

Scilab Textbook Companion for
A Textbook Of 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 4

Electron Ballistics

Scilab code Exa 4.1 Calculation of acceleration time taken and distance covered an

```
1  clc;clear;
2  //Example 4.1
3  //Calculation of acceleration ,time taken ,distance
   covered and kinetic energy of an accelerating
   proton
4
5  //given values
6  m=1.67*10^-27;//mass of proton in kg
7  q=1.602*10^-19;//charge of proton in Coulomb
8  v1=0;//initial velocity in m/s
9  v2=2.5*10^6;//final velocity in m/s
10 E=500;//electric field strength in V/m
11 //calculation
12 a=E*q/m;//acceleration
13 disp(a,'acceleration of proton in (m/s^2) is:');
14 t=v2/a;//time
15 disp(t,'time(in s) taken by proton to reach the
   final velocity is:');
16 x=a*t^2/2;//distance
17 disp(x,'distance (in m)covered by proton in this
   time is:');
```

```
18 KE=E*q*x; //kinetic energy
19 disp(KE, 'kinetic energy(in J) at the time is:');
```

Scilab code Exa 4.2 electrostatic deflection

```
1 clc;clear;
2 //Example 4.2
3 //electrostatic deflection
4 //given values
5 V1=2000; //in volts ,potential difference through
   which electron beam is accelerated
6 l=.04; //length of rectangular plates
7 d=.015; //distance between plates
8 V=50; //potential difference between plates
9 //calculations
10 alpha=atan(1*V/(2*d*V1))*(180/%pi); //in degrees
11 disp(alpha, 'angle of deflection of electron beam is:
   ');
12 v=5.93*10^5*sqrt(V1); //horizontal velocity in m/s
13 t=1/v; //in s
14 disp(t, 'transit time through electric field is:')
```

Scilab code Exa 4.3 electron projected at an angle into a uniform electric field

```
1 clc;clear;
2 //Example 4.3
3 //electron projected at an angle into a uniform
   electric field
4 //given values
5 v1=4.5*10^5; //initial speed in m/s
6 alpha=37*%pi/180; //angle of projection in degrees
7 E=200; //electric field intensity in N/C
8 e=1.6*10^-19; //in C
```

```

9 m=9.1*10^-31; //in kg
10 a=e*E/m; //acceleration in m/s^2
11 t=2*v1*sin(alpha)/a; //time in s
12 disp(t, 'time taken by electron to return to its
    initial level is:')
13 H=(v1^2*sin(alpha)*sin(alpha))/(2*a); //height in m
14 disp(H, 'maximum height reached by electron is:')
15 s=(v1^2)*(2*sin(alpha)*cos(alpha))/(2*a); //
    displacement in m
16 disp(s, 'horizontal displacement (in m) when it reaches
    maximum height is:')

```

Scilab code Exa 4.4 motion of an electron in a uniform magnetic field

```

1 clc;clear;
2 //Example 4.4
3 //motion of an electron in a uniform magnetic field
4 //given values
5 V=200; //potential difference through which electron
    is accelerated in volts
6 B=0.01; //magnetic field in wb/m^2
7 e=1.6*10^-19; //in C
8 m=9.1*10^-31; //in kg
9 v=sqrt(2*e*V/m); //electron velocity in m/s
10 disp(v, 'electron velocity is:')
11 r=m*v/(e*B); //in m
12 disp(r, 'radius of path (in m) is:')

```

Scilab code Exa 4.5 motion of an electron in a uniform magnetic field acting at an

```

1 clc;clear;
2 //Example 4.5

```

```

3 //motion of an electron in a uniform magnetic field
  acting at an angle
4 //given values
5 v=3*10^7;//electron speed
6 B=.23;//magnetic field in wb/m^2
7 q=45*%pi/180;//in degrees ,angle in which electron
  enter field
8 e=1.6*10^-19;//in C
9 m=9.1*10^-31;//in kg
10 R=m*v*sin(q)/(e*B);//in m
11 disp(R,'radius of helical path is:')
12 p=2*%pi*m*v*cos(q)/(e*B);//in m
13 disp(p,'pitch of helical path(in m) is:')

```

Scilab code Exa 4.6 Magnetostatic deflection

```

1 clc;clear;
2 //Example 4.6
3 //Magnetostatic deflection
4 //given values
5 D=.03;//deflection in m
6 m=9.1*10^-31;//in kg
7 e=1.6*10^-19;//in C
8 L=.15;//distance between CRT and anode in m
9 l=L/2;
10 V=2000;//in voltsin wb/
11 B=D*sqrt(2*m*V)/(L*l*sqrt(e));//in wb/m^2
12 disp(B,'transverse magnetic field acting (in wb/m^2)
  is:')

```

Scilab code Exa 4.7 electric and magnetic fields in crossed configuration

```

1 clc;clear;

```

```
2 //Example 4.7
3 //electric and magnetic fields in crossed
  configuration
4 //given values
5 B=2*10^-3;//magnetic field in wb/m^2
6 E=3.4*10^4;//electric field in V/m
7 m=9.1*10^-31;//in kg
8 e=1.6*10^-19;//in C
9 v=E/B;//in m/s
10 disp(v,'electron speed is:')
11 R=m*v/(e*B);//in m
12 disp(R,'radius of circular path (in m) when electric
  field is switched off')
```

Chapter 5

Electron Optics

Scilab code Exa 5.1 Electron refraction calculation of potential difference

```
1  clc; clear;
2  //Example 5.1
3  //Electron refraction , calculation of potential
   difference
4
5  //given values
6  V1=250; //potential by which electrons are
   accelerated in Volts
7  alpha1=50*%pi/180; //in degree
8  alpha2=30*%pi/180; //in degree
9  b=sin(alpha1)/sin(alpha2);
10 //calculation
11 V2=(b^2)*V1;
12 a=V2-V1;
13 disp(a, 'potential difference(in volts) is:');
```

Scilab code Exa 5.2 Cyclotron


```

1  clc;clear;
2  //Example 5.2&5.3
3  //Cyclotron, calculation of magnetic induction,
   maximum energy
4
5  //given values
6  f=12*(10^6); //oscillator frequency in Hertz
7  r=.53; //radius of the dee in metre
8  q=1.6*10^-19; //Deuteron charge in C
9  m=3.34*10^-27; //mass of deuteron in kg
10 //calculation
11 B=2*%pi*f*m/q; //
12 disp(B, 'magnetic induction (in Tesla) is:');
13 E=B^2*q^2*r^2/(2*m);
14 disp(E, 'maximum energy to which deuterons can be
   accelerated (in J) is ')
15 E1=E*6.24*10^18/10^6; //conversion of energy into MeV
16 disp(E1, 'maximum energy to which deuterons can be
   accelerated (in MeV) is ');

```

Scilab code Exa 5.4 calculation of linear separation of lines formed on photograph

```

1  clc;clear;
2  //Example 5.4
3  //Mass spectrograph, calculation of linear
   separation of lines formed on photographic plates
4
5  //given values
6  E=8*10^4; //electric field in V/m
7  B=.55 //magnetic induction in Wb/m^2
8  q=1.6*10^-19; //charge of ions
9  m1=20*1.67*10^-27; //atomic mass of an isotope of
   neon
10 m2=22*1.67*10^-27; //atomic mass of other isotope of
   neon

```

```
11 //calculation
12 x=2*E*(m2-m1)/(q*B^2);//
13 disp(x,'separation of lines (in metre) is:')
```

Chapter 6

Properties of Light

Scilab code Exa 6.1 Optical path calculation

```
1  clc; clear;
2  //Example 6.1
3  //Optical path calculation
4
5  //given values
6  n=1.33; //refractive index of medium
7  x=.75; //geometrical path in micrometre
8  //calculation
9  y=x*n; //
10 disp(y, 'optical path (in micrometre) is:')
```

Scilab code Exa 6.2 Coherence length calculation

```
1  clc; clear;
2  //Example 6.2
3  //Coherence length calculation
4
5  //given values
```

```
6 l=1*10^-14; //line width in metre
7 x=10.6*10^-6; //IR emission wavelength in metre
8 //calculation
9 y=x^2/l; //
10 disp(y, 'coherence length(in metre) is:')
```

Chapter 7

Interference and Diffraction

Scilab code Exa 7.1 plane parallel thin film

```
1  clc;clear;
2  //Example 7.1
3  //plane parallel thin film
4
5  //given values
6  x=5890*10^-10;//wavelength of light in metre
7  n=1.5;//refractive index
8  r=60*%pi/180;//angle of refraction in degree
9  //calculation
10 t=x/(2*n*cos(r));
11 disp(t*10^6,'thickness of plate (in micrometre) is:');
    );
```

Scilab code Exa 7.2 wedge shaped thin film

```
1  clc;clear;
2  //Example 7.2
3  //wedge shaped thin film
```

```

4
5 //given values
6 x=5893*10^-10; //wavelength of light in metre
7 n=1.5; //refractive index
8 y=.1*10^-3; //fringe spacing
9 //calculation
10 z=x/(2*n*y); //angle of wedge
11 alpha=z*180/%pi; //conversion of radian into degree
12 disp(alpha, 'angle of wedge (in degree) is:');

```

Scilab code Exa 7.3 Newtons ring experiment

```

1 clc;clear;
2 //Example 7.3
3 //Newton's ring experiment- calculation of
   refractive index
4
5 //given values
6 D1=1.5; //diameter (in cm)of tenth dark ring in air
7 D2=1.27; //diameter (in cm)of tenth dark ring in
   liquid
8
9
10 //calculation
11 n=D1^2/D2^2;
12 disp(n, 'refractive index of liquid is');

```

Scilab code Exa 7.4 nonreflecting film

```

1 clc;clear;
2 //Example 7.4
3 //nonreflecting film
4

```

```
5 //given values
6 l=5500*10^-10; //wavelength of light
7 n1=1.33; //refractive index of water
8 n2=1.52; //refractive index of glass window pane
9 x=sqrt(n1); //to check if it is nonreflecting
10
11 //calculation
12 t=1/(4*n1); //thickness of water film required
13 disp(t*10^6, 'minimum thickness of film (in metre) is
    ');
```

Chapter 8

Polarization

Scilab code Exa 8.2 Polarizer

```
1  clc; clear;
2  //Example 8.2
3  //Polarizer , calculation of angle
4
5  //given values
6  Io=1; //intensity of polarised light
7  I1=Io/2; //intensity of beam polarised by first by
   first polariser
8  I2=Io/3; //intensity of light polarised by second
   polariser
9
10
11 //calculation
12 a=acos(sqrt(I2/I1));
13 alpha=a*180/%pi; //conversion of angle into degree
14 disp(alpha, 'angle between characteristic directions
   (in degree) is ');
```

Scilab code Exa 8.3 calculation of birefringence


```
1  clc;clear;
2  //Example 8.3
3  //calculation of birefringence
4
5  //given values
6
7  l=6*10^-7;//wavelength of light in metre
8  d=3*10^-5;//thickness of crystal
9
10
11 //calculation
12 x=1/(4*d);
13 disp(x, 'the birefringance of the crystal is ');
```

Chapter 11

Architectural Acoustics

Scilab code Exa 11.1 calculation of total absorption and average absorption coefficient

```
1  clc; clear;
2  //Example 11.1
3  //calculation of total absorption and average
   absorption coefficient
4
5  //given values
6
7  V=20*15*5; //volume of hall in m^3
8  t=3.5; //reverberation time of empty hall in sec
9
10
11 //calculation
12 a1=.161*V/t; //total absorption of empty hall
13 k=a1/(2*(20*15+15*5+20*5));
14 disp(k, 'the average absorption coefficient is');
```

