lambda);
13
14 //answer in book is wrong

```

Scilab code Exa 7.3 To determine the ratio in higher energy and lower energy

```

1 //clc();
2 clear;
3 //To determine the ratio in higher energy and lower
  energy
4 Eg=3*1.6*10^-19;   //energy gap in J
5 T=50+273;         //temperature in kelvin
6 Kb=1.38*10^-23;   //boltzmann constant in J/K
7 A=Eg/(Kb*T);
8 R=exp(-A);
9 printf("ratio in higher energy and lower energy is "
  );
10 disp(R);
11
12 //answer in book is wrong

```

Scilab code Exa 7.4 To determine the ratio of stimulated emission rate to spontaneous emission

```

1 //clc();

```

```

2 clear;
3 //To determine the ratio of stimulated emission rate
  to spontaneous emission
4 lambda=0.5*10^-9;           //wavelength in nm
5 h=6.626*10^-34;           //plank constant in Js
6 T=1000;                   //temperature in K
7 Kb=1.381*10^-23;         //boltzmann constant in J/
  K
8 c=3*10^8;
9 new=c/lambda;
10 disp(new);
11 A=(h*new)/(Kb*T);
12 disp(A);
13 X=1/(exp(A)-1);
14 printf("ratio is");
15 disp(X);
16
17 //answer in book is wrong

```

Scilab code Exa 7.5 To determine the wavelength

```

1 //clc();
2 clear;
3 //To determine the wavelength
4 Eg=1.43*1.602*10^-19;     //band gap energy in J
5 T=300;                   //temperature in K
6 h=6.626*10^-34;
7 c=3*10^8;
8 lambda=(h*c)/Eg;
9 disp(lambda);
10 lambda=lambda*10^6;     //converting into
  micrometre
11 printf("the GaAs photodetector will cease to operate
  above in micrometre is");
12 disp(lambda);

```


Chapter 8

Fiber optics and holography

Scilab code Exa 8.1 To calculate refractive index of material of the core

```
1 //clc();
2 clear;
3 //To calculate refractive index of material of the
   core
4 NA=0.39;           //numerical aperture
5 delta=0.05;       //fractional index change
6 A=sqrt(2*delta);
7 n1=NA/A;
8 printf("refractive index of the core is %f",n1);
```

Scilab code Exa 8.2 To calculate the fractional index change

```
1 //clc();
2 clear;
3 //To calculate the fractional index change
4 n1=1.563;          //core refractive index
5 n2=1.498;          //cladding refractive index
6 delta=(n1-n2)/n1;
7 printf("fractional index change is %f",delta);
```

Scilab code Exa 8.3 To calculate numerical aperture

```
1 //clc();
2 clear;
3 //To calculate numerical aperture
4 n1=1.55;           //refractive index of core
5 n2=1.50;           //refractive index of cladding
6 n0=1;
7 NA=sqrt(n1^2-n2^2)/n0;
8 printf("numerical aperture is %f",NA);
```

Scilab code Exa 8.4 To calculate angle of acceptance

```
1 //clc();
2 clear;
3 //To calculate angle of acceptance
4 n1=1.563;           //refractive index of core
5 n2=1.498;           //refractive index of cladding
6 NA=sqrt(n1^2-n2^2);
7 theta0=asind(NA);
8 printf("angle of acceptance is %f degrees",theta0);
```

Scilab code Exa 8.5 To calculate critical angle

```
1 //clc();
2 clear;
3 //To calculate critical angle
4 n1=1.53;           //refractive index of core
5 n2=1.42;           //refractive index of cladding
```

```
6 thetac=asind(n2/n1);
7 printf("critical angle is %f degrees",thetac);
```

Scilab code Exa 8.6 To calculate numerical aperture and acceptance angle

