Scilab Textbook Companion for Engineering Physics by T. Sreekanth, K. V. Kumar And S. Chandralingam[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Optics

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

```
clc();
clear;
// To calculate the intensity ratio of bright and dark fringes
I1=1;
I2=25;
// Intensity is directly proportional to square of the amplitude
A1=sqrt(I1);
A2=sqrt(I2);
Imax=(A1+A2)^2;
Imin=(A1-A2)^2;
I=Imax/Imin;
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

```
clc();
clear;
// To determine the order that will be visible at a
   point
n1=21;
lambda1=6000*10^(-8);              // The 21st order
   maximum is observed for source of light in
   centimetres
lambda2=4500*10^(-8);
n2=(n1*lambda1)/(lambda2);
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 seperation in Youngs double slit experiment

```
clc();
clear;
// To determine the slit seperation in Young's
   double slit experiment
lambda=5100*10^(-8);          //A source of light in
   centimetres
D=200;                  // Seperation between screen
   and slit in centimetres
beeta=0.01;             // Overall seperation from
   double slit in metres
d=(lambda*D)/beeta;
printf("The seperation 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

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

Scilab code Exa 1.5 To determine the fringe width

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

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

```
clc();
clear;
// To determine the wavelength of source of light
```

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

Scilab code Exa 1.7 To calculate the wavelength of monochromatic light

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

Scilab code Exa 1.8 To determine the fringe width

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

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

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

```
clc();
clear;
// To determine the thickness of a soap film
mew=1.33;             //refractive index of soap film
n=2;
lambda=7000*10^(-8);         //wavelength of red light
    in centimetres
t=(((2*n)+1)*(lambda/2))/(2*mew);
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

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

```
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

```
clc();
clear;
// To determine the thickness of the glass plate
mew=1.56;            //refractive index of the glass
   plate
lambda=5000*10^(-8);         //wavelength of the light
    in centimetres
n=16;
t=(n*lambda)/(mew-1);
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

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

```
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

```
clc();
clear;
// To calculate the thickness of the glass plate
lambda=5000*10^(-8);              //wavelength of light in centimetres
n=6;                       //shift of the central range or the ratio between S and beeta
mew=1.5;                   //refractive index of glass plate
t=(n*lambda)/(mew-1);
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

```
clc();
clear;
// To determine the refractive index of liquid in Newton's ring
D8=1.42;             //diameter of the 8th ring in centimetres
D8new=1.25;          //new diameter of the 8th ring in centimetres
mew=(D8^2)/(D8new^2);
```

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

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

```
clc();
clear;
// To determine the thickness of the thinnest film
n=1;
lambda=6000*10^(-8);            //wavelength of yellow
    light in centimetres
mew=1.33;                 //refractive index of the film
r=0;                      //angle of refraction in
   degrees
t=(n*lambda)/(2*mew*cosd(r)*10^(-2));
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

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

```
Dn=0.35;              //diameter of 8th ring in centimetres
R=(Dm^2-Dn^2)/(4*lambda*(m-n));
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

```
clc();
clear;
// To determine the refractive index of the liquid
D12air=1.45;              //diameter of 12th ring in air medium
D12liq=1.25;              //diameter of 12th ring in liquid
mew=(D12air^2)/(D12liq^2);
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

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

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

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

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

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

```
clc();
clear;
//To determine the wavelength of the light used
R=70;           //radius of curvature of the lens in
    centimetres
n=10;
Dn=0.433        //diameter of 10th dark ring in
    centimetres
lambda=(Dn^2)/(4*R*n);
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

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

Scilab code Exa 1.22 To determine the wavelength of light

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

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

Scilab code Exa 1.23 To determine the wavelength of spectral line

```
clc();
clear;
//To determine the wavelength of spectral line
n=2;
N=4250;              //grating in lines per centimetre
theta=30;            //angle in degrees
e=1/N;
lambda=(e*sind(theta)*10^8)/n;
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 seperation

