Scilab Textbook Companion for Concepts Of Physics (volume - 2) by H. C. Verma[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 23

Heat and Temperature

Scilab code Exa 23.1 `To calculate the room temperature in Centigrades`

```

//To calculate the room temperature in centigrades

//example 23.1

clear;

clc;

p0=73;//pressure (in centimeter) at 0 degree celsius

p=77.8;//pressure (in centimeter) at room
   temperature

p100=100.3;//pressure (in centimeter) at 100 degree
   celsius

t=(p-p0)/(p100-p0)*100;//formula for finding the
   room temperature in centigrades

printf("room temperature=%.d degree celsius",t);
```

Chapter 24

Kinetic Theory of Gases

Scilab code Exa 24.1 To Find the rms speed of Nitrogen

```

//To calculate the rms speed of Nitrogen

//Example 24.1

clear;

clc;

p=1.0*10^5;//Pressure(in N/m^2) at STP

rho=1.25;//Density(in kg/m^3) of Nitrogen

Vrms=sqrt(3*p/rho);//rms speed of nitrogen at STP

printf("The rms speed of Nitrogen=%.f m/s",Vrms);
```

Scilab code Exa 24.2 To find the rms speed of hydrogen

```

//To calculate the rms speed of hydrogen molecules
   at the same temperature

//Example 24.2

clear;

clc;

v1=490;//rms speed of nitrogen at 273 Kelvin

m1=28;//molecular weight of nitrogen

m2=2;//molecular weight of hydrogen

v2=v1*sqrt(m1/m2);//rms speed of hydrogen at 273
   Kelvin

printf("rms speed of hydrogen=%d m/s    (wrong answer
    given in the book)",v2);
```

Scilab code Exa 24.3 To calculate the number of molecules in each cubic metre

```

//To calculate the number of molecules in each cubic
    metre

//Example 24.3

clear;
```

```
clc;

p=1.0*10^5;//pressure in N/m^2

v=1;//volume in cubic metre

t=300;//temperature in Kelvin

k=1.38*10^-23;//boltzmann constant(J/K)

n=p*v/(k*t);//formula for finding number of
    molecules

printf("number of molecule=%f*10^25",n/(10^25));
```

Scilab code Exa 24.4 To calculate the rms speed of Oxygen molecules

```

//To calculate the rms speed of oxygen molecules

//Example 24.4

clear;

clc;

R=8.3;//universal gas constant in J/mol-K

T=300;//temperature in Kelvin

M0=0.032;//molecular weight in kg/mol

```

```
V=sqrt(3*R*T/M0);//formula for finding the rms speed

printf("the rms speed of oxygen molecule=%d m/s",V);
```

Scilab code Exa 24.5 To calculate the external pressure

```

//To calculate the external pressure

//Example 24.5

clear;

clc;

Psat=2710;//saturated pressure in millimetre of Hg
    at 140 degree celsius

Pvap=760;//vapour pressure in millimetre of Hg(1 atm
    =760 mm of Hg)

Pext=Psat/Pvap;//external vapour pressure at 140
    degree celsius

printf("external vapour pressure at 140 degree
    celsius=%2f atm",Pext);
```

Scilab code Exa 24.6 To calculate the relative humidity

```
//To calculate the relative humidity

//Example 24.6

clear;

clc;

Pvap=12;//vapour pressure of air at 20 degree
    celsius

SVP=17.5;//saturation vapour pressure at 20 degree
    celsius

RH=Pvap/SVP;//relative humidity

printf("Relative Humidity=%.2f",RH);
```

Scilab code Exa 24.7 To calculate the relative humidity

```
//To calculate the relative humidity

//Example 24.7

clear;

clc;

Pvap=8.94;//vapour pressure at the dew point in (mm
    of Hg)

```

```
SVP=55.1;//saturation vapour pressure at the air
    temperature in (mm of Hg)

RH=(Pvap/SVP)*100;//finding the relative humidity

printf("Relative Humidity=%.1f percent",RH);
```