```
1 //clc();
2 clear;
3 //To calculate numerical aperture and acceptance
  angle
4 n1=1.6;           //refractive index of core
5 n2=1.4;           //refractive index of cladding
6 n0=1.33;          //water refractive index
7 NA=sqrt(n1^2-n2^2)/n0;
8 printf("numerical aperture is %f",NA);
9 theta0=asind(NA);
10 printf("acceptance angle is %f degrees",theta0);
```

Scilab code Exa 8.7 To calculate fractional index change

```
1 //clc();
2 clear;
3 //To calculate fractional index change
4 n1=1.5;           //core refractive index
5 n2=1.3;           //cladding refractive index
6 delta=(n1-n2)/n1;
7 printf("fractional index change is %f",delta);
```

Scilab code Exa 8.8 To calculate angle of refraction at the interface

```
1 //clc();
```

```

2 clear;
3 //To calculate angle of refraction at the interface
4 n1=1.6;           //refractive index of medium
5 n2=1.55;         //refractive index of core
6 theta1=60;      //angle of incidence in degrees
7 A=sind(theta1);
8 disp(A);
9 theta2=asind(n1*A/n2);
10 printf("angle of refraction is %f degrees",theta2);
11
12 //answer in book is wrong

```

Scilab code Exa 8.9 To calculate refractive index of core

```

1 //clc();
2 clear;
3 //To calculate refractive index of core
4 delta=0.14;       //fractional index change
5 n2=1.3;           //refractive index of cladding
6 n1=n2/(1-delta);
7 printf("refractive index of core is %f",n1);

```

Scilab code Exa 8.10 To calculate numerical aperture

```

1 //clc();
2 clear;
3 //To calculate numerical aperture
4 theta0=26.80;    //acceptance angle in degrees
5 NA=sind(theta0);
6 printf("numerical aperture is %f",NA);

```

Chapter 9

Dielectrics

Scilab code Exa 9.1 To determine the electronic polarisability

```
1 //clc();
2 clear;
3 //To determine the electronic polarisability
4 epsilon_r=3.75; //relative dielectric constant
5 T=27; //temperature in C
6 gamma=1/3; //internal field constant
7 rho=2050; //density of sulphur in kg/m^3
8 Ma=32; //atomic weight of sulphur in a.
   m.u
9 epsilon_0=8.85*10^-12;
10 Na=6.022*10^23;
11 A=(epsilon_r-1)/(epsilon_r+2);
12 printf("%f",A);
13 alpha_e=(A*3*epsilon_0*Ma)/(rho*Na);
14 printf("electronic polarisability of sulphur in Fm^2
   is");
15 disp(alpha_e);
```

Scilab code Exa 9.2 To determine the capacitance and charge on the plates

```

1 //clc ();
2 clear;
3 //To determine the capacitance and charge on the
  plates
4 A=10^-2;           //area of capacitor m^2
5 d=10^-2;           //seperation of capacitor plates
  in m
6 V=100;             //potential in V
7 epsilon0=8.85*10^-12;
8 C=(A*epsilon0)/d;
9 C=C*10^12;         //converting into PF
10 printf("capacitance of the capacitor is %f PF",C);
11 C=8.85*10^-12;
12 Q=C*V;
13 printf("charge on plates in C is");
14 disp(Q);

```

Scilab code Exa 9.3 To determine the electronic polarisability of He atoms

```

1 //clc ();
2 clear;
3 //To determine the electronic polarisability of He
  atoms
4 epsilon_r=1.0000684; //dielectric constant
5 N=2.7*10^25;         //number of atoms per unit
  volume
6 epsilon0=8.85*10^-12;
7 alphae=(epsilon0*(epsilon_r-1))/N;
8 printf("electronic polarizability in Fm^2 is ");
9 disp(alphae);

```

Scilab code Exa 9.4 To determine dielectric constant of the material

```

1 //clc ();
2 clear;
3 //To determine dielectric constant of the material
4 N=3*10^28;           //density of atoms in atoms/m^3
5 alphae=10^-40;      //electronic constant
   polarizability in Fm^2
6 epsilon0=8.85*10^-12;
7 //consider A=(epsilon_r -1)/(epsilon_r +2)
8 A=(N*alphae)/(3*epsilon0);
9 epsilon_r=((2*A)+1)/(1-A);
10 printf("dielectric constant of the material is %f F/
   m",epsilon_r);
11
12 //answer in book is wrong

```

Scilab code Exa 9.5 To determine resultant voltage across the capacitor