Scilab code Exa 11.2 calculation of average absorption coefficient

```

1  clc;clear;
2  //Example 11.2
3  //calculation of average absorption coefficient
4
5  //given values
6
7  V=10*8*6;//volume of hall in m^3
8  t=1.5;//reverberation time of empty hall in sec
9  A=20;//area of curtain cloth in m^2
10 t1=1;//new reverberation time in sec
11
12 //calculation
13 a1=.161*V/t;//total absorption of empty hall
14 a2=.161*V/t1;//total absorption after a curtain
    cloth is suspended
15
16 k=(a2-a1)/(2*20);
17 disp(k,'the average absorption coefficient is ');

```

Scilab code Exa 11.3 calculation of average absorption coefficient and area

```

1  clc;clear;
2  //Example 11.3
3  //calculation of average absorption coefficient and
    area
4
5  //given values
6
7  V=20*15*10;//volume of hall in m^3
8  t=3.5;//reverberation time of empty hall in sec
9  t1=2.5;//reduced reverberation time
10 k2=.5;//absorption coefficient of curtain cloth
11 //calculation
12 a1=.161*V/t;//total absorption of empty hall
13 k1=a1/(2*(20*15+15*10+20*10));

```

```
14 disp(k1, 'the average absorption coefficient is ');
15 a2=.161*V/t1; //total absorption when wall is covered
    with curtain
16 a=t1*(a2-a1)/(t1*k2);
17 disp(a, 'area of wall to be covered with curtain(in m
    ^2) is: ')
```

Chapter 12

Ultrasonics

Scilab code Exa 12.1 calculation of natural frequency

```
1  clc; clear;  
2  //Example 12.1  
3  //calculation of natural frequency ,magnetostriction  
4  
5  //given values  
6  
7  l=40*10^-3; //length of pure iron rod  
8  d=7.25*10^3; //density of iron in kg/m^3  
9  Y=115*10^9; //Young's modulus in N/m^2  
10  
11 // calculation  
12 f=(1*sqrt(Y/d))/(2*1);  
13 disp(f*10^-3, 'the natural frequency(in kHz) is ');
```

Scilab code Exa 12.2 calculation of natural frequency

```
1  clc; clear;  
2  //Example 12.2
```

```

3 //calculation of natural frequency
4
5 //given values
6
7 t=5.5*10^-3;//thickness in m
8 d=2.65*10^3;//density in kg/m^3
9 Y=8*10^10;//Young's modulus in N/m^2
10
11
12 //calculation
13 f=(sqrt(Y/d))/(2*t);//frequency in hertz
14 disp(f*10^-3,'the natural frequency(in kHz) is ');

```

Scilab code Exa 12.3 calculation of depth and wavelength

```

1 clc;clear;
2 //Example 12.3
3 //calculation of depth and wavelength
4
5 //given values
6
7 f=.07*10^6;//frequency in Hz
8 t=.65;//time taken for pulse to return
9 v=1700;//velocity of sound in sea water in m/s
10
11 //calculation
12 d=v*t/2;//
13 disp(d,'the depth of sea(in m) is ');
14 l=v/f;//wavelength of pulse in m
15 disp(l*10^2,'wavelength of pulse (in cm)is ');

```

Chapter 13

Atomic Physics

Scilab code Exa 13.1 calculation of rate of flow of photons

```
1  clc;clear;
2  //Example 13.1
3  //calculation of rate of flow of photons
4
5  //given values
6
7  l=5893*10^-10; //wavelength of light in m
8  P=40; //power of sodium lamp in W
9  d=10; //distance from the source in m
10 s=4*pi*d^2; //surface area of radius in m^2
11 c=3*10^8; //velocity of light in m/s
12 h=6.626*10^-34; //Planck's constant in Js
13 //calculation
14 E=P*1; //
15 disp(E, 'total energy emitted per second(in Joule)is '
      );
16 n=E*1/(c*h); //total no of photons
17 R=n/s;
18 disp(R, 'rate of flow of photons per unit area (in /m
      ^2) is ')
```

Scilab code Exa 13.2 calculation of threshold wavelength and stopping potential

```
1 clc;clear;
2 //Example 13.2
3 //calculation of threshold wavelength and stopping
  potential
4
5 //given values
6
7 l=2000;//wavelength of light in armstrong
8 e=1.6*10^-19;//charge of electron
9 W=4.2;//work function in eV
10 c=3*10^8;//velocity of light in m/s
11 h=6.626*10^-34;//Planck's constant in Js
12 //calculation
13 x=12400/(W);//h*c=12400 eV
14 disp(x,'threshold wavelength(in Armstrong)is ');
15 Vs=(12400/l-W);//
16 disp(Vs,'stopping potential (in VOLTS) is ')
```

Scilab code Exa 13.3 calculation of momentum of Xray photon undergoing scattering

```
1 clc;clear;
2 //Example 13.3
3 //calculation of momentum of X-ray photon undergoing
  scattering
4
5 //given values
6
7 alpha=60*%pi/180;//scattering angle in radian
8 e=1.6*10^-19;//charge ofelectrone
9 W=12273;//work function in eV
```



```

10 c=3*10^8; //velocity of light in m/s
11 h=6.626*10^-34; //Planck's constant in Js
12 hc=12400; //in eV
13 m=9.1*10^-31 //restmass of photon in kg
14 //calculation
15 x=hc/(W); //wavelength of photon undergoing modified
    scattering in armstrong
16 y=x-(h/(m*c))*(1-cos(alpha));
17 p=h/y*10^10;
18 disp(p, 'momentum of photon(in kg-m/s) is ');

```

Scilab code Exa 13.4 calculation of wavelength of scattered radiation and velocity

```

1  clc;clear;
2  //Example 13.4
3  //calculation of wavelength of scattered radiation
    and velocity of recoiled electron
4
5  //given values
6
7  alpha=30*%pi/180; //scattering angle in radian
8  e=1.6*10^-19; //charge ofelectron
9  x=1.372*10^-10; //wavelength of incident radiation in
    m
10 c=3*10^8; //velocity of light in m/s
11 h=6.626*10^-34; //Planck's constant in Js
12 m=9.1*10^-31 //rest mass of photon in kg
13 hc=12400; //in eV
14 //calculation
15
16 y=((x+(h/(m*c))*(1-cos(alpha))))*10^10;
17 disp(y, 'wavelength of scattered radiation (in
    armstrong) is ');
18 x1=x*10^10; //converting incident wavelength into
    armstrong

```

```

19 KE=hc*e*((1/x1)-(1/y)); //kinetic energy in Joule
20 disp(KE, 'kinetic energy in joule is ');
21 v=sqrt(2*KE/m);
22 disp(v, 'velocity of recoiled electron (in m/s^2) is ')
    ;

```

Scilab code Exa 13.5 calculation of wavelength of light emitted

```

1  clc;clear;
2  //Example 13.5
3  //calculation of wavelength of light emitted
4
5  //given values
6  e=1.6*10^-19; //charge of electrone
7  c=3*10^8; //velocity of light
8  h=6.626*10^-34; //Planck's constant in Js
9  E1=5.36; //energy of first state in eV
10 E2=3.45; //energy of second state in eV
11
12
13 //1) calculation
14
15 l=h*c*10^10/((E1-E2)*e);
16 disp(l, 'wavelength of scattered light (in Armstrong)
    is ');

```

Scilab code Exa 13.6 calculation of de Broglie wavelength

```

1  clc;clear;
2  //Example 13.6
3  //calculation of de Broglie wavelength
4
5  //1) given values

```

```

6 e=1.6*10^-19;
7 h=6.626*10^-34;//Planck's constant in Js
8 V=182;//potential difference in volts
9 m=9.1*10^-31;//mass of e in kg
10
11
12 //1) calculation
13
14 l=h/sqrt(2*e*m*V);
15 disp(1, 'de Brogliewavelength (in m) is ');
16
17
18 //2) given values
19 m1=1;//mass of object in kg
20 v=1;//velocity of object in m/s
21 l1=h/(m1*v);
22 disp(l1, 'debrogie wavelength of object in m) is ');

```

Scilab code Exa 13.7 calculation of uncertainty in position

```

1 clc;clear;
2 //Example 13.7
3 //calculation of uncertainty in position
4
5 //1) given values
6
7 h=6.626*10^-34;//Planck's constant in Js
8 v1=220;//velocity of e in m/s
9 m=9.1*10^-31;//mass of e in kg
10 A=0.065/100;//accuracy
11
12
13 //1) calculation
14 v2=v1*A;//uncertainty in speed
15 x1=h/(2*pi*m*v2);//

```

```

16 disp(x1,'uncertainty in position of e (in m)is ');
17
18
19 //2)given values
20 m1=150/1000;//mass of object in kg
21 x2=h/(2*%pi*m1*v2);
22 disp(x2,'uncertainty in position of baseball(in m)
    is ');

```

Scilab code Exa 13.8 Energy states of an electron and grain of dust

```

1  clc;clear;
2  //Example 13.8
3  //calculation of energy states of an electron and
    grain of dust and comparing
4
5  //1)given values
6  L1=10*10^-10;//width of potential well in which e is
    confined
7  L2=.1*10^-3;//width of potential well in which grain
    of dust is confined
8  h=6.626*10^-34;//Planck's constant in Js
9  v1=10^6;//velocity of garin of dust in m/s
10 m1=9.1*10^-31;//mass of e in kg
11 m2=10^-9;//mass of grain in kg
12
13 //1)calculation
14
15 Ee1=1^2*h^2/(8*m1*L1^2);//first energy state of
    electron
16 disp(Ee1,'first energy state of e is ');
17 Ee2=2^2*h^2/(8*m1*L1^2);//second energy state of
    electron
18 disp(Ee2,'second energy state of e is ');
19 Ee3=3^2*h^2/(8*m1*L1^2);//third energy state of

```

```

    electron
20 disp(Ee3,'third energy state of e is ');
21 disp('Energy levels of an electron in an infinite
    potential well are quantised and the energy
    difference between the successive levels is quite
    large. Electron cannot jump from one level to
    other on strength of thermal energy. Hence
    quantization of energy plays a significant role
    in case of electron')
22
23 Eg1=1^2*h^2/(8*m2*L2^2); //first energy state of
    grain of dust
24 disp(Eg1,'first energy state of grain of dust is ');
25 Eg2=2^2*h^2/(8*m2*L2^2); //second energy state of
    grain of dust
26 disp(Eg2,'second energy state of grain of dust is ')
    ;
27 Eg3=3^2*h^2/(8*m2*L2^2); //third energy state of
    grain of dust
28 disp(Eg3,'third energy state of grain of dust is ')
    ;
29 KE=m2*v1^2/2; //kinetic energy of grain of dust;
30 disp(KE,'kinetic energy of grain of dust is ');
31 disp('The energy levels of a grain of dust are so
    near to each other that they constitute a
    continuum. These energy levels are far smaller
    than the kinetic energy possessed by the grain of
    dust. It can move through all these energy levels
    without an external supply of energy. Thus
    quantization of energy levels is not at all
    significant in case of macroscopic bodies.')