```
clc();
clear;
//To determine the angular seperation
lambda=600*10^(-9);            //wavelength of light
    in metres
a=1*10^(-6);                   //slit width in metres
n=1;
theta=asind((n*lambda)/a);
printf("the angular seperation 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

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

Scilab code Exa 1.26 To determine the slit width

```
clc();
clear;
//To determine the slit width
x=4.2*10^(-3);          //distance between central max
    to first max in metres
D=0.6;                  //distance between screen and
    slit in metres
lambda=6000*10^(-10);           //wavelength of light
    in metres
d=(D*lambda)/x;
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

```
clc();
clear;
//To calculate the possible order of spectra
N=5.905*10^3;          //grating lines in lines per
    centimetre
lambda=6000*10^(-8);       //wavelength of light in
    centimetres
d=1/N;
m=d/lambda;
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

```
clc();
clear;
//To determine the wavelength of light in Fraulhofer
     double slit diffraction
D=150;               //distance between slit and
    screen in centimetres
d=0.03;               //seperation between slits in
    centimetres
beeta=0.3;            //fringe seperation in
    centimetres
lambda=(beeta*d*10^8)/D;
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

```
clc();
clear;
//To determine the fundamental frequency of crystal
t=0.002;              //thickness of the crystal in
   metres
V=5750;               //velocity of sound waves in
   metres per sec
new=V*10^(-6)/(2*t);
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

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

```
rho=2.5*10^3;            //density of crystal in kg/cm^3
new=(sqrt(Y/rho))/(2*l);
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

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

Scilab code Exa 2.4 To determine the natural frequency of iron

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

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

Scilab code Exa 2.5 To determine the capacitance

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

Scilab code Exa 2.6 To determine the fundamental frequency

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

Scilab code Exa 2.7 To determine the fundamental frequency

```
clc();
clear;
//To determine the fundamental frequency
t=0.001;          //thickness of the crystal in metres
rho=2650;         //density of quartz in kg/m^3
Y=7.9*10^10;            //youngs modulus in N/m^2
V=sqrt(Y/rho);
printf("the fundamental frequency is %f m/s",V);
//For fundamental mode of vibration , the thickness must be equal to lambda/2
lambda=2*t;
new=V/lambda;
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

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

Scilab code Exa 3.2 To determine reverberation time of hall

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

```
S2=130;                //Area of wooden floor in m^2
C2=0.06;               //Coefficient of absorption of wooden floor in O.W.U
S3=20;                 //Area of wooden door in m^2
C3=0.06;               //Coefficient of absorption of wooden door in O.W.U
S4=170;                //Area of plastered ceiling in m^2
C4=0.04;               //Coefficient of absorption of plastered ceiling in O.W.U
S5=100;                //Area of cushioned chairs in m^2
C5=1.0;                //Coefficient of absorption of cushioned chairs in O.W.U
S6=120;                //Area of audience in m^2
C6=4.7;                //Coefficient of absorption of audience in O.W.U
A1=S1*C1;              //Absorption due to plastered wall
A2=S2*C2;              //Absorption due to wooden floor
A3=S3*C3;              //Absorption due to wooden door
A4=S4*C4;              //Absorption due to plastered ceiling
A5=S5*C5;              //Absorption due to cushioned chairs
A6=S6*C6;              //Absorption due to 120 persons
A=A1+A2+A3+A4+A5;
T1=(0.165*V)/A;
printf("Reverberation time when hall is empty is %f sec",T1);
T2=(0.165*V)/(A6+A);
printf("Reverberation time when hall is with full capacity of audience is %f sec",T2);
A7=100*C6;            //Absorption due to 100 persons
T3=(0.165*V)/(A7+A);
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