```

1 //clc ();
2 clear;
3 //To determine resultant voltage across the
   capacitor
4 A=650*10^-4;        //area of capacitor plate in m^2
5 d=4*10^-2;         //seperation of parallel plate
   capacitor in m
6 Q=2*10^-10;        //charge on capacitor in C
7 epsilon_r=3.5;     //dielectric constant of
   material
8 epsilon0=8.85*10^-12;
9 C=(A*epsilon0)/d;
10 disp(C);
11 V=Q/C;
12 printf("resultant voltage across capacitor in V is "
   );
13 disp(V);

```

Scilab code Exa 9.6 To compute the polarisation

```
1 //clc ();
2 clear;
3 //To compute the polarisation
4 A=6.45*10^-4;           //area of capacitor plates in
   m^2
5 d=2*10^-3;             //capacitor plates seperation
   in m
6 V=12;                   //potential in V
7 epsilon_r=5.0;          //dielectric constant
8 N=6.023*10^23;         //avagadro number in mol
   inverse
9 epsilon_0=8.85*10^-12;
10 alpha_e=(epsilon_0*(epsilon_r-1))/N;
11 printf("polarisation in Fm^2 is ");
12 disp(alpha_e);
13
14 //answer in book is wrong
```

Scilab code Exa 9.7 To determine the displacement when He atom is subjected to a field

```
1 //clc ();
2 clear;
3 //To determine the displacement when He atom is
   subjected to a field
4 epsilon_r=1.0000684;    //dielectric constant
5 Na=2.7*10^25;           //density of atoms in
   atoms/m^3
6 E=10^6;                 //electric field in V/m
7 e=1.6*10^-19;
```



```

8 Z=2; //atomic number
9 r03=(epsilon_r-1)/(4*pi*Na);
10 r0=(r03)^(1/3);
11 printf("radius of electron cloud is");
12 disp(r0);
13 //displacement (X)=(4*pi*epsilon_0*E*r03)/(Z*e)
14 //but 4*pi*epsilon_0=1/(9*10^9). Let A=4*pi*epsilon_0
15 A=1/(9*(10^9));
16 X=(A*E*r03)/(Z*e);
17 printf("displacement in metres when He atom is
    subjected to a field is");
18 disp(X);

```

Scilab code Exa 9.8 To determine the atomic polarizability

```

1 //clc();
2 clear;
3 //To determine the atomic polarizability
4 epsilon_r=4; //relative permeability
5 epsilon_0=8.85*10^-12;
6 N=2.08*10^3; //density of atoms in kg/m^3
7 Ma=32; //atomic weight in a.m.u
8 A=(epsilon_r-1)/(epsilon_r+2);
9 disp(A);
10 alpha=(A*3*epsilon_0)/N;
11 printf("atomic polarizability in Fm^2 is");
12 disp(alpha);
13
14 //answer in book is wrong

```

Scilab code Exa 9.9 To determine energy stored in the condenser

```

1 //clc();

```

```

2 clear;
3 //To determine energy stored in the condenser
4 C=4*10^-6;           //capacitance of condenser in F
5 epsilon_r=200;       //relative permeability
6 V=2000;              //applied voltage in V
7 C0=C/epsilon_r;
8 disp(C0);
9 E=(1/2)*C0*(V);
10 printf("energy stored in Joule is")
11 disp(E);
12
13 //answer in book is wrong

```

Scilab code Exa 9.10 To determine the polarisability of He and its relative permittivity