```

Chapter 14

Lasers

Scilab code Exa 14.1 calculation of intensity of laser beam

```
1 clc; clear;  
2 //Example 14.1  
3 //calculation of intensity of laser beam  
4  
5 //given values  
6 P=10*10-3; //Power in Watt  
7 d=1.3*10-3; //diametre in m  
8 A=%pi*d2/4; //area in m2  
9  
10  
11 //calculation  
12 I=P/A;  
13 disp(I, 'intensity (in W/m2) is ');
```

Scilab code Exa 14.2 calculation of intensity of laser beam

```
1 clc; clear;  
2 //Example 14.2
```

```

3 //calculation of intensity of laser beam
4
5 //given values
6 P=1*10^-3;//Power in Watt
7 l=6328*10^-10;//wavelength in m
8 A=l^2;//area in m^2
9
10
11 //calculation
12 I=P/A;
13 disp(I, 'intensity (in W/m^2) is ');

```

Scilab code Exa 14.3 calculation of coherence length bandwidth and line width

```

1 clc;clear;
2 //Example 14.3
3 //calculation of coherence length ,bandwidth and line
  width
4
5 //given values
6 c=3*10^8;//velocity of light in m/s
7 t=.1*10^-9;//timedivision in s
8 l=6238*10^-10;//wavelength in m
9
10 //calculation
11 x=c*t;
12 disp(x, 'coherence length (in m) is ');
13 d=1/t;
14 disp(d, 'bandwidth (in Hz) is ');
15 y=l^2*d/c;//line width in m
16 disp(y*10^10, 'line width(in armstrong )is ');

```

Scilab code Exa 14.4 calculation of frequency difference

```

1  clc;clear;
2  //Example 14.4
3  //calculation of frequency difference
4
5  //given values
6  c=3*10^8;//velocity of light in m/s
7  l=.5;//distance in m
8
9  //calculation
10 f=c/(2*l);//in hertz
11 disp(f/10^6,'frequency difference (in MHz) is ');

```

Scilab code Exa 14.5 calculation of frequency difference

```

1  clc;clear;
2  //Example 14.5
3  //calculation of no of cavity modes
4
5  //given values
6  c=3*10^8;//velocity of light in m/s
7  n=1.75;//refractive index
8  l=2*10^-2;//length of ruby rod in m
9  x=6943*10^-10;//wavelength in m
10 y=5.3*10^-10;//spread of wavelength in m
11
12 //calculation
13 d=c/n/l;
14 f=c*y/x^2;
15 m=f/d;
16 disp(m,'no of modes is ');

```

Chapter 15

Atomic nucleus and nuclear energy

Scilab code Exa 15.1 calculation of binding energy per nucleon

```
1  clc;clear;
2  //Example 15.1
3  //calculation of binding energy per nucleon
4
5  //given values
6  Mp=1.00814;//mass of proton in amu
7  Mn=1.008665;//mass of nucleon in amu
8  M=7.01822;//mass of Lithium nucleus in amu
9  amu=931;//amu in MeV
10 n=7-3;//no of neutrons in lithium nucleus
11
12 //calculation
13 ET=(3*Mp+4*Mn-M)*amu;//total binding energy in MeV
14 E=ET/7;//7 is the mass number
15 disp(E, 'Binding energy per nucleon in MeV is');
```

Scilab code Exa 15.2 calculation of energy

```
1  clc; clear;
2  //Example 15.2
3  //calculation of energy
4
5  //given values
6  M1=15.00001; //atomic mass of N15 in amu
7  M2=15.0030; //atomic mass of O15 in amu
8  M3=15.9949; //atomic mass of O16 in amu
9  amu=931.4; //amu in MeV
10 mp=1.0072766; //restmass of proton
11 mn=1.0086654; //restmass of neutron
12
13 //calculation
14 Q1=(M3-mp-M1)*amu;
15 disp(Q1, 'energy required to remove one proton from
        O16 is ');
16 Q2=(M3-mn-M2)*amu;
17 disp(Q2, 'energy required to remove one neutron from
        O16 is ');
```

Scilab code Exa 15.3 calculation of binding energy

```
1  clc; clear;
2  //Example 15.3
3  //calculation of binding energy
4
5  //given values
6  Mp=1.00758; //mass of proton in amu
7  Mn=1.00897; //mass of nucleon in amu
8  M=4.0028; //mass of Helium nucleus in amu
9  amu=931.4; //amu in MeV
10
11 //calculation
```

```

12 E1=(2*Mp+2*Mn-M)*amu;//total binding energy
13 disp(E1,'Binding energy in MeV is ');
14 E2=E1*10^6*1.6*10^-19;
15 disp(E2,'binding energy in Joule is ');

```

Scilab code Exa 15.4 calculation of binding energy

```

1  clc;clear;
2  //Example 15.4
3  //calculation of amount of unchanged material
4
5  //given values
6  T=2;//half life in years
7  k=.6931/T;//decay constant
8  M=4.0028;//mass of Helium nucleus in amu
9  amu=931.4;//amu in MeV
10 No=1;//initial amount in g
11
12 //calculation
13 N=No*(%e^(-k*2*T));
14 disp(N,'amount of material remaining unchanged after
      four years(in gram) is ');

```

Scilab code Exa 15.5 calculation of halflife

```

1  clc;clear;
2  //Example 15.5
3  //calculation of amount of halflife
4
5  //given values
6  t=5;//time period in years
7  amu=931.4;//amu in MeV
8  No=5;//initial amount in g

```

```

9 N=5-(10.5*10^-3); //amount present after 5 years
10
11
12 //calculation
13 k=log(N/No)/t; //decay constant
14 T=-.693/k;
15 disp(T, 'halflife in years is ');

```

Scilab code Exa 15.6 calculation of activity

```

1 clc;clear;
2 //Example 15.6
3 //calculation of activity
4
5 //given values
6 t=28; //half life in years
7 m=10^-3; //mass of sample
8 M=90; //atomic mass of strontium
9 NA=6.02*10^26; //avogadro's number
10
11
12 //calculation
13 n=m*NA/M; //no of nuclei in 1 mg sample
14 k=.693/(t*365*24*60*60); //decay constant
15 A=k*n;
16 disp(A, 'activity of sample(in disintegrations per
    second) is ');

```

Scilab code Exa 15.7 calculation of age of mineral

```

1 clc;clear;
2 //Example 15.7
3 //calculation of age of mineral

```

```

4
5 //given values
6 t=4.5*10^9;//half life in years
7 M1=238;//atomic mass of Uranium in g
8 m=.093;//mass of lead in 1 g of uranium in g
9 NA=6.02*10^26;//avogadro's number
10 M2=206;//atomic mass of lead in g
11
12 //calculation
13 n=NA/M1;//no of nuclei in 1 g of uranium sample
14 n1=m*NA/M2;//no of nuclei in m mass of lead
15 c=n1/n;
16 k=.693/t;//decay constant
17 T=(1/k)*log(1+c);
18 disp(T,'age of mineral in years is ');

```

Scilab code Exa 15.8 calculation of age of wooden piece

```

1 clc;clear;
2 //Example 15.8
3 //calculation of age of wooden piece
4
5 //given values
6 t=5730;//half life of C14 in years
7 M1=50;//mass of wooden piece in g
8 A1=320;//activity of wooden piece (disintegration
   per minute per g)
9 A2=12;//activity of living tree
10
11 //calculation
12 k=.693/t;//decay constant
13 A=A1/M1;//activity after death
14
15 T=(1/k)*log(A2/A);
16 disp(T,'age of mineral in years is ');

```

Scilab code Exa 15.9 calculation of energy released

```
1  clc;clear;
2  //Example 15.9
3  //calculation of energy released
4
5  //given values
6  M1=10.016125;//atomic mass of Boron in amu
7  M2=13.007440;//atomic mass of C13 in amu
8  M3=4.003874;//atomic mass of Helium in amu
9  mp=1.008146;//mass of proton in amu
10 amu=931;//amu in MeV
11
12 //calculation
13 Q=(M1+M3-(M2+mp))*amu;//total binding energy in M
14 disp(Q,'Binding energy per nucleon in MeV is');
```

Scilab code Exa 15.10 calculation of crossection

```
1  clc;clear;
2  //Example 15.10
3  //calculation of crossection
4
5  //given values
6  t=.01*10^-3;//thickness in m
7  n=10^13;//no of protons bombarding target per s
8  NA=6.02*10^26;//avogadro's number
9  M=7;//atomic mass of lithium in kg
10 d=500;//density of lithium in kg/m^3
11 n0=10^8;//no of neutrons produced per s
12 //calculation
```

```

13 n1=d*NA/M;//no of target nuclei per unit volume
14 n2=n1*t;//no of target nuclei per area
15 A=n0/(n*n2);
16 disp(A,'crosssection(in m^2) for this reaction is');

```

Scilab code Exa 15.11 calculation of final energy

```

1  clc;clear;
2  //Example 15.11
3  //calculation of final energy
4
5  //given values
6  B=.4;//max magnetic field in Wb/m^2
7  c=3*10^8;
8  e=1.6*10^-19;
9  d=1.52;//diametre in m
10 r=d/2;
11
12 //calculation
13 E=B*e*r*c;//E=pc,p=mv=Ber
14 disp(E,'final energy of e(in J) is');
15 E1=(E/e)/10^6;
16 disp(E1,'final energy of e (in MeV) is');

```

Scilab code Exa 15.12 calculation of amount of fuel

```

1  clc;clear;
2  //Example 15.12
3  //calculation of amount of fuel
4
5  //given values
6  P=100*10^6;//power required by city
7  M=235;//atomic mass of Uranium in g

```

```

8 e=20/100; //conversion efficiency
9 NA=6.02*10^26; //avogadros number
10 E=200*10^6*1.6*10^-19; //energy released per fission
11 t=8.64*10^4; //day in seconds
12
13
14 //calculation
15 E1=P*t; //energy requirement
16 m=E1*M/(NA*e*E); //no of nuclei N=NA*m/M, energy
    released by m kg is N*E, energy requirement=e*N*E
17 disp(m, 'amount of fuel(in kg) required is ');

```

Scilab code Exa 15.13 calculation of power output

```

1 clc;clear;
2 //Example 15.13
3 //calculation of power output
4
5 //given values
6 M=235; //atomic mass of Uranium in kg
7 e=5/100; //reactor efficiency
8 m=25/1000; //amount of uranium consumed per day in kg
9 E=200*10^6*1.6*10^-19; //energy released per fission
10 t=8.64*10^4; //day in seconds
11 NA=6.02*10^26; //avogadros number
12
13 //calculation
14 n=NA*m/M; //no of nuclei in 25g
15 E1=n*E; //energy produced by n nuclei
16 E2=E1*e; //energy converted to power
17 P=E2/t; //power output in Watt
18 disp(P/10^6, 'power output in MW is ');

```

Scilab code Exa 15.14 calculation of power developed

```
1  clc; clear;
2  //Example 15.14
3  //calculation of power developed
4
5  //given values
6  M=235; //atomic mass of Uranium in kg
7  m=20.4; //amount of uranium consumed per day in kg
8  E=200*106*1.6*10-19; //energy released per fission
9  t=3600*1000; //time of operation
10 NA=6.02*1026; //avogadros number
11
12 //calculation
13 n=NA*m/M; //no of nuclei in 20.4kg
14 E1=n*E; //energy produced by n nuclei
15 P=E1/t; //in Watt
16 disp(P/106, 'power developed in MW is ');
```