```
clc();
clear;
//To determine average absorbing power of surfaces
V=120000;          //Volume of hall in m^3
T=1.5;             //Reverberation time in sec
S=25000;           //Total sound absorbing surface in
    m^2
a=(0.165*V)/(T*S);
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

```
clc();
clear;
//To determine the effect on reverberation time
V=2265;           //volume of hall in m^3
A=92.9;           //Total absorption in m^2
T1=(0.165*V)/A;
//when one audien fill the hall then total
    absorption will be 2*A
T2=(0.165*V)/(2*A);
printf("T1=%f sec",T1);
printf("when one audien fill the hall then total
    absorption is %f sec",T2);
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

```
clc();
clear;
//To determine reverberation time of the hall
V=1000;             //volume of hall in m^3
A1=400;             //area of wall in m^2
A2=100;             //area of floor in m^2
A3=100;             //area of ceiling in m^2
N=0.02;             //number of cushion chairs of wall
a1=0.01;            //absorption coefficient of ceiling
a2=0.05;            //absorption coefficient of floor
a3=1.0;             //absorption coefficient of each cushion chair
T=(0.165*V)/((A1*N)+(A2*a1)+(A2*a2)+(A3*a3))
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

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

//answer in book is wrong
```

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

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

//answer in book is wrong
```

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

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

Scilab code Exa 4.4 To determine magnetic induction and dipole moment

```
clc();
clear;
//To determine magnetic induction and dipole moment
```

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

Scilab code Exa 4.5 To determine average number of Bohr magnetons

```
clc();
clear;
//To determine average number of Bohr magnetons
Is=1.96*10^6;            //saturation magnetisation in amp/m
a=3;                //cube edge of iron
A0=3*10^-10;          //A0 in m
mewB=9.27*10^-24;           //bohr magneton in amp/m^2
N=2/(A0^a);
mewbar=Is/N;
mewAB=mewbar/mewB;
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

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

Scilab code Exa 4.7 To determine permeability

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

//answer in book is wrong
```

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

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

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

Scilab code Exa 4.9 To determine the hysteresis loss per cycle

```
clc();
clear;
//To determine the hysteresis loss per cycle
A=100;           //area of hysteresis loop in m^2
B=0.01;          //flux density in Wb/m^2
H=40;            //magnetic field in amp/m
M=7650;          //atomic weight in kg/m^3
L=A*B*H;
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

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

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

Chapter 5

Superconductivity

Scilab code Exa 5.1 To determine magnitude of critical magnitutic field

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

Scilab code Exa 5.2 To determine the value of critical field

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

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

Scilab code Exa 5.3 To determine transition temperature

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

Scilab code Exa 5.4 To determine critical current value

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

Scilab code Exa 5.5 To determine isotopic mass

```
clc();
clear;
//To determine isotopic mass
M1=199.5;          //isotopic mass in a.m.u
T1=5;              //first critical temperature in K
T2=5.1;            //second critical temperature in K
M2=M1*(T1/T2)^2;
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

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

Scilab code Exa 5.7 To determine critical temperature

```
clc();
clear;
//To determine critical temperature
M1=199.5;           //isotopic mass in a.m.u
M2=203.4;           //isotopic mass in a.m.u
Tc1=4.185;          //first critical temperature
```

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

Scilab code Exa 5.8 To determine generating EM waves frequency

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

//answer in book is wrong
```

Scilab code Exa 5.9 To determine critical temperature

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

Scilab code Exa 5.10 To determine the maximum critical temperature

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

Chapter 6

Crystal structure and X ray diffraction

Scilab code Exa 6.1 To determine density

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

Scilab code Exa 6.2 To determine the lattice constant

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

```
//To determine the lattice constant
n=2;                    //number of atoms per unit cell
M=55.85;              //atomic weight in a.m.u
N=6.02*10^26;         //avagadro number in kg/mol
rho=7860;             //density in kg/m^3;
a=((n*M)/(N*rho))^(1/3);
printf("lattice constant in m is ");
disp(a);