Chapter 25

Calorimetry

Scilab code Exa 25.1 `To calculate the kinetic energy`

```

//To calculate the kinetic energy

//Example 25.1

clear;

clc;

m=10;//mass in kg

v=36;//speed in kmph

E=[1/2*m*(v*10^3/3600)^2]/4.186;//formula for
    finding kinetic energy

printf("kinetic energy=%f cal",E);
```

Scilab code Exa 25.2 Calculate the heat supplied to the block

```
//To calculate the heat supplied to the block

//Example 25.2

clear;

clc;

m=60;//mass of a copper block in grams

s=0.09;//specific heat capacity of copper in (cal/g-degree celsius)

t=20;//temperature increased by degree celcius

Q=m*s*t;//formula for finding the heat supplied to the block

printf("Heat=%f cal",Q);
```

Scilab code Exa 25.3 To calculate the mass of melted ice

```
//To calculate the mass of melted Ice
```

```
//Example 25.3

clear;

clc;

m=0.2;//mass of a piece of ice in kg at 25 degree Celsius

s=4200;//specific heat capacity of water in J/kg-k

t1=25;//Initial Temperature in Celsius

t2=0;//Final Temperature in Celsius

Q=m*s*(t1-t2);//formula for finding the heat

L=3.4*10^5;//specific latent heat of fusion of ice in J/kg

M=Q/L;//The amount of ice melted

printf("Mass of the Ice Melted=%f gram",M*1000);
```

Scilab code Exa 25.4 `To Calculate the Specific Latent Heat Capacity`

```

//To calculate the Specific Latent Heat of vaporization of water

//Example 25.4

clear;

clc;
```

```
m=1.5;//Mass of steam condensed in grams

s=1;//Specific Heat Capacity in cal/g-C

t1=100;//Initial Temperature in degree Celsius

t2=30;//Final Temperature in degree Celsius

t=t1-t2;//Change in Temperature in degree Celsius

Q2=m*s*t;//Heat lost in the process of cooling from
    100 degree Celsius to 30 degree Celsius in
    calories

We=15;//Wateer Equivalent of Calorimeter in grams

Mw=165;//Mass of water in grams

t3=25;//Initial Temperature in degree Celsius

t4=30;//Final Temperature in degree Celsius

T=t4-t3;//Change in temperature in degree Celsius

Q3=(We+Mw)*s*T;//Heat supplied to raise the
    temperature from 25 degree Celsius to 30 degree
    Celsius in Calories

L=(Q3-Q2)/m;//Specific Latent Heat of Vapourization
    of water

printf("Specific Latent Heat of Vapourization of
    water=%f cal/g",L);
```

Chapter 26

Laws of Thermodynamics

Scilab code Exa 26.1 To calculate the increase in Internal Energy

```

//To calculate the increase in Internal Energy in
   the process

//Example 26.1

clear;

clc;

delQ=418;//Heat given to the gas in Joules

delW=40;//Work done by the gas in Joules

delU=delQ-delW;//formula for finding increase the
   internal energy

printf("Increase in Internal Energy=%.f joule",delU)
   ;
```

Scilab code Exa 26.2 To Calculate the amount of Work

```

//To Calculate the Work Done by the Gas

//Example 26.2

clear;

clc;

pA=120*10^3;//pressure (in Pa) of the gas at Point A

pB=120*10^3;//pressure (in Pa) of the gas at Point B

pC=200*10^3;//pressure (in Pa) of the gas at Point C

VA=200*10^-6;//Volume at point A in m^3

VB=450*10^-6;//Volume at point B  in m^3

VC=450*10^-6;//Volume at point C in m^3

delVab=VB-VA;//change in the volume of the gas from
    point A to B

Wab=pA*delVab;//formula for finding the work done by
     the gas in the process A to B

printf("The Work done by the gas in the process A to
     B=%d joule",Wab);