Scilab code Exa 15.15 calculation of amount of dueterium consumed

```
1  clc; clear;
2  //Example 15.15
3  //calculation of amount of dueterium consumed
4
5  //given values
6  M1=2.01478; //atomic mass of Hydrogen in amu
7  M2=4.00388; //atomic mass of Helium in amu
8  amu=931; //amu in MeV
9  e=30/100; //efficiency
10 P=50*106; //output power
11 NA=6.026*1026; //avogadro number
12 t=8.64*104; //seconds in a day
13
14 //calculation
```

```
15 Q=(2*M1-M2)*amu;//energy released in a D-D reaction
    in MeV
16 Q=Q*e*10^6/2;//actual output per dueterium atom in
    eV
17 n=P/(Q*1.6*10^-19);//no of D atoms required
18 m=n*M1/NA;//equivalent mass of D required per s
19 X=m*t;
20
21 disp(X,'Deuterium requirement per day in kg is');
```

Chapter 16

Structure of Solids

Scilab code Exa 16.1 calculation of density

```
1  clc; clear;
2  //Example 16.1
3  //calculation of density
4
5  //given values
6  a=3.36*10^-10; //lattice constant in m
7  M=209; //atomicmass of polonium in kg
8  N=6.02*10^26; //avogadro's number
9  z=1; //no of atom
10 //calculation
11 d=z*M/(N*a^3)
12
13 disp(d, 'density (in kg/m^3) is ');
```

Scilab code Exa 16.2 calculation of no of atoms

```
1  clc; clear;
2  //Example 16.2
```

```

3 //calculation of no of atoms
4
5 //given values
6 a=4.3*10^-10;//edge of unit cell in m
7 d=963;//density in kg/m^3
8 M=23;//atomicmass of sodium in kg
9 N=6.02*10^26;//avogadro's number
10
11 //calculation
12 z=d*N*a^3/M;
13
14 disp(z,'no of atoms is');

```

Scilab code Exa 16.3 calculation of distance

```

1 clc;clear;
2 //Example 16.3
3 //calculation of distance
4
5 //given values
6 z=4;//no of atoms in fcc
7 d=2180;//density in kg/m^3
8 M=23+35.3;//atomicmass of sodium chloride in kg
9 N=6.02*10^26;//avogadro's number
10
11 //calculation
12 a1=z*M/(N*d);
13 a=a1^(1/3);
14 l=a/2;//in m
15
16 disp(1*10^10,'distance between adjacent chlorine and
    sodium atoms in armstrong is');

```

Scilab code Exa 16.4 calculation of interatomic spacing

```
1  clc; clear;
2  //Example 16.4
3  //calculation of interatomic spacing
4
5  //given values
6  alpha=30*%pi/180; //Bragg angle in degree
7  h=1;
8  k=1;
9  l=1;
10 m=1; //order of reflection
11 x=1.75*10^-10; //wavelength in m
12
13 //calculation
14 d=m*x/(2*sin(alpha));
15 a=d*sqrt(h^2+k^2+l^2); //in m
16
17 disp(a*10^10, 'interatomic spacing in armstrong is');
```

Chapter 17

The Band Theory of Solids

Scilab code Exa 17.1 calculation of velocity of fraction of free electrons

```
1  clc; clear;
2  //Example 17.1
3  //calculation of probability
4
5  //given values
6  E=.01; //energy difference in eV
7  kT=.026; //temperature equivalent at room temp in e
8
9  //calculation
10 P=1/(1+(%e^(E/kT)));
11
12 disp(P, 'interatomic spacing is');
```

Scilab code Exa 17.2 calculation of velocity of e

```
1  clc; clear;
2  //Example 17.2
3  //calculation of velocity of e
```

```

4
5 //given values
6 e=1.6*10^-19;//charge of e in C
7 E=2.1*e;//fermi level in J
8 m=9.1*10^-31;//mass of e in kg
9
10 //calculation
11 v=sqrt(2*E/m);
12
13 disp(v,'velocity of e(in m/s)');

```

Scilab code Exa 17.3 calculation of velocity of fraction of free electrones

```

1 clc;clear;
2 //Example 17.3
3 //calculation of velocity of fraction of free
  electrons
4
5 //given values
6 E=5.5;//fermi level in eV
7 kT=.026;//temperture equivalent at room temp in e
8
9 //calculation
10 f=2*kT/E;
11
12 disp(f,'fraction of free electrone\s upto width kT
  on either side of Ef is ');

```

Chapter 18

Semiconductors

Scilab code Exa 18.2 calculation of probability

```
1  clc; clear;
2  //Example 18.2
3  //calculation of probability
4
5  //given values
6  T=300; //temp in K
7  kT=.026; //temperture equivalent at room temp in eV
8  Eg=5.6; //forbidden gap in eV
9
10 //calculation
11 f=1/(1+%e^(Eg/(2*kT)));
12
13 disp(f, 'probability of an e being thermally promoted
    to conduction band is');
```

Scilab code Exa 18.3 calculation of fraction of e in CB

```
1  clc; clear;
```



```

2 //Example 18.3
3 //calculation of fraction of e in CB
4
5 //given values
6 T=300;//temp in K
7 kT=.026;//temperture equivalent at room temp in eV
8 Eg1=.72;//forbidden gap of germanium in eV
9 Eg2=1.1;//forbidden gap of silicon in eV
10 Eg3=5.6;//forbidden gap of diamond in eV
11
12 //calculation
13 f1=%e^(-Eg1/(2*kT));
14 disp(f1,'fraction of e in conduction band of
    germanium is ');
15 f2=%e^(-Eg2/(2*kT));
16 disp(f2,'fraction of e in conduction band of
    silicon is ');
17 f3=%e^(-Eg3/(2*kT));
18 disp(f3,'fraction of e in conduction band of
    diamond is ');

```

Scilab code Exa 18.4 calculation of fractionional change in no of e

```

1 clc;clear;
2 //Example 18.3
3 //calculation of fractionional change in no of e
4
5 //given values
6 T1=300;//temp in K
7 T2=310;//temp in K
8 Eg=1.1;//forbidden gap of silicon in eV
9 k=8.6*10^-5;//boltzmann's constant in eV/K
10
11 //calculation
12 n1=(10^21.7)*(T1^(3/2))*10^(-2500*Eg/T1);//no of

```

```

    conduction e at T1
13 n2=(10^21.7)*(T2^(3/2))*10^(-2500*Eg/T2); //no of
    conduction e at T2
14 x=n2/n1;
15 disp(x, 'fractional change in no of e is ');

```

Scilab code Exa 18.5 calculation of resistivity

```

1  clc;clear;
2  //Example 18.5
3  //calculation of resistivity
4
5  //given values
6  e=1.6*10^-19;
7  ni=2.5*10^19; //intrinsic density of carriers per m^3
8  ue=.39; //mobility of e
9  uh=.19; //mobility of hole
10
11
12 //calculation
13 c=e*ni*(ue+uh); //conductivity
14 r=1/c; //resistivity
15 disp(r, 'resistivity in ohm m is ');

```

Scilab code Exa 18.6 calculation of conductivity of intrinsic and doped semiconduc

```

1  clc;clear;
2  //Example 18.6
3  //calculation of conductivity of intrinsic and doped
    semiconductors
4
5  //given values
6  h=4.52*10^24; //no of holes per m^3

```

```

7 e=1.25*10^14;//no of electrons per m^3
8 ue=.38;//e mobility
9 uh=.18;//hole mobility
10 q=1.6*10^-19;//charge of e in C
11 //calculation
12 ni=sqrt(h*e);//intrinsic concentration
13 ci=q*ni*(ue+uh);
14 disp(ci,'conductivity of semiconductor(in S/m) is ');
15 cp=q*h*uh;
16 disp(cp,'conductivity of doped semiconductor (in S/m
) is ');

```

Scilab code Exa 18.7 calculation of hole concentration

```

1 clc;clear;
2 //Example 18.7
3 //calculation of hole concentration
4
5 //given values
6 ni=2.4*10^19;//carrier concentration per m^3
7 N=4*10^28;//concentration of ge atoms per m^3
8
9 //calculation
10 ND=N/10^6;//donor cocntrtn
11 n=ND;//no of electrones
12
13 p=ni^2/n;
14 disp(p,'concentartion of holes per m^3 is ');

```

Scilab code Exa 18.8 calculation of Hall voltage

```

1 clc;clear;
2 //Example 18.8

```

```
3 //calculation of Hall voltage
4
5 //given values
6 ND=10^21;//donor density per m^3
7 B=.5;//magnetic field in T
8 J=500;//current density in A/m^2
9 w=3*10^-3;//width in m
10 e=1.6*10^-19;//charge in C
11
12 //calculation
13
14
15 V=B*J*w/(ND*e);//in volts
16 disp(V*10^3,'Hall voltage in mv is');
```

Chapter 19

PN Junction Diode

Scilab code Exa 19.1 calculation of potential barrier

```
1  clc;clear;
2  //Example 19.1
3  //calculation of potential barrier
4
5  //given values
6  e=1.6*10^-19;
7  n=4.4*10^28;//no of atoms per m^3
8  kT=.026*e;//temp eqvlnt at room temp
9  ni=2.4*10^19;//no of intrinsic carriers per m^3
10 NA=n/10^6;//no of acceptors
11 ND=n/10^6;//no of donors
12
13 //calculation
14 V=(kT/e)*log(NA*ND/ni^2);
15 disp(V,'potential barrier in volts is');
```

Scilab code Exa 19.2 calculation of current

```
1  clc;clear;
2  //Example 19.2
3  //calculation of current
4
5  //given values
6  e=1.6*10-19;
7  kT=.026*e;//temp eqvlnt at room temp
8  Io=2*10-7;//current flowing at room temp in A
9  V=.1;//forward bias voltage in volts
10
11 //calculation
12 I=Io*(%e(e*V/kT)-1);//in Ampere
13 disp(I*106, 'current flowing when forward bias
    applied(in microampere)is ');
```

Chapter 21

Magnetic Materials

Scilab code Exa 21.1 calculation of magnetizing force and relative permeability

```
1  clc;clear;
2  //Example 21.1
3  //calculation of magnetizing force and relative
   permeability
4
5  //given values
6  M=2300;//magnetization in A/m
7  B=.00314;//flux density in Wb/m^2
8  u=12.57*10^-7;//permeability in H/m
9
10 //calculation
11 H=(B/u)-M;
12 disp(H,'magnetizing force(in A/m)is ');
13 Ur=B/(u*M);
14 disp(Ur,'relative permeability is')
```

Scilab code Exa 21.2 calculation of magnetization and magnetic flux density

```

1  clc;clear;
2  //Example 21.2
3  //calculation of magnetization and magnetic flux
   density
4
5  //given values
6  H=105; //external field in A/m
7  X=5*10-5; //susceptibility
8  u=12.57*10-7; //permeability in H/m
9
10 //calculation
11 M=X*H;
12 disp(M, 'magnetization (in A/m) is ');
13 B=u*(M+H);
14 disp(B, 'magnetic flux density (in wb/m2) is ')

```

Scilab code Exa 21.3 calculation of relative permeability

```

1  clc;clear;
2  //Example 21.3
3  //calculation of relative permeability
4
5  //given values
6
7  X=3.7*10-3; //susceptibility at 300k
8  T=300; //temp in K
9  T1=200; //temp in K
10 T2=500; //temp in K
11
12 //calculation
13 C=X*T; //curie constant
14 XT1=C/T1;
15 disp(XT1, 'relative permeability at T1 is ');
16 XT2=C/T2;
17 disp(XT2, 'relative permeability at T2 is ')

```


Chapter 22

Superconductivity

Scilab code Exa 22.1 calculation of magnetic field

```
1  clc;clear;
2  //Example 22.1
3  //calculation of magnetic field
4
5  //given values
6
7  Tc=7.2;//transition temp in K
8  T=5;//temp in K
9  Hc=3.3*10^4;//magnetic field at T in A/m
10
11
12 //calculation
13 Hc0=Hc/(1-(T^2/Tc^2));
14 disp(Hc0,'max value of H at 0K (in A/m) is ');
```