//answer in book is wrong
```

Scilab code Exa 6.3 To determine the lattice constant

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

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

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

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

Scilab code Exa 6.5 To calculate the density

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

Scilab code Exa 6.6 To calculate the percentage of volume change

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

```
disp(V1);
a2=2*sqrt(2)*r2;     //lattice constant in FCC
    structure
Vu2=a2^3;     //volume of unit cell of FCC
n2=4;
V2=Vu2/n2;
disp(V2);
PV=(V1-V2)*100/V2;
printf("percentage volume change is")
disp(PV);
```

Scilab code Exa 6.7 To calculate the maximum radius of sphere

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

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

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

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

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

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

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

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

```
//To calculate the angle at which third order reflection can occur
n=3;        //diffraction order
lambda=0.79*10^-10;      //wavelength in m
d=3.04*10^-10;           //spacing in m
theta=asind((n*lambda)/(2*d));
printf("braggs angle in degrees is");
disp(theta);
```

Scilab code Exa 6.11 To calculate the glancing angle

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

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

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

```
//To calculate the space of the reflecting plane and
    volume
lambda=3*10^-10;       //wavelength in m
h=1;
k=0;
l=0;
theta=40;          //glancing angle in degrees
n=1;          //diffraction order
d=(n*lambda)/(2*sind(theta));
printf("space of the reflecting plane in m is");
disp(d);
x=sqrt(h^2+k^2+l^2);
a=d*x;
V=a^3;
printf("volume of unit cell in m^3 is");
disp(V);
```

Scilab code Exa 6.13 To calculate miller indices of reflecting planes

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

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

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

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

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

```
H=6.625*10^-34;         //plancks constant
c=3*10^10;              //velocity of light
a=5.63*10^-10;            //lattice constant in m
d=a/(sqrt(h^2+k^2+l^2));
lambda=(2*d*sind(theta))/n;
printf("wavelength in metres is");
disp(lambda);
E=(H*c)/lambda;
E=E/(1.6*10^-19);            //converting from J to eV
printf("energy of X-ray beam in eV is");
disp(E);

//answer in book is wrong
```

Scilab code Exa 6.16 To calculate the spacing of the crystal

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

Scilab code Exa 6.17 To calculate the lattice parameter of lead

```
clc();
clear;
//To calculate the lattice parameter of lead
lambda=1.5*10^-10;
h=2;
k=0;
l=2;
theta=34;      //bragg angle in degrees
n=1;
d=(n*lambda)/(2*sind(theta));
disp(d);
a=d*(sqrt(h^2+k^2+l^2));
a=a*10^10;       //converting from metres into
   angstrom
printf("lattice parameter in angstrom is");
disp(a);
```

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

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

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

Chapter 7

Laser

Scilab code Exa 7.1 To determine matter wave energy

```
clc();
clear;
//To determine matter wave energy
V=3*10^3;          //velocity of matter wave in m/s
lambda=600*10^-9;          //wavelength in m
h=6.6*10^-34;              //planck's constant in Js
E=(h*V)/lambda;
printf("matter wave energy in J is");
disp(E);

//answer in book is wrong
```

Scilab code Exa 7.2 To calculate wavelength of emitted photons

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

```
C=3*10^8;          //velocity of photon in m/s
h=6.6*10^-34;         //plank's constant in Js
lambda=(h*C)/Eg;
printf("wavelength of emitted photons in m is");
disp(lambda);
lambda=lambda*10^9;         //converting into nm
printf("wavelength of emitted photons in nm is");
disp(lambda);

//answer in book is wrong
```

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

```
clc();
clear;
//To determine the ratio in higher energy and lower
   energy
Eg=3*1.6*10^-19;           //energy gap in J
T=50+273;                  //temperature in kelvin
Kb=1.38*10^-23;            //boltzmann constant in J/K
A=Eg/(Kb*T);
R=exp(-A);
printf("ratio in higher energy and lower energy is "
   );
disp(R);

//answer in book is wrong
```

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