```

1 //clc();
2 clear;
3 //To determine the polarisability of He and its
  relative permittivity
4 R=0.55*10^-10;       //radius of He atom in m
5 N=2.7*10^25;         //density in atoms/m^3;
6 epsilon_0=8.85*10^-12;
7 alphae=4*pi*epsilon_0*R^3;
8 printf("polarisability in Fm^2 is ");
9 disp(alphae);
10 epsilon_r=((N*alphae)/epsilon_0)+1;
11 printf("relative permittivity in Fm^2 is");
12 disp(epsilon_r);

```

Scilab code Exa 9.11 To determine field strength and total dipole moment

```

1 //clc();

```

```
2 clear;
3 //To determine field strength and total dipole
  moment
4 A=180*10^-4;           //area of capacitor in m
5 C=3*10^-6;            //capacitance in F
6 epsilon_r=8;          //relative permittivity
7 V=10;                 //potential in V
8 epsilon_0=8.85*10^-12;
9 E=(V*C)/(epsilon_0*epsilon_r);
10 printf("field strength in V/m is");
11 disp(E);
12 T=epsilon_0*(epsilon_r-1)*E*A;
13 printf("total dipole moment in Coul m is ");
14 disp(T);
15
16 //answer in book is wrong
```

Chapter 10

Thermal Properties

Scilab code Exa 10.1 To determine the specific heat per Kmol and highest lattice frequency

```
1 //clc();
2 clear;
3 //To determine the specific heat per Kmol and
   highest lattice frequency
4 T=20;           //specific heat
5 Td=1850;        //numerical temperature
6 K=1.38*10^-23;
7 N=6.02*10^26;
8 R=K*N;
9 a=%pi^4;
10 b=12*a*R*T^3;
11 Cv=b/(5*Td^3);
12 printf("specific heat in Joule/kmol-k is");
13 disp(Cv);
14 h=6.626*10^-34;
15 Vd=(K*Td)/h;
16 printf("highest lattice frquency in sec -1 is");
17 disp(Vd);
```

Scilab code Exa 10.2 To estimate the heat required to raise the temperature

```
1 //clc();
2 clear;
3 //To estimate the heat required to raise the
  temperature
4 m=2;          //mass in k mol
5 TD=281;      //debye's temperature in K
6 A=%pi^4;
7 R=8.3*10^3;
8 function Q=f(T),Q=m*12*A*(R/5)*((T/TD)^3),
  endfunction
9 I=intg(10,50,f)
10 printf("the heat required in Joule is");
11 disp(I);
```

Scilab code Exa 10.3 To compute the lattice specific heat and estimate the electronic specific heat

```
1 //clc();
2 clear;
3 //To compute the lattice specific heat and estimate
  the electronic specific heat
4 T=300;      //specific heat at constant volume
5 Td=418;     //debye temperature
6 Ef=11.7;    //fermi energy in ev
7 R=1.99;
8 p1=(%pi)^4;
9 Cv=(12*p1*R*(T^3))/(5*(Td^3));
10 printf("vibrational specific heat in cal/mol-k is");
11 disp(Cv);
```

```

12 Ef=Ef*4.2*1.6*10^-19;      //converting from eV to
    cal
13 k=5.796*10^-23;          //boltzmann constant in cal/
    k
14 Tf=Ef/k;
15 p2=(%pi)^2;
16 Ce=(p2*R*T)/(2*Tf);
17 printf("electronic specific heat in cal/mol-k is");
18 disp(Ce);
19
20 //answer in book is wrong

```

Scilab code Exa 10.4 To estimate the lattice heat capacity

```

1 //clc();
2 clear;
3 //To estimate the lattice heat capacity
4 Td1s1=300;      //debye temperature of s1
5 Td2s2=250;      //debye temperature of s2
6 Cvs15=0.05;     //heat capacity of s1 at 5k
7 Cvs2=Cvs15*(Td1s1/Td2s2)^3;
8 printf("lattice heat capacity of s2 in J/mol-k is");
9 disp(Cvs2);
10 Cvs12=Cvs15*(2/5)^3;
11 printf("lattice heat capacity of s1 at 2k in J/mol-k
    is");
12 disp(Cvs12);

```