Scilab code Exa 22.2 calculation of transition temperature

```
1  clc;clear;
```

```

2 //Example 22.2
3 //calculation of transition temperature
4
5 //given values
6
7 T=8;//temp in K
8 Hc=1*10^5;//critical magnetic field at T in A/m
9 Hc0=2*10^5;//magnetic field at 0 K in A/m
10
11 //calculation
12 Tc=T/(sqrt(1-Hc/Hc0));
13 disp(Tc,'transition temp in K is ');

```

Scilab code Exa 22.3 calculation of temp at which there is max critical field

```

1 clc;clear;
2 //Example 22.3
3 //calculation of temp at which there is max
   critical field
4
5 //given values
6
7 Tc=7.26;//critical temp in K
8 Hc=8*10^5;//max critical magnetic field at T in A/m
9 H=4*10^4;// subjected magnetic field at in A/m
10
11 //calculation
12 T=Tc*(sqrt(1-H/Hc));
13 disp(T,'max temp for superconductivity in K is ');

```

Chapter 23

Dielectrics

Scilab code Exa 23.1 calculation of relative permittivity

```
1  clc;clear;
2  //Example 23.1
3  //calculation of relative permittivity
4
5  //given values
6
7  E=1000;//electric field in V/m
8  P=4.3*10^-8;//polarization in C/m^2
9  e=8.85*10^-12;//permittivity in F/m
10
11
12 //calculation
13 er=1+(P/(e*E));
14 disp(er,'relative permittivity of NaCl is ');
```

Scilab code Exa 23.2 calculation of electronic polarizability

```
1  clc;clear;
```

```

2 //Example 23.2
3 //calculation of electronic polarizability
4
5 //given values
6
7 e=8.85*10^-12;//permittivity in F/m
8 er=1.0024;//relative permittivity at NTP
9 N=2.7*10^25;//atoms per m^3
10
11
12 //calculation
13 alpha=e*(er-1)/N;
14 disp(alpha,'electronic polarizability (in F/m^2) is '
    );

```

Scilab code Exa 23.3 calculation of electronic polarizability and relative permittivity

```

1 clc;clear;
2 //Example 23.3
3 //calculation of electronic polarizability and
   relative permittivity
4
5 //given values
6
7 e=8.85*10^-12;//permittivity in F/m
8 N=9.8*10^26;//atoms per m^3
9 r=.53*10^-10;//radius in m
10
11
12 //calculation
13 alpha=4*%pi*e*r^3;
14 disp(alpha,'electronic polarizability (in F/m^2) is '
    );
15 er=1+(4*%pi*N*r^3);
16 disp(er,'relative permittivity is')

```

Scilab code Exa 23.4 calculation of electronic polarizability and relative permittivity

```
1  clc;clear;
2  //Example 23.4
3  //calculation of electronic polarizability and
   relative permittivity
4
5  //given values
6  w=32; //atomic weight of sulphur
7  d=2.08*10^3; //density in kg/m^3
8  NA=6.02*10^26; //avogadros number
9  alpha=3.28*10^-40; //electronic polarizability in F.m
   ^2
10 e=8.854*10^-12; //permittivity
11 //calculation
12
13 n=NA*d/w;
14 k=n*alpha/(3*e);
15 er=(1+2*k)/(1-k);
16 disp(er,'relative permittivity is')
```

Scilab code Exa 23.5 calculation of ionic polarizability

```
1  clc;clear;
2  //Example 23.5
3  //calculation of ionic polarizability
4
5  //given values
6  n=1.5; //refractive index
7  er=6.75; //relative permittivity
8
```

```

9 //calculation
10 Pi=(er-n^2)*100/(er-1);
11 disp(Pi,'percentage ionic polarizability (in %) is '
    )

```

Scilab code Exa 23.6 calculation of frequency and phase difference

```

1 clc;clear;
2 //Example 23.6
3 //calculation of frequency and phase difference
4
5 //given values
6 t=18*10^-6;//relaxation time in s
7
8 //calculation
9 f=1/(2*%pi*t);
10 disp(f,'frequency at which real and imaginary part
    of complx dielectric constant are equal is');
11 alpha=atan(1)*180/%pi;// phase difference between
    current and voltage( 1 because real and imaginry
    parts are equal of the dielectric constant)
12 disp(alpha,'phase difference (in degree) is');

```

Scilab code Exa 23.7 calculation of frequency

```

1 clc;clear;
2 //Example 23.7
3 //calculation of frequency
4
5 //given values
6 t=5.5*10^-3;//thickness of plate in m
7 Y=8*10^10;//Young's modulus in N/m^2
8 d=2.65*10^3;//density in kg/m^3

```

```
9
10
11
12 // calculation
13 f=sqrt(Y/d)/(2*t); //in Hz
14 disp(f/10^3, 'frequency of fundamental note(in KHz)
    is ');
```

Chapter 24

Fibre optics

Scilab code Exa 24.1 Fiber optics numerical aperture calculation

```
1  clc;clear;
2  //Example 24.1
3  //Fiber optics
4
5  //given values
6  n=1.5;//refractive index
7  x=.0005;//fractional index difference
8
9  //calculation
10 u=n*(1-x);
11 disp(u,'cladding index is');
12 alpha=asin(u/n)*180/%pi;
13 disp(alpha,'critical internal reflection angle(in
    degree) is');
14 theta=asin(sqrt(n^2-u^2))*180/%pi;
15 disp(theta,'critical acceptance angle(in degree) is'
    );
16 N=n*sqrt(2*x);
17 disp(N,'numerical aperture is');
```

Scilab code Exa 24.2 calculation of acceptance angle

```
1  clc;clear;
2  //Example 24.2
3  //calculation of acceptance angle
4
5  //given values
6  n=1.59;//cladding refractive index
7  u=1.33;//refractive index of water
8  N=.20;//numerical aperture of fibre
9  //calculation
10 x=sqrt(N^2+n^2);//index of fibre
11 N1=sqrt(x^2-n^2)/u;//numerical aperture when fibre
    is in water
12 alpha=asin(N1)*180/%pi;
13 disp(alpha,'acceptance angle in degree is');
```

Scilab code Exa 24.3 calculation of normalised frequency

```
1  clc;clear;
2  //Example 24.3
3  //calculation of normalised frequency
4
5  //given values
6  n=1.45;//core refractive index
7  d=.6;//core diametre in m
8  N=.16;//numerical aperture of fibre
9  l=.9*10^-6;//wavelength of light
10
11 //calculation
12 u=sqrt(n^2+N^2);//index of glass fibre
13 V=%pi*d*sqr(u^2-n^2)/l;
```

```
14 disp(V, 'normalised frequency is ');
```

Scilab code Exa 24.4 calculation of normalised frequency and no of modes

```
1 clc;clear;
2 //Example 24.4
3 //calculation of normalised frequency and no of
  modes
4
5 //given values
6 n=1.52;//core refractive index
7 d=29*10^-6;//core diametre in m
8 l=1.3*10^-6;//wavelength of light
9 x=.0007;//fractional refractive index
10
11 //calculation
12 u=n*(1-x);//index of glass fibre
13 V=%pi*d*sqrt(n^2-u^2)/l;
14 disp(V, 'normalised frequency is ');
15 N=V^2/2;
16 disp(N, 'no of modes is ');
```

Scilab code Exa 24.5 calculation of numerical aperture and maximum acceptance angle

```
1 clc;clear;
2 //Example 24.5
3 //calculation of numerical aperture and maximum
  acceptance angle
4
5 //given values
6 n=1.480;//core refractive index
7 u=1.47;//index of glass
8 l=850*10^-9;//wavelength of light
```

```

9 V=2.405; //V-number
10
11 // calculation
12 r=V*1/sqrt(n^2-u^2)/%pi/2; //in m
13 disp(r*10^6, 'core radius in micrometre is ');
14 N=sqrt(n^2-u^2);
15 disp(N, 'numerical aperture is ');
16 alpha=asin(N)*180/%pi;
17 disp(alpha, 'max acceptance angle is ');

```

Scilab code Exa 24.6 calculation of power level

```

1 clc;clear;
2 //Example 24.6
3 //calculation of power level
4
5 //given values
6 a=3.5; //attenuation in dB/km
7 Pi=.5*10^-3; //initial power level in W
8 l=4; //length of cable in km
9
10 // calculation
11 Po=Pi*10^6/(10^(a*l/10));
12 disp(Po, 'power level after km(in microwatt) is ');

```

Scilab code Exa 24.7 calculation of power loss

```

1 clc;clear;
2 //Example 24.7
3 //calculation of power loss
4
5 //given values
6 Pi=1*10^-3; //initial power level in W

```

```
7 l=.5;//length of cable in km
8 Po=.85*Pi
9
10 //calculation
11 a=(10/l)*log10(Pi/Po);
12 disp(a,'loss in dB/km is ');
```

Chapter 25

Digital electronics

Scilab code Exa 25.1 sum of two binary numbers

```
1  clc;clear;
2  //Example 25.1
3  //calculation of sum of two binary numbers
4
5  //given values
6  X='0011';//first binary number
7  Y='0101';//second binary number
8
9  //calculation
10 x=bin2dec(X);//decimal equivalent
11 y=bin2dec(Y);//decimal equivalent
12 z=x+y;
13 Z=dec2bin(z);
14 disp(Z,'Sum of the given binary numbers is ')
```

check Appendix [AP 1](#) for dependency:

bin21dec.sci

check Appendix [AP 2](#) for dependency:

dec21bin.sci

Scilab code Exa 25.2 sum of two binary numbers

```
1 clc;  
2 clear;  
3 //example 25.2  
4 //addition of binary numbers  
5  
6 a=1010.00;           //first number  
7 b=0011.11;           //second number  
8 A=bin21dec(a);       //converting a in to decimal number  
9 B=bin21dec(b);       //converting b in to decimal number  
10 S=A+B;               //adding the two decimal numbers  
11 temp=dec21bin(S);    //converting the decimal sum back  
    to binary  
12 format('v',10);     //changing the default precision  
    to 8  
13 disp(temp,'sum is '); //displaying the final output
```

check Appendix [AP 1](#) for dependency:

bin21dec.sci

check Appendix [AP 2](#) for dependency:

dec21bin.sci

Scilab code Exa 25.3 sum of two binary numbers

```
1 clc;  
2 clear;  
3 //example 25.3  
4 //addition of two binary numbers  
5
```

```

6 a=1011.01;           //first number
7 b=1101.11;           //second number
8 A=bin21dec(a);       //converting a in to decimal number
9 B=bin21dec(b);       //converting b in to decimal number
10 S=A+B;              //adding the two decimal numbers
11 temp=dec21bin(S);   //converting the decimal sum back
                        to binary
12 format('v',10);     //changing the default precision
                        to 8
13 disp(temp,'sum is '); //displaying the final
                        output

```

Scilab code Exa 25.4 difference of two binary numbers

```

1 clc;clear;
2 //Example 25.4
3 //calculation of difference of two binary numbers
4
5 //given values
6 X='1011';//first binary number
7 Y='0101';//second binary number
8
9 //calculation
10 x=bin2dec(X);//decimal equivalent
11 y=bin2dec(Y);//decimal equivalent
12 z=x-y;
13 Z=dec2bin(z);
14 disp(Z,'difference of the given binary numbers ');