```
clc();
```

```
clear;
//To determine the ratio of stimulated emission rate
    to spontaneous emission
lambda=0.5*10^-9;          //wavelength in nm
h=6.626*10^-34;            //plank constant in Js
T=1000;                    //temperature in K
Kb=1.381*10^-23;           //boltzmann constant in J/
   K
c=3*10^8;
new=c/lambda;
disp(new);
A=(h*new)/(Kb*T);
disp(A);
X=1/(exp(A)-1);
printf("ratio is");
disp(X);

//answer in book is wrong
```

Scilab code Exa 7.5 To determine the wavelength

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

Chapter 8

Fiber optics and holography

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

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

Scilab code Exa 8.2 To calculate the fractional index change

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

Scilab code Exa 8.3 To calculate numerical aperture

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

Scilab code Exa 8.4 To calculate angle of acceptance

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

Scilab code Exa 8.5 To calculate critical angle

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

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

Scilab code Exa 8.6 To calculate numerical aperture and acceptance angle

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

Scilab code Exa 8.7 To calculate fractional index change

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

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

```
clc();
```

```
clear;
//To calculate angle of refraction at the interface
n1=1.6;             //refractive index of medium
n2=1.55;            //refractive index of core
theta1=60;          //angle of incidence in degrees
A=sind(theta1);
disp(A);
theta2=asind(n1*A/n2);
printf("angle of refraction is %f degrees",theta2);

//answer in book is wrong
```

Scilab code Exa 8.9 To calculate refrative index of core

```
clc();
clear;
//To calculate refrative index of core
delta=0.14;             //fractional index change
n2=1.3;                 //refractive index of cladding
n1=n2/(1-delta);
printf("refractive index of core is %f",n1);
```

Scilab code Exa 8.10 To calculate numerical aperture

```
clc();
clear;
//To calculate numerical aperture
theta0=26.80;             //acceptance angle in degrees
NA=sind(theta0);
printf("numerical aperture is %f",NA);
```

Chapter 9

Dielectrics

Scilab code Exa 9.1 To determine the electronic polarisability

```
clc();
clear;
//To determine the electronic polarisability
epsilonr=3.75;          //relative dielectric constant
T=27;                   //temperature in C
gama=1/3;               //internal field constant
rho=2050;               //density of sulphur in kg/m^3
Ma=32;                  //atomic weight of sulphur in a.m.u
epsilon0=8.85*10^-12;
Na=6.022*10^23;
A=(epsilonr-1)/(epsilonr+2);
printf("%f",A);
alphae=(A*3*epsilon0*Ma)/(rho*Na);
printf("electronic polarisability of sulphur in Fm^2 is");
disp(alphae);
```

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

```
clc();
clear;
//To determine the capacitance and charge on the
    plates
A=10^-2;                //area of capacitor m^2
d=10^-2;                //seperation of capacitor plates
     in m
V=100;                  //potential in V
epsilon0=8.85*10^-12;
C=(A*epsilon0)/d;
C=C*10^12;              //converting into PF
printf("capacitance of the capacitor is %f PF",C);
C=8.85*10^-12;
Q=C*V;
printf("charge on plates in C is");
disp(Q);
```

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

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

Scilab code Exa 9.4 To determine dielectric constant of the material

```
clc();
clear;
//To determine dielectric constant of the material
N=3*10^28;            //density of atoms in atoms/m^3
alphae=10^-40;        //electronic constant polarizability in Fm^2
epsilon0=8.85*10^-12;
//consider A=(epsilonr-1)/(epsilonr+2)
A=(N*alphae)/(3*epsilon0);
epsilonr=((2*A)+1)/(1-A);
printf("dielectric constant of the material is %f F/m",epsilonr);

//answer in book is wrong
```

Scilab code Exa 9.5 To determine resultant voltage across the capacitor