```

```
delVbc=VC-VB;//change in the volume of the gas from
    point B to C

Wbc=(pC-pB)*delVbc;//formula for finding the work
    done by the gas in the process B to C

printf("\nThe Work done by the gas in the process B
    to C=%d joule",Wbc);

delVca=VC-VA;//change in the volume of the gas from
    point C to A

Wca=(0.5*(pC-pA)*delVca)+Wab;//formula for finding
    the work done by the gas in the process C to A

printf("\nThe Work done by the gas in the process C
    to A=%d joule",-Wca);
```

Chapter 27

Specific Heat Capacities of Gases

Scilab code Exa 27.1 To find the amount of Heat needed to raise the temperature fr

```
//Find the Amount of Heat needed to raise the
   temperature from 25 degree celsius to 35 degree
   celsius.

//Example 27.1

clear;

clc;

Ao=0.32;//Mass of Oxygen kept in gram

W=32;//Molecular weight of Oxygen in g/mol

n=Ao/W;//Number of moles of oxygen

Cv=20;//Molar Heat Capacity of Oxygen at constant
   volume
```

```

T1=25;//Initial Temperature

T2=35;//Final Temperature

delT=T2-T1;//Change in Temperature

Q=n*Cv*delT;//Amount of Heat needed

printf("Amount of Heat required=%d joule",Q);
```

Scilab code Exa 27.2 To calculate the amount of Heat required to raise the tempera

```

//Find the Amount of Heat required to raise the
   temperature to 400 Kelvin

//Example 27.2

clc;

clear;

V=0.2;//Volume of tank in m^3

p=1*10^5;//Pressure of Helium Gas in N/M^2

T1=300;//Initial Temperature of Helium Gas in Kelvin

T2=400;//Final Temperature of Helium Gas in Kelvin

R=8.31;//Universal Gas Constant in J/mol-K

```

```
n=int((p*V)/(R*T1));//Amount of moles of Helium Gas

Cv=3;//Molar Heat Capacity at Constant Volume

Q=n*Cv*(T2-T1);//Amount of Heat Required in calories

printf("The amount of Heat required=%d cal",Q);
```

Scilab code Exa 27.3 To Calculate the ratio of Cp to Cv

```

//To Find the ratio of Cp/Cv

//Example 27.3

clc;

clear;

Cv=5;//Molar Heat Capacity of Gas at constant volume

R=2;//Universal Gas constant in cal/mol-K

Cp=Cv+R;//Molar Heat Capacity of Gas at constant
    pressure

gama=Cp/Cv;//The ratio Cp/Cv

printf("Cp/Cv=%f",gama);
```

Scilab code Exa 27.4 `To Calculate the Final Temperature of the air`

```
//To calculate the Final Temperature of the air

//Example 27.4

clc;

clear;

T1=288;//Initial Temperature of Dry Air in Kelvin

p1=10;//Initial pressure of Dry Air in atm

p2=1;//Final pressure of Dry Air in atm

gama=1.41;//The ratio Cp/Cv

T2=T1*(p2/p1)^((gama-1)/gama);//Final Temperature of
    Gas

printf("The final temperature of gas=%f K",T2);
```

Scilab code Exa 27.5 `To calculate the Internal Energy of 1 gram of oxygen at STP`

```
//To Calculate the Internal Energy of 1 gram of
   oxygen at STP.

//Example 27.5

clc;

clear;

m=1;//Mass of Oxygen taken in grams

M=32;//Molecular Weight of Oxygen in g/mol

n=m/M;//Number of moles of Oxygen

R=8.31;//Universal Gas Constant in J/mol-K

T=273;//Temperature in Kelvin at STP

U=int(n*((5/2)*R*T));//Internal Energy of Oxygen

printf("Internal Energy of Oxygen=%d J",U);
```