```

Scilab code Exa 25.5 difference of two binary numbers

```

1 clc;clear;
2 //Example 25.5

```



```

3 //calculation of difference of two binary numbers
4
5 //given values
6 X='1000';//first binary number
7 Y='0011';//second binary number
8
9 //calculation
10 x=bin2dec(X);//decimal equivalent
11 y=bin2dec(Y);//decimal equivalent
12 z=x-y;
13 Z=dec2bin(z);
14 disp(Z,'difference of the given binary numbers ')

```

check Appendix [AP 1](#) for dependency:

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check Appendix [AP 2](#) for dependency:

dec21bin.sci

Scilab code Exa 25.6 difference of two binary numbers

```

1 clc;
2 clear;
3 //example 25.6
4 //binary subtraction
5
6 format('v',8);//changing the default precision to 8
7 a=1001.01;//first number
8 b=0011.10;//second number
9 A=bin21dec(a);//converting a in to decimal number
10 B=bin21dec(b);//converting b in to decimal number
11 S=A-B; //multiply the two decimal numbers
12 temp=dec21bin(S);//converting the decimal product
    back to binary
13

```

```
14 disp(temp, 'difference is '); //displaying the final
    output
```

Scilab code Exa 25.7 product of two binary numbers

```
1  clc;clear;
2  //Example 25.7
3  //calculation of product of two binary numbers
4
5  //given values
6  X='10101'; //first binary number with last two digits
    in fractional part
7  Y='101'; //second binary number with last two digits
    in fractional part
8
9  //calculation
10 x=bin2dec(X); //decimal equivalent
11 y=bin2dec(Y); //decimal equivalent
12 z=x*y;
13 Z=dec2bin(z);
14 disp(Z, 'product of the given binary numbers is ')
```

check Appendix [AP 1](#) for dependency:

bin21dec.sci

check Appendix [AP 2](#) for dependency:

dec21bin.sci

Scilab code Exa 25.8 binary multiplication

```
1  clc;
2  clear;
```

```

3 //example 25.8
4 //binary multiplication
5
6 format('v',8); //changing the default precision to 8
7 a=10101.01; //first number
8 b=110.10; //second number
9 A=bin21dec(a); //converting a in to decimal number
10 B=bin21dec(b); //converting b in to decimal number
11 S=A*B; //multiply the two decimal numbers
12 temp=dec21bin(S); //converting the decimal product
    back to binary
13
14 disp(temp, 'product is '); //displaying the final
    output

```

Scilab code Exa 25.9 binary division

```

1 clc;clear;
2 //Example 25.9
3 //calculation of quotient of two binary numbers
4
5 //given values
6 X='1101001'; //divident
7 Y='101'; //divisor
8
9 //calculation
10 x=bin2dec(X); //decimal equivalent
11 y=bin2dec(Y); //decimal equivalent
12 z=x/y;
13 Z=dec2bin(z);
14 disp(Z, 'quotient of the given binary numbers with
    last two digits in fractional part is ')

```

check Appendix [AP 1](#) for dependency:

bin21dec.sci

check Appendix [AP 2](#) for dependency:

dec21bin.sci

Scilab code Exa 25.10 binary division

```
1  clc;
2  clear;
3  //example 25.10
4  //binary division
5
6  format('v',8); //changing the default precision to 8
7  a=11001; //first number
8  b=100; //second number
9  A=bin21dec(a); //converting a in to decimal number
10 B=bin21dec(b); //converting b in to decimal number
11 S=A/B; //multiply the two decimal numbers
12 temp=dec21bin(S); //converting the decimal product
    back to binary
13
14 disp(temp, 'quotient is '); //displaying the final
    output
```

Scilab code Exa 25.11 octal addition

```
1  clc;clear;
2  //Example 25.11
3  //calculation of sum of two octal numbers
4
5  //given values
6  X='256'; //divident
7  Y='437'; //divisor
8
```

```
9 // calculation
10 x=oct2dec(X); //decimal equivalent
11 y=oct2dec(Y); //decimal equivalent
12 z=x+y;
13 Z=dec2oct(z); //binary equivalent
14 disp(Z, 'sum of the given octal numbers is')
```

Scilab code Exa 25.12 octal multiplication

```
1 clc;clear;
2 //Example 25.12
3 //calculation of product of two octal numbers
4
5 //given values
6 X='15'; //divident
7 Y='24'; //divisor
8
9 // calculation
10 x=oct2dec(X); //decimal equivalent
11 y=oct2dec(Y); //decimal equivalent
12 z=x*y;
13 Z=dec2oct(z); //binary equivalent
14 disp(Z, 'product of the given octal numbers is')
```

Scilab code Exa 25.13 hexadecimal addition

```
1 clc;clear;
2 //Example 25.13
3 //calculation of sum of hexadecimal numbers
4
5 //given values
6 X1='C';
7 X2='A';
```

```

8 X3='E';
9 Y1='3';
10 Y2='2';
11 Y3='D';
12
13 // calculation
14 x1=hex2dec(X1); // decimal equivalent
15 x2=hex2dec(X2); // decimal equivalent
16 x3=hex2dec(X3); // decimal equivalent
17 y1=hex2dec(Y1); // decimal equivalent
18 y2=hex2dec(Y2); // decimal equivalent
19 y3=hex2dec(Y3); // decimal equivalent
20 z1=x1+y1;
21 z2=x2+y2;
22 z3=x3+y3;
23 Z1=dec2hex(z1); // binary equivalent of sum
24 Z2=dec2hex(z2); // binary equivalent of sum
25 Z3=dec2hex(z3); // binary equivalent of sum
26 disp(Z1,'sum of the first set of hexadecimal numbers
    is ');
27 disp(Z2,'sum of the second set of hexadecimal
    numbers is ');
28 disp(Z3,'sum of the thirdm set of hexadecimal
    numbers is ');

```

Scilab code Exa 25.14 binary to decimal conversion

```

1 clc;clear;
2 //Example 25.13
3 //conversion of binary to decimal
4
5 //given values
6 X=10.101; //binary number
7
8 // calculation

```

```
9 Z=(1*2^1)+(0*2^0)+(1*2^-1)+(0*2^-2)+(1*2^-3);
10 disp(Z,'decimal equivalent of the given binary
    number is')
```

Scilab code Exa 25.15 decimal to binary conversion

```
1  clc;clear;
2  //Example 25.15
3  //conversion of decimal to binary
4
5  //given values
6  X=43;//decimal number
7
8  //calculation
9  Z=dec2bin(X);
10 disp(Z,'binary equivalent of the given decimal
    number is');
```

Scilab code Exa 25.16 decimal to binary conversion

```
1  clc;//clears the command window
2  clear;//clears all the variables
3  //example 25.16
4  //decimal to binary conversion
5
6  format('v',18);//changing the default precision to 20
    significant digits
7
8  i=1;x=1;//flag bits
9
10 dec=43.3125;//given decimal number which should be
    expressed in binary
```

```

11 temp2=floor(dec); //separating integer part from the
    given number
12 temp4=modulo(dec,1); //separating decimal part from
    the given number
13
14 while(temp2>0) //storing each integer digit in vector
    for convenience
15     p(i)=(modulo(floor(temp2),2))
16     temp2=floor(temp2/2);
17     i=i+1;
18 end
19
20 temp2=0; //clearing temporary variable 'temp2'
21
22 for j=1:length(p)
23 //multiplying bits of integer part with their
    position values and adding
24     temp2=temp2+(p(j)*10^(j-1));
25 end
26
27 while(temp4~=0) //storing each decimal digit in
    vector for convenience
28     temp4=temp4*2;
29     d(x)=floor(temp4);
30     x=x+1;
31     temp4=modulo(temp4,1);
32 end
33
34 temp5=0; //clearing temporary variable 'temp5'
35
36 for j=1:length(d)
37 //multiplying bits of decimal part with their
    position values and adding
38     temp5=temp5+(10^(-1*j)*d(j))
39 end
40
41 temp3=temp2+temp5;
42 //finally adding both the integer and decimal parts

```



```
    to get total output.  
43 disp(temp3,'the equivalent binary number is');
```

Scilab code Exa 25.17 decimal to octal conversion

```
1  clc;//clears the command window  
2  clear;//clears all the variables  
3  //example 25.17  
4  //decimal to octa conversion  
5  
6  format('v',8);//making the default precision to 8  
   significant digits  
7  i=1;w=1;  
8  dec=375.23;//given decimal number which should be  
   expressed in base 8  
9  temp=modulo(dec,1);//separating decimal part from  
   the given number  
10 temp2=floor(dec);//separating integer part from the  
   given number  
11  
12  
13 while(temp2>0)//storing each integer digit in vector  
   for convenience  
14     p(i)=(modulo(floor(temp2),8))  
15     temp2=floor(temp2/8);  
16     i=i+1;  
17 end  
18  
19 temp2=0;//clearing temporary variable 'temp2'  
20  
21 for j=1:length(p)  
22 //multiplying bits of integer part with their  
   position values and adding  
23     temp2=temp2+(p(j)*10^(j-1));  
24 end
```

```

25
26 while(temp~=0) //storing each decimal digit in
    vector for convenience
27     temp=temp*8;
28     q(w)=floor(temp);
29     w=w+1;
30     temp=modulo(temp,1);
31 end
32
33 temp1=0; //flag bit
34 for k=1:length(q)
35 //multiplying bits of decimal part with their
    position values and adding
36     temp1=temp1+(10^(-1*k)*q(k));
37 end
38 temp3=temp2+temp1;
39 disp(temp3,'octal number is ');

```

Scilab code Exa 25.18 octal to binary conversion

```

1  clc;clear;
2  //Example 25.18
3  //ocatl to binary conversion
4
5  //given values
6  X='257';//octal number
7
8  //calculation
9  x=oct2dec(X);//decimal equivalent
10 Z=dec2bin(x);
11 disp(Z,'binary number is ')

```

Scilab code Exa 25.19 octal to binary conversion

```

1  clc; //clears the command window
2  clear; //clears all the variables
3  //example 25.19
4  //octal to binary conversion
5
6  format('v',8); //setting the default precision to 8
7
8  i=1;w=1;
9
10 bin=34.56; //Given octal number which we need to be
    convert into binary
11 temp1=floor(bin); //separating integer part from the
    given number
12 temp0=modulo(bin,1); //separating decimal part from
    the given number
13 temp2=temp0*102; //converting decimal value to
    integer for convenience
14 while(temp1>0) //storing each integer digit in
    vector for convenience
15     p(i)=modulo(temp1,10);
16     temp1=round(temp1/10);
17     i=i+1;
18 end
19
20 while(temp2>0) //storing each decimal digit in
    vector for convenience
21     q(w)=modulo(temp2,10);
22     temp2=floor(temp2/10);
23     w=w+1;
24
25 end
26 temp1=0; //clearing temporary variable 'temp1
27
28 for i=1:2
29 //multiplying bits of decimal part with their
    position values and adding
30     temp1=temp1+(p(i)*8(i-1));
31 end

```

```

32
33 temp2=0;//clearing temporary variable 'temp2'
34 for z=1:2
35 //multiplying bits of decimal part with their
    position values and adding
36     temp2=temp2+(q(z)*8^(-1*(3-z)));
37
38 end
39
40 temp=temp1+temp2;
41 //adding both integer and decimal parts to get total
    deciaml value.
42 dec=temp;
43
44 temp2=floor(dec); //separating integer part from the
    given number
45 temp3=modulo(dec,1);//separating decimal part from
    the given number
46 format('v',18);//setting the default precision to 8
47
48 i=1;x=1;//flag bits
49
50 while(temp2>0)//storing each integer digit in vector
    for convenience
51     p(i)=(modulo(floor(temp2),2))
52     temp2=floor(temp2/2);
53     i=i+1;
54 end
55
56 temp2=0; //clears temporary variable 'temp2'
57
58 for j=1:length(p)
59 //multiplying bits of integer part with their
    position values and adding
60     temp2=temp2+(p(j)*10^(j-1));
61 end
62
63 temp4=modulo(temp3,1);