```
clc();
clear;
//To determine resultant voltage across the capacitor
A=650*10^-4;          //area of capacitor plate in m^2
d=4*10^-2;            //seperation of parallel plate capacitor in m
Q=2*10^-10;           //charge on capacitor in C
epsilonr=3.5;         //dielectric constant of material
epsilon0=8.85*10^-12;
C=(A*epsilon0)/d;
disp(C);
V=Q/C;
printf("resultant voltage across capacitor in V is ");
disp(V);
```

Scilab code Exa 9.6 To compute the polarisation

```
clc();
clear;
//To compute the polarisation
A=6.45*10^-4;           //area of capacitor plates in
   m^2
d=2*10^-3;              //capacitor plates seperation
   in m
V=12;                   //potential in V
epsilonr=5.0;           //dielectric constant
N=6.023*10^23;          //avagadro number in mol
   inverse
epsilon0=8.85*10^-12;
alphae=(epsilon0*(epsilonr-1))/N;
printf("polarisation in Fm^2 is ");
disp(alphae);

//answer in book is wrong
```

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

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

```
Z=2;                //atomic number
r03=(epsilonr-1)/(4*%pi*Na);
r0=(r03)^(1/3);
printf("radius of electron cloud is");
disp(r0);
//displacement(X)=(4*pi*epsilon0*E*r03)/(Z*e)
//but 4*pi*epsilon0=1/(9*10^9). Let A=4*pi*epsilon0
A=1/(9*(10^9));
X=(A*E*r03)/(Z*e);
printf("displacement in metres when He atom is
   subjected to a field is");
disp(X);
```

Scilab code Exa 9.8 To determine the atomic polarizability

```
clc();
clear;
//To determine the atomic polarizability
epsilonr=4;           //relative permeability
epsilon0=8.85*10^-12;
N=2.08*10^3;          //density of atoms in kg/m^3
Ma=32;                //atomic weight in a.m.u
A=(epsilonr-1)/(epsilonr+2);
disp(A);
alpha=(A*3*epsilon0)/N;
printf("atomic polarizability in Fm^2 is");
disp(alpha);

//answer in book is wrong
```

Scilab code Exa 9.9 To determine energy stored in the condenser

```
clc();
```

```
clear;
//To determine energy stored in the condenser
C=4*10^-6;              //capacitance of condenser in F
epsilonr=200;           //relative permeability
V=2000;                 //applied voltage in V
C0=C/epsilonr;
disp(C0);
E=(1/2)*C0*(V);
printf("energy stored in Joule is")
disp(E);

//answer in book is wrong
```

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

```
clc();
clear;
//To determine the polarisability of He and its
   relative permittivity
R=0.55*10^-10;             //radius of He atom in m
N=2.7*10^25;               //density in atoms/m^3;
epsilon0=8.85*10^-12;
alphae=4*%pi*epsilon0*R^3;
printf("polarisability in Fm^2 is ");
disp(alphae);
epsilonr=((N*alphae)/epsilon0)+1;
printf("relative permittivity in Fm^2 is");
disp(epsilonr);
```

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

```
clc();
```

```
clear;
//To determine field strength and total dipole
   moment
A=180*10^-4;          //area of capacitor in m
C=3*10^-6;            //capacitance in F
epsilonr=8;           //relative permittivity
V=10;                 //potential in V
epsilon0=8.85*10^-12;
E=(V*C)/(epsilon0*epsilonr);
printf("field strength in V/m is");
disp(E);
T=epsilon0*(epsilonr-1)*E*A;
printf("total dipole moment in Coul m is ");
disp(T);

//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

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

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

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

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

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

```
Ef=Ef*4.2*1.6*10^-19;        //converting from eV to
    cal
k=5.796*10^-23;         //boltzmann constant in cal/
    k
Tf=Ef/k;
p2=(%pi)^2;
Ce=(p2*R*T)/(2*Tf);
printf("electronic specific heat in cal/mol-k is");
disp(Ce);

//answer in book is wrong
```

Scilab code Exa 10.4 To estimate the lattice heat capacity

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