Chapter 28

Heat Transfer

Scilab code Exa 28.1 `Amount of Heat Flow per second`

```
//To Calculate the Amount of Heat flowing per second
    through the cube.

//Example 28.1

clear;

clc;

x=0.1;//Edge Length of the Copper Cube in cm

A=x^2;//Area of cross section in cm^2

K=385;//Thermal Conductivity of Copper in W/m-deg
    Celsius

T1=100;//Temperature of the first face

T2=0;//Temperature at the second face

```

```
Rf=K*A*(T1-T2)/x;//Amount of Heat flowing per second (del(Q)/del(t))

printf("The amount of heat flowing per sec=%d W",Rf);
```

Scilab code Exa 28.2 To Find the Thermal Resistance of Aluminium Rod

```

//To Calculate the Thermal Resistance of an aluminium rod

//Example 28.2

clear;

clc;

x=0.2;//Length of Aluminium Rod in metres

K=200;//Thermal Conductivity of Aluminium in W/m-K

A=1*10^-4;//Area of Cross Section in metre^2

R=x/(K*A);//Thermal Resistance in K/W

printf("The Thermal Resistance is of Aluminium Rod=%d K/W",R);
```

Scilab code Exa 28.3 To Calculate the Temperature at Sun Surface

```
//To Calculate the Temperature of Sun
//Example 28.3

clear;

clc;

b=0.288;//Wein Constant in cm-K

Lambda=470*10^(-7);//Wavelength corresponding to
   maximum intensity in centimetres

T=b/Lambda;//Temperature at the Surface of Sun

printf("Temperature at the sun surface = %f K",T);//
   The answer provided in the textbook is wrong
```

Scilab code Exa 28.4 To Calculate the Net Rate of Heat Loss

```

//To calculate the Net Rate of Heat Loss

//Example 28.4

clear;

clc;

A=10*10^-4;//Surface Area of Blackbody in m^2

T=400;//Initial Temperature in Kelvin
```

```

T0=300;//Final Temperature in Kelvin

Sigma=5.67*10^-8;//Stefan Constant

delU=Sigma*A*(T^4-T0^4);//Net Rate of Heat Loss

printf("The net rate of loss of heat is=%2f W",delU)
    ;
```

Scilab code Exa 28.5 To Calculate the time for cooling

```

//To Calculate the Amount of Time for Cooling

//Example 28.5

clear;

clc;

T1=70;//Initial Temperature in degree Celsius in
    First Case

T2=60;//Final Temperature in degree Celsius in First
     Case

Tav=(T1+T2)/2;//Average Temperature in First Case

Ts=30;//Temperature of Surrounding in degree Celsius

Tdif1=Tav-Ts;//Average Temperature Difference from
    Surrounding in first case
```

```
t=5;//Time taken for cooling from 70 deg Celsius to
    60 deg Celsius

Rt=(T1-T2)/t;//Rate of fall of Temperature

bA=Rt/Tdif1;//Product of Wein Constannt and Area

T3=60;//Initial Temperature in degree Celsius in
    second case

T4=50;//Final Temperature in degree Celsius in
    second case

Tdif2=T3-T4;//Change in Temperature in second case

Tav1=(T3+T4)/2;//Average Temperature in second case

Tdif3=Tav1-Ts;//Average Temperature Difference from
    Surrounding in second case

t1=Tdif2/(bA*Tdif3);//Time taken by the liquid to
    cool

printf("Time taken by the liquid to cool=%d min",t1)
    ;
```

Chapter 29

Electric Field and Potential

Scilab code Exa 29.1 `To Find the Electric Field at a point`

```

//To Calculate the Electric Field at a point

//Example 29.1

clear;

clc;

AC=5*10^-2;//The length of AC in metres

PC=12*10^-2;//The length of PC in metres

AP=sqrt(AC^2+PC^2);//Length of AP by Pythagoras
    Theorem

Theta=acos(AC/AP);//Measure of angle PAC

Q1=10*10^-6;//First Charge in Coloumbs

Q2=-10*10^-6;//Second Charge in Coloumbs
```

```
K=9*10^9;//Value of constant (1/(4*pi* 0 ))
EA=Q1*K/AP^2;//Electric Field at P due to First Charge
EB=-Q2*K/AP^2;//Electric Field at P due to First Charge
E=(EA+EB)*cos(Theta);//Magnitude of resultant Electric Field
printf("elctric field at point P=%.1f*10^6 N/C",E/10^6);
```