```

```

64
65 while(temp4~=0) //storing each decimal digit in
    vector for convenience
66     temp4=temp4*2;
67     d(x)=floor(temp4);
68     x=x+1;
69     temp4=modulo(temp4,1);
70 end
71
72 temp5=0; //clears temporary variable 'temp2'
73
74 for j=1:length(d)
75 //multiplying bits of decimal part with their
    position values and adding
76     temp5=temp5+(10^(-1*j)*d(j))
77 end
78
79 temp=temp2+temp5;
80 //finally adding both the integer and decimal parts
    to get total output.
81 disp(temp,'binary number is');

```

Scilab code Exa 25.20 binary to octal conversion

```

1 clc; //clears the command window
2 clear; //clears all the variables
3 i=1;w=1;
4 bin=1011.01101; //Given binary number which we need
    to be convert into octal
5
6 //conversion to decimal first
7 temp1=floor(bin); //separating integer part from the
    given number
8 temp2=modulo(bin,1); //separating decimal part from
    the given number

```

```

9 temp2=temp2*10^5;//converting decimal value to
  integer for convenience
10 while(temp1>0)//storing each integer digit in vector
    for convenience
11     p(i)=modulo(temp1,10);
12     temp1=floor(temp1/10);
13     i=i+1;
14 end
15 while(temp2>0)//storing each decimal digit in vector
    for convenience
16     q(w)=modulo(temp2,2);
17     temp2=(temp2/10);
18     temp2=floor(temp2);
19     w=w+1;
20 end
21 temp1=0;//flag bit
22 for i=1:length(p)//checking whether it is a binary
    number or not
23     if(p(i)>1) then
24         disp('not a binary number');
25         abort;
26     end
27 end
28 for i=1:length(p)
29 //multiplying bits of integer part with their
    position values and adding
30     temp1=temp1+(p(i)*2^(i-1));
31 end
32 temp2=0;//flag bit
33 for z=1:length(q)
34 //multiplying bits of decimal part with their
    position values and adding
35     temp2=temp2+(q(z)*2^(-1*(6-z)));
36 end
37 dec=temp1+temp2;
38 //finally adding both the integer and decimal parts
    to get decimal equivalent
39

```

```

40 //conversion from decimal to octal
41
42 format('v',8); //making the default precision to 8
    significant digits
43 i=1;w=1;
44
45 temp=modulo(dec,1); //separating decimal part from
    the given number
46 temp2=floor(dec); //separating integer part from the
    given number
47
48
49 while(temp2>0) //storing each integer digit in vector
    for convenience
50     r(i)=(modulo(floor(temp2),8))
51     temp2=floor(temp2/8);
52     i=i+1;
53 end
54
55 temp2=0; //clearing temporary variable 'temp2'
56
57 for j=1:length(r)
58 //multiplying bits of integer part with their
    position values and adding
59     temp2=temp2+(r(j)*10^(j-1));
60 end
61
62 while(temp~=0) //storing each decimal digit in
    vector for convenience
63     temp=temp*8;
64     s(w)=floor(temp);
65     w=w+1;
66     temp=modulo(temp,1);
67 end
68
69 temp1=0; //flag bit
70 for k=1:length(s)
71 //multiplying bits of decimal part with their

```

```

    position values and adding
72     temp1=temp1+(10^(-1*k)*s(k));
73 end
74 temp3=temp2+temp1;
75 disp(temp3, 'octal number is ');

```

Scilab code Exa 25.21 hexa to decimal conversion

```

1  clc;clear;
2  //Example 25.21
3  //hexadecimal to decimal conversion
4
5  //given values
6  X='AC5';//hexadecimal number
7
8  //calculation
9  x=hex2dec(X);//decimal equivalent
10 disp(x, 'decimal number is ');

```

Scilab code Exa 25.22 decimal to hexadecimal conversion

```

1  clc;//clears the command window
2  clear;//clears all the variables
3  //example 25.22
4  //decimal to hexadecimal conversion
5  format('v',4);//making the default precision to 8
   significant digits
6  dec=379.54;//given decimal
7  w=1;i=1;
8
9  temp1=floor(dec);//separating integer part from the
   given number

```



```

10 temp2=modulo(dec,1); //separating decimal part from
    the given number
11 x=dec2hex(temp1); //hexadecimal equivalent of integer
    part
12 s=0;
13
14 while(temp2~=0) //storing each decimal digit in
    vector for convenience
15     temp2=temp2*16;
16     q(w)=floor(temp2);
17     s=s+1; //counter of a
18     a(w)=dec2hex(q(w));
19     w=w+1;
20     temp2=modulo(temp2,1);
21 end
22 f=a(1);
23 for i=2:s
24     f=f+a(i);
25 end
26 b='.'; //for concatenating to get the decimal part of
    hexadecimal
27 hex=x+b+f; //concatenating integer and decimal part
28 disp(hex, 'hexadecimal equivalent is ');

```

Scilab code Exa 25.23 hexa to binary conversion

```

1  clc;clear;
2  //Example 25.23
3  //hexadecimal to binary conversion
4
5  //given values
6  X='7AB'; //hexadecimal number
7
8  //calculation
9  x=hex2dec(X); //decimal equivalent

```

```
10 z=dec2bin(x);
11 disp(z,'binary number is ');
```

Scilab code Exa 25.24 binary to hexa conversion

```
1 clc;clear;
2 //Example 25.24
3 //binary to hexadecimal conversion
4
5 //given values
6 X='1011101';//binary number
7
8 //calculation
9 x=bin2dec(X);//decimal equivalent
10 z=dec2hex(x);
11 disp(z,'hexadecimal number is ');
```

Scilab code Exa 25.25 Substraction by ones complement method

```
1
2 clc;
3 clear;
4 //Example 25.25
5 //substraction by one's complement method
6 //aaa=input(" Enter the first no (in decimal) :");
7 //bb=input(" Enter the number from which first no
   has to be substracted:");
8 bb=14;
9 aaa=-7;// subtraction is addition of negative
   number
10 if aaa<0 then
11     aa=-1*aaa;
12 else aa=aaa;
```

```

13 end
14 a=0;
15 b=0;
16 q=0;
17 for i=1:5           //converting from decimal to
    binary
18     x=modulo(aa,2);
19     a= a + (10^q)*x;
20     aa=aa/2;
21     aa=floor(aa);
22     q=q+1;
23 end
24 q=0;
25 for i=1:5         //converting from decimal to binary
26     y=modulo(bb,2);
27     b= b + (10^q)*y;
28     bb=bb/2;
29     bb=floor(bb);
30     q=q+1;
31 end
32 for i=1:5
33     a1(i)=modulo(a,10);
34     a=a/10;
35     a=round(a);
36
37 end
38 for i=1:5
39     b1(i)=modulo(b,10);
40     b=b/10;
41     b=round(b);
42 end;
43 if aaa<0 then // making one's complement if number is
    less than zero
44     for i=1:5
45         a1(i)=bitcmp(a1(i),1);
46     end
47
48     car(1)=0;

```

```

49
50 for i=1:5
51     c1(i)=a1(i)+b1(i)+car(i);
52     if c1(i)== 2 then
53         car(i+1)= 1;
54         c1(i)=0;
55     elseif c1(i)==3 then
56         car(i+1)= 1;
57         c1(i)=1;
58     else
59         car(i+1)=0;
60     end;
61 end;
62 car2(1)=car(6);
63 re=0;
64 format('v',18);
65     for i=1:5
66         re=re+(c1(i)*(10^(i-1))) //result of one's
67             complement addition
68     end;
69
70
71 for i=1:5
72     s(i)=modulo(re,10);
73     re=re/10;
74     re=round(re);
75 end;
76
77 for i=1:5
78     re1(i)=s(i)+car2(i); //addition of carry after one's
79         complement addition
80     if re1(i)== 2 then
81         car2(i+1)= 1;
82         re1(i)=0;
83     elseif re1(i)==3 then
84         car2(i+1)= 1;
85         re1(i)=1;

```

```

85     else
86         car2(i+1)=0;
87     end;
88 end;
89
90 re2=0;
91 format('v',18);
92 for i=1:5
93     re2=re2+(re1(i)*(10^(i-1)))
94 end;
95
96 disp(re,'difference is ')

```

Scilab code Exa 25.26 Substraction by ones complement method

```

1
2 clc;
3 clear;
4 //example 25.26
5 //substraction by one's complement method
6 //a=input(" Enter the first no (binary) :");
7 //b=input(" Enter the number from which first no has
   to be subtracted:");
8 a=10001;
9 b=10011;
10 q=0;
11
12 for i=1:5
13     a1(i)=modulo(a,10);
14     a=a/10;
15     a=round(a);
16
17 end
18 for i=1:5
19     b1(i)=modulo(b,10);

```

```

20     b=b/10;
21     b=round(b);
22 end;
23 for i=1:5//making one's complement of number to be
    subtracted
24     a1(i)=bitcmp(a1(i),1);
25 end
26
27 car(1)=0;
28
29 for i=1:5
30     c1(i)=a1(i)+b1(i)+car(i);
31     if c1(i)== 2 then
32         car(i+1)= 1;
33         c1(i)=0;
34     elseif c1(i)==3 then
35         car(i+1)= 1;
36         c1(i)=1;
37     else
38         car(i+1)=0;
39     end;
40 end;
41 car2(1)=car(6);
42 re=0;
43 format('v',18);
44 for i=1:5
45     re=re+(c1(i)*(10^(i-1))) //result of one's
        complement addition
46 end;
47
48
49 for i=1:5
50     s(i)=modulo(re,10);
51     re=re/10;
52     re=round(re);
53 end;
54 if car2(1)==1 then// checking carry
55

```

```

56 for i=1:5
57   re1(i)=s(i)+car2(i); //addition of carry after one's
      complement addition
58   if re1(i)== 2 then
59       car2(i+1)= 1;
60       re1(i)=0;
61   elseif re1(i)==3 then
62       car2(i+1)= 1;
63       re1(i)=1;
64   else
65       car2(i+1)=0;
66   end;
67 end;
68
69 re2=0;
70 format('v',18);
71   for i=1:5
72       re2=re2+(re1(i)*(10^(i-1)))
73   end;
74 disp(re2,'difference is') ;
75
76 else
77   for i=1:5
78       re1(i)=bitcmp(s(i),1);
79   end
80   re2=0;
81   for i=1:5
82       re2=re2+(re1(i)*(10^(i-1)))
83   end;
84   re2=-1*re2;
85   disp(re2,'difference is') ;
86   end;

```

Scilab code Exa 25.27 Substraction by ones complement method

```

1
2 clc;
3 clear;
4 //example 25.27
5 //subtraction by one's complement method
6 //a=input(" Enter the first no (binary) :");
7 //b=input(" Enter the number from which first no has
      to be subtracted:");
8 a=10011;
9 b=10001;
10 q=0;
11
12 for i=1:5
13     a1(i)=modulo(a,10);
14     a=a/10;
15     a=round(a);
16 end
17 for i=1:5
18     b1(i)=modulo(b,10);
19     b=b/10;
20     b=round(b);
21 end;
22 for i=1:5//making one's complement of number to be
      subtracted
23     a1(i)=bitcmp(a1(i),1);
24 end
25
26 car(1)=0;
27
28 for i=1:5
29     c1(i)=a1(i)+b1(i)+car(i);
30     if c1(i)== 2 then
31         car(i+1)= 1;
32         c1(i)=0;
33     elseif c1(i)==3 then
34         car(i+1)= 1;
35         c1(i)=1;
36     else