Scilab code Exa 29.3 To Calculate the amount of Work

```
//To Calculate the Work Done by a person in pulling them apart to infinite separations
//Example 29.3
clear;
clc;
Q1=10*10^-6;//First Charge in Coloumbs
Q2=10*10^-6;//Second Charge in Coloumbs
Q3=10*10^-6;//Third Charge in Coloumbs
```

```
K=9*10^9;//Value of constant (1/(4*pi* 0 ))

x=0.1;//Length of side of the Equilateral Triangle in metres

U=3*Q1*Q2*K/x;//Potential Energy of the System

printf("The amount of work done to pull the charges apart=%f J",U);
```

Scilab code Exa 29.4 To Find the Electric Potential

```

//To find the Electric Potential

//Example 29.4

clear;

clc;

Q1=10*10^-6;//First Charge in Coloumbs

Q2= 20*10^-6;//Second Charge in Coloumbs

r=0.02;//Distance between the charges in metres

K=9*10^9;//Value of constant (1/(4*pi* 0 ))

V1=Q1*K*2/r;//Electric Potential due to First Charge

V2=Q2*K*2/r;//Electric Potential due to Second Charge
```

```
V=V1+V2;//Net Potential

printf("net potential=%f MV",V/10^6);
```

Chapter 30

Gauss Law

Scilab code Exa 30.1 `To Calculate the Flux of Electric Field`

```

//To Find the Flux of Electric Field through the
    surface bounded by the frame

//Example 30.1

clear;

clc;

delS=0.01;//Length of Edge of the Square frame in
    metres

E=20;//Electric Field in V/m

Theta=%pi/3;//Angle between Normal and Electric
    Field

Flux=E*delS*cos(Theta);//Electric Flux through the
    Surface

```

```
printf("Net flux of Electric Field=%f V/m",Flux);
```

Chapter 31

Capacitors

Scilab code Exa 31.1 To Calculate the Capacitance

```

//To Calculate the Capacitance of the capacitor

//Example 31_1

clear;

clc;

Q=60*10^-6;//Charge on the capacitor

V=12;//Potential difference between the plates

C=Q/V;//Formula for finding the capacitance of the
   capacitor

printf("Capacitance of the capacitor=%f *10^-6 F",C
   *10^6);
```

Scilab code Exa 31.3 To Calculate the Capacitance

```

//To Calculate the Capacitance of a parallel plate capacitor

//Example 31.3

clear;

clc;

a=20*10^-2;//Length of Side of Parallel Plate Capacitor

A=a^2;//Area of the Capacitor Plate

d=1*10^-3;//Separation between the two plates

e0=8.85*10^-12;//Permitivity in farad/meter

C=e0*A/d;//Formula for finding capacitance of parallel plate capacitor

printf("capacitance of the parallel plate capacitor=%f pF",C*10^12);
```

Scilab code Exa 31.4 To Calculate the Charge on each Capacitor

```
//To Calculate the Charge on each Capacitor

//Example 31.4

clear;

clc;

C1=10*10^-6;//Capacitance of First Capacitor

C2=20*10^-6;//Capacitance of Second Capacitor

C=C1*C2/(C1+C2);//Equivalent capacitance of C1 and
    C2 in series

V=30;//Apllied Voltage

Q=C*V;//Formula for finding the charge on each
    capacitor

printf("The charge on each capacitor=%f uC",Q*10^6);
```

Scilab code Exa 31.5 To Find the Equivalent Capacitance of the combination

```
//To Find the Equivalent Capacitance of the
    combination

//Example 31.5

clear;

```

```
clc;

C1=10*10^-6;//Capacitance of the First Capacitor

C2=20*10^-6;//Capacitance of the Second Capacitor

C=C1+C2;//Equivalent capacitance of parallel
    combination of C1 and C2

C3=30*10^-6;//Capacitance of the third Capacitor

Ceq=C*C3/(C+C3);//Equivalent capacitance of Series
    combination of C and C3

printf("The equivalent Capacitance of the
    combination= %f uF",Ceq*10^6);
```

Scilab code Exa 31.7 To Calculate the Energy stored in Capacitor

```

//To Calculate the Energy stored in Capacitor

//Example 31.7

clear;

clc;

C=100*10^-6;//Capacitance of the capacitor in
    Faraday

V=20;//Potential Difference in Volts

```

```
U=1/2*C*V^2;//Formula for finding the energy stored
    in a capacitor

printf("The energy stored in the capacitor= %f J",U)
    ;
```

Scilab code Exa 31.8 To Calculate the Equivalent Capacitance

```

//To Calculate the Equivalent Capacitance

//Example 31.8

clear;

clc;

C0=40*10^-6;//Capacitance of the first Capacitor

K=4;//Dielectric Constant

C1=K*C0;//Capacitance of the capacitor C0 with the
    dielectric

C2=40*10^-6;//Capacitance of the second Capacitor

C=C1*C2/(C1+C2);//formula for finding the equivalent
     capacitor connected in series

printf("Equivalent capacitance of the system= %f uF"
    ,C*10^6);
```

Chapter 32

Electric current in conductors

Scilab code Exa 32.1 To Calculate the Current and Current Density

```

//To Calculate the Current and Current Density

//Example 32.1

clear;

clc;

n=6.0*10^16;//Total number of electrons

e=1.6*10^-19;//Charge of an electron

q=n*e;//Total charge crossing a prependicular cross
   section in one sec

t=1;//Time in seconds

i=q/t;//Current

printf("(a)Current(i)= % f*10^-3 A",i*10^3);
```

```

s=1.0*10^-3;//electron beam has an apperture

J=i/s;//current density

printf("\n(b)Current density in the beam (j)= %.1f
    *10^3 A/m^2",J);
```

Scilab code Exa 32.2 To Calculate the Drift Speed

```

//To Calculate the Drift Speed

//Example 32.2

clear;

clc;

i=1;//Current exist in a copper wire in Amperes

e=1.6*10^-19;//Charge of an electron

n=8.5*10^28;//Number of free electrons

A=2*10^-6;//Cross Section Area of copper wire

Vd=i/(A*n*e);//Formula for finding the drift speed
    of the electron

printf("Drift speed of electrons= %f mm/s",Vd*10^3);
```

Scilab code Exa 32.3 To Calculate the Resistance of an aluminium wire

```
//To Calculate the Resistance of an aluminium wire

//Example 32.3

clear;

clc;

rho=2.6*10^-8;//Resistivity of Aluminium in ohm-
   metre

l=0.50;//Length of Aluminium wire in metres

A=2*10^-6;//Cross sectional area of aluminium wire
   in metre^2

R=rho*l/A;//Formula for finding the resistance of an
    aluminium wire

printf("Resistance of the aluminium wire= %f ohm",R)
   ;
```

Scilab code Exa 32.4 To Calculate the Resistance and Energy

```
//To Calculate the Resistance and Energy

//Example 32.4

clear;

clc;

U1=400;//Thermal energy developed in resistor in
    Joules

i1=2;//Current in Amperes

t=10;//Time in seconds

R=U1/(i1^2*t);//Formula for finding the resistance

printf("(a)Resistance of resistor= %f ohm",R);

i2=4;//New Value of Current in Amperes

U=(i2)^2*R*t;//Formula for finding the thermal
    energy developed when the current is 4A

printf("\n(b) Thermal energy developed in the
    Resistor= %d J",U);
```