```



```

37         car(i+1)=0;
38     end;
39 end;
40 car2(1)=car(6);
41 re=0;
42 format('v',18);
43 for i=1:5
44     re=re+(c1(i)*(10^(i-1))) //result of one's
        complement addition
45 end;
46
47 for i=1:5
48     s(i)=modulo(re,10);
49     re=re/10;
50     re=round(re);
51 end;
52 if car2(1)==1 then // checking carry
53
54 for i=1:5
55     re1(i)=s(i)+car2(i); //addition of carry after one's
        complement addition
56     if re1(i)== 2 then
57         car2(i+1)= 1;
58         re1(i)=0;
59     elseif re1(i)==3 then
60         car2(i+1)= 1;
61         re1(i)=1;
62     else
63         car2(i+1)=0;
64     end;
65 end;
66
67 re2=0;
68 format('v',18);
69 for i=1:5
70     re2=re2+(re1(i)*(10^(i-1)))
71 end;
72 re2= -1*re2;

```

```

73 disp(re2, 'difference is ') ;
74
75 else
76     for i=1:5
77         re1(i)=bitcmp(s(i),1);
78     end
79     re2=0;
80     for i=1:5
81         re2=re2+(re1(i)*(10^(i-1)))
82     end;
83     re2=-1*re2;
84     disp(re2, 'difference is ') ;
85
86 end;

```

Scilab code Exa 25.28 finding twos complement

```

1  clc;
2  clear;
3  //example25.28
4  //finiding two's complement
5  //a=input(" Enter the number (binary) :");
6  a=1010;
7  for i=1:4
8      a1(i)=modulo(a,10);
9      a=a/10;
10     a=round(a);
11
12 end
13 for i=1:4//making one's complement of number
14     a1(i)=bitcmp(a1(i),1);
15 end
16 for i=1:4
17     car(1)=1;
18     re(i)=a1(i)+car(i);//addition of one to one's

```

```

        complement to contain two's complement
19     if re(i)== 2 then
20         car(i+1)= 1;
21         re(i)=0;
22     elseif re(i)==3 then
23         car(i+1)= 1;
24         re(i)=1;
25     else
26         car(i+1)=0;
27     end;
28 end;
29
30 re2=0;
31 format('v',18);
32 for i=1:4
33     re2=re2+(re(i)*(10^(i-1)))
34 end;
35 disp(re2,'two s complement is ');

```

Scilab code Exa 25.29 Addition of negative number by twos complement method

```

1
2 clc;
3 clear;
4 //Example 25.29
5 //addition of negative number by by two's complement
  method
6 //bb=input(" Enter the first no (in decimal) :");
7 //aaa=input(" Enter the negative number that has to
  be added");
8 bb=14;
9 aaa=-7;
10 if aaa<0 then
11     aa=-1*aaa;
12 else aa=aaa;

```

```

13 end
14 a=0;
15 b=0;
16 q=0;
17 for i=1:5           //converting from decimal to
    binary
18     x=modulo(aa,2);
19     a= a + (10^q)*x;
20     aa=aa/2;
21     aa=floor(aa);
22     q=q+1;
23 end
24 q=0;
25 for i=1:5         //converting from decimal to binary
26     y=modulo(bb,2);
27     b= b + (10^q)*y;
28     bb=bb/2;
29     bb=floor(bb);
30     q=q+1;
31 end
32 for i=1:5
33     a1(i)=modulo(a,10);
34     a=a/10;
35     a=round(a);
36
37 end
38 for i=1:5
39     b1(i)=modulo(b,10);
40     b=b/10;
41     b=round(b);
42 end;
43 if aaa<0 then// making one's complement of the
    negative number
44     for i=1:5
45         a1(i)=bitcmp(a1(i),1);
46     end
47
48     car(1)=0;

```

```

49
50 for i=1:5
51     c1(i)=a1(i)+b1(i)+car(i);
52     if c1(i)== 2 then
53         car(i+1)= 1;
54         c1(i)=0;
55     elseif c1(i)==3 then
56         car(i+1)= 1;
57         c1(i)=1;
58     else
59         car(i+1)=0;
60     end;
61 end;
62 re=0;
63 format('v',18);
64     for i=1:5
65         re=re+(c1(i)*(10^(i-1))) //result of one's
            complement addition
66     end;
67 for i=1:5
68     s(i)=modulo(re,10);
69     re=re/10;
70     re=round(re);
71 end;
72 if car(6)==1 then// checking carry
73     car2(1)=1;
74
75 for i=1:5
76     re1(i)=s(i)+car2(i);//addition of carry after one's
            complement addition
77     if re1(i)== 2 then
78         car2(i+1)= 1;
79         re1(i)=0;
80     elseif re1(i)==3 then
81         car2(i+1)= 1;
82         re1(i)=1;
83     else
84         car2(i+1)=0;

```

```

85     end;
86 end;
87
88 re2=0;
89 format('v',18);
90     for i=1:5
91         re2=re2+(re1(i)*(10^(i-1)))
92     end;
93
94     disp(re2,'difference is') ;
95
96 else
97     for i=1:5
98         re1(i)=bitcmp(s(i),1);
99     end
100    re2=0;
101    for i=1:5
102        re2=re2+(re1(i)*(10^(i-1)))
103    end;
104    re2=-1*re2;
105    disp(re2,'difference is') ;
106    end;

```

Scilab code Exa 25.30 Substraction by twos complement method

```

1
2 clc;
3 clear;
4 //example 25.27
5 //substarction by one's complement method
6 //a=input(" Enter the first no (binary) :");
7 //b=input(" Enter the number from which first no has
   to be substracted:");
8 a=10011;
9 b=10001;

```

```

10 q=0;
11
12 for i=1:5
13     a1(i)=modulo(a,10);
14     a=a/10;
15     a=round(a);
16 end
17 for i=1:5
18     b1(i)=modulo(b,10);
19     b=b/10;
20     b=round(b);
21 end;
22 for i=1:5 //making one's complement of number to be
    subtracted
23     a1(i)=bitcmp(a1(i),1);
24 end
25
26 car(1)=0;
27
28 for i=1:5
29     c1(i)=a1(i)+b1(i)+car(i);
30     if c1(i)== 2 then
31         car(i+1)= 1;
32         c1(i)=0;
33     elseif c1(i)==3 then
34         car(i+1)= 1;
35         c1(i)=1;
36     else
37         car(i+1)=0;
38     end;
39 end;
40
41 re=0;
42 format('v',18);
43 for i=1:5
44     re=re+(c1(i)*(10^(i-1))) //result of one's
        complement addition
45 end;

```

```

46
47 for i=1:5
48     s(i)=modulo(re,10);
49     re=re/10;
50     re=round(re);
51 end;
52 if car(6)==1 then// checking carry
53
54 for i=1:5
55     re1(i)=s(i)+car2(i);//addition of carry after one's
        complement addition
56     if re1(i)== 2 then
57         car2(i+1)= 1;
58         re1(i)=0;
59     elseif re1(i)==3 then
60         car2(i+1)= 1;
61         re1(i)=1;
62     else
63         car2(i+1)=0;
64     end;
65 end;
66
67 re2=0;
68 format('v',18);
69 for i=1:5
70     re2=re2+(re1(i)*(10^(i-1)))
71 end;
72 re2= -1*re2;
73 disp(re2,'difference is ') ;
74
75 else
76     for i=1:5
77         re1(i)=bitcmp(s(i),1);
78     end
79     re2=0;
80     for i=1:5
81         re2=re2+(re1(i)*(10^(i-1)))
82     end;

```



```
83     re2=-1*re2;  
84     disp(re2,'difference is ') ;  
85  
86 end;
```

Appendix

Scilab code AP 1 Binary to Decimal convertor

```
1 //bin21dec is a function whcih converts any binary
   number given to it will output its equivalent
   decimal number
2 //pass the binary number as an argument to the
   function
3 // For eg:bin21decimal(1010)
4 //Will give an output of 10
5
6 function [temp]=bin21dec(bin)
7     i=1;w=1;
8
9     temp1=floor(bin);
                                   //separating
                                   integer part from the given number
10    temp2=modulo(bin,1);
                                   //separating
                                   decimal part from the given number
11    temp2=temp2*103;
                                   //converting
                                   decimal value to interger for convenience
12
13    while(temp1>0)
14        p(i)=modulo(temp1,10);
15        temp1=floor(temp1/10);
```

```

16         i=i+1;
17     end
18
19     while(temp2>0)
20         //storing each integer digit in vector for
21         convenience
22         q(w)=modulo(temp2,2);
23         temp2=(temp2/10);
24         temp2=floor(temp2);
25         w=w+1;
26     end
27
28     temp1=0;
29     //clearing the temporary variable 'temp2'
30
31     for i=1:length(p)
32         //checking whether it is binary or not.
33         if(p(i)>1) then
34             disp('not a binary number');
35             abort;
36         end
37     end
38
39     for i=1:length(p)
40         //multiplying the bits of integer part with
41         their position values and adding
42         temp1=temp1+(p(i)*2^(i-1));
43     end
44
45     temp2=0;
46     //clearing the temporary variable 'temp2'
47
48     for z=1:w-1
49         //multiplying the bits of decimal part with
50         their position values and adding
51         temp2=temp2+(q(z)*2^(-1*(4-z)));
52     end
53
54

```

```

45     temp=temp1+temp2;
        //finally adding both the integer and decimal
        parts to get total output.
46 endfunction

```

Scilab code AP 2 Decimal to Base 2 Converter

```

1 //dec21bin is a function whcih converts any decimal
    number given to it will output its equivalent
    binary number
2 //pass the decimal number as an argument to the
    function
3 // For eg:dec21bin(10)
4 //Will give an output of 1010
5
6 function [temp]=dec21bin(dec)
7     temp2=floor(dec);
                                //separating
    integer part from the given number
8     temp4=modulo(dec,1);
                                //separating
    decimal part from the given number
9
10    format('v',18);
                                //changing
    the default precision to 18
11
12    i=1;p=0;x=1;
                                // flag
    bits
13
14    while(temp2>0)
        //storing each integer digit in vector for
        convenience
15        p(i)=(modulo(floor(temp2),2))
16        temp2=floor(temp2)/2;
17        i=i+1;
18    end

```

```

19
20     temp2=0;
      //clearing the temporary variable 'temp2'
21
22     for j=1:length(p)
      //multiplying the bits of integer part with
      //their position values and adding
23         temp2=temp2+(p(j)*10^(j-1));
24     end
25
26     while(temp4~=0)
      //storing
      //each integer digit in vector for convenience
27         temp4=temp4*2;
28         d(x)=floor(temp4);
29         x=x+1;
30         temp4=modulo(temp4,1);
31     end
32
33     temp5=0;
      //clearing the temporary variable 'temp2'
34
35     for j=1:x-1
      //
      //multiplying the bits of decimal part with
      //their position values and adding
36         temp5=temp5+(10^(-1*j)*d(j))
37     end
38
39     temp=temp2+temp5;
      //
      //finally adding both the integer and decimal
      //parts to get total output.
40 endfunction

```