Scilab code Exa 32.5 To Calculate the Potential Difference and Thermal Energy

```

//To Calculate the Potential Difference and Thermal
    Energy

```

```
//Example 32.5

clear;

clc;

V=2.0;//Emf of battery in Volts

i=0.100;//Current in Amperes

r=0.50;//Resistance in ohms

Vab=V-i*r;//Potential difference across the
    terminals

printf("(a) Potential difference across the
    terminals= %f V",Vab);

t=10;//Time in seconds

U=i^2*r*t;//Formula for finding the thermal energy
    developed in the battery

printf("\n(b) Thermal energy developed in the
    battery is= %.2f J",U);
```

Scilab code Exa 32.7 find the value of resistance

```

//Find the value of Resistance

//Example 32.7

```

```
clear;

clc;

R1=10;//Resistance(R1) of Wheatstone Bridge Circuit

R2=20;//Resistance(R2) of Wheatstone Bridge Circuit

R4=40;//Resistance(R4) of Wheatstone Bridge Circuit

R3=R1*R4/R2;//formula for finding the wheatstone
    bridge resistance (R3)

printf("Resistance(R) = %d ohms for zero current in
    the 50 ohms resistor",R3);
```

Scilab code Exa 32.8 To Find the Reading of Ammeter

```

//Find the Reading of the Ammeter

//Example 32.8

clear;

clc;

R1=140.8;//Given resistance

RA=480;//Reactance of the Coil

Rsh=20;//Shunt resistance

```

```
Req=RA*Rsh/(RA+Rsh);//Equivalent resistance of the
    ammeter

Reqc=R1+Req;//Equivalent resistance of the circuit

I=Rsh/Reqc;//current goes through the ammeter

printf("Reading of the Ammeter is = %f A",I);
```

Scilab code Exa 32.9 To Find the Time Constant and Time taken for Charge Storage

```

//To Find the Time Constant and Time taken for
    Charge Storage

//Example 32.9

clear;

clc;

C=100*10^-6;//Capacitance of the Capacitor in
    Faraday

R=2;//Internal resistance of battery in Ohms

T0=R*C;//Time constant in seconds

printf("(a) Time constant = %f us",T0*10^6);

E=12;//EMF of the bettery

q=0.99*E*C;//Charge at time (t)
```

```
t=-log(1-(q/(E*C)))*T0;//Time taken before 99% of
    the Maximum Charge is stored on the Capacitor

printf("\n(b) Time taken before 99 percent of the
    Maximum Charge is stored on the Capacitor = %.2f
    ms",t*10^3);
```

Scilab code Exa 32.10 To Find the Charge Remaining on the Capacitor

```

//To Find the Charge Remaining on the Capacitor 1s
    after the connection is made

//Example 32.10

clear;

clc;

C=50*10^-6;//Capacitance of Parallel Plate Capacitor

R=1.0*10^3;//Resistance of the connected Resistor

T0=C*R;//Time constant of RC Circuit

t=1;//Duration of Discharge of Capacitor

Q=400*10^-6;//Initial Charge on the Capacitor

q=Q*exp(-t/T0);//Charge remaining on the Cpacitor
```

```
printf("Charge remaining on the capacitor after 1s =
    %.2f*10^-7 uC",q*10^13);
```

Chapter 33

Thermal and Chemical Effects of Electric Current

Scilab code Exa 33.1 To Calculate the Heat Developed in each resistor

```
//To Calculate the Heat Developed in each of the
   three resistor

//Example 33.1

clear;

clc;

R1=6;//Resistance of the first resistor

R2=3;//Resistance of the second resistor

Req=R1*R2/(R1+R2);//Equivalent resistance of R1 and
   R2

R3=1;//Resistance of the third resistor

```

```
R=Req+R3;//Equivalent resistance of the circuit

V=9;//Voltage across the battery

i=V/R;//Current through the Circuit

t=60;//Time in seconds

H3=i^2*R3*t;//Heat developed in third resistor

i1=i*R/(R1+R2);//Current through the 6 ohm resistor

H1=i1^2*R1*t;//Heat developed in first resistor

i2=i-i1;//current through the 3 ohm resistor

H2=i2^2*R2*t;//heat developed in Second Resistor

printf("Heat developed in the first resistor=%d J",H1);

printf("\nHeat developed in the second resistor=%d J",H2);

printf("\nHeat developed in the third resistor=%d J",H3);
```

Scilab code Exa 33.2 To Calculate the Neutral Temperature

```

//To Calculate the Neutral Temperature

//Example 33.2
```

```
clear;

clc;

ThetaI=530;//Inversion temperature in degree Celsius

ThetaC=10;//Temperature of the cold junction in
    degree Celsius

ThetaN=(ThetaI+ThetaC)/2;//Neutral temperature in
    degree Celsius

printf("Neutral Temperature = %d degree celsius",
    ThetaN);
```

Scilab code Exa 33.3 To Find Thermal Coefficients a and b

```

//To Find Thermal Coefficients a and b

//Example 33.3

clear;

clc;

acupb=2.76*10^-6;//Coefficient(a) for Copper-Lead
    Thermocouple

afepb=16.6*10^-6;//Coefficient(a) for Iron-Lead
    Thermocouple

```

```
acufe=acupb-afepb;//Coefficient(a) for Copper−Iron
    Thermocouple

bcupb=0.012*10^-6;//Coefficient(b) for Copper−Lead
    Thermocouple

bfepb=-0.030*10^-6;//Coefficient(b) for Iron−Lead
    Thermocouple

bcufe=bcupb-bfepb;//Coefficient(b) for Copper−Iron
    Thermocouple

printf("Thermal Coefficient (a) for Copper−Iron
    Thermocouple = %f uV/deg C",acufe*10^6);

printf("\nThermal Coefficient (b) for Copper−Iron
    Thermocouple =%f uV/deg C^2",bcufe*10^6);
```

Scilab code Exa 33.4 To Calculate the Electric Current

```

//To Calculate the Electric Current

//Example 33.4

clear;

clc;

m=0.972;//Mass of Chromium deposited in grams

Z=0.00018;//Electrochemical Equivalent of Chromium

```

```
t=3*3600;//Time is in seconds

I=m/(Z*t);//Electric Current required to deposit the
    Chromium in three hours

printf("Electric Current required to deposit 0.972g
   of Chromium in three hours = %f A",I);
```

Chapter 34

Magnetic Field

Scilab code Exa 34.1 `To Find the Force and Acceleration`

```

//To Find the Force and Acceleration

//Example 34.1

clear;

clc;

q=1.6*10^-19;//Charge on a proton in Coloumbs

v=3.0*10^6;//Projected Speed of the Proton in m/s

B=2.0*10^-3;//Uniform magnetic field strength in
    Tesla

theta=%pi/2;//Angle between Magnetic Field and
    Velocity

F=q*v*B*sin(theta);//Force on the proton due to
    Magnetic Field
```

```
printf("Force on the proton = %f*10^-16 N",F*10^16);

m=1.67*10^-27;//Mass of a proton in kg

a=F/m;//Acceleration of the proton in m/s^2

printf("\n Acceleration of the proton=%f*10^11 m/s^2
   ",a*10^-11);
```

Scilab code Exa 34.2 To calculate the Time Period

```

//To calculate the Time Period

//Example 34.2

clear;

clc;

m=10*10^-6;//Mass of the particle in kg

q=100*10^-6;//Charge of the particle in Coloumbs

B=25*10^-3;//Magnetic Field Strength in Tesla

T=2*%pi*m/(q*B);//Time Period in seconds

printf("Time Period of the charge = %d seconds",T);
```

Scilab code Exa 34.4 `To Find the Magnetic Dipole Moment of the Current Loop`

```

//To Find the Magnetic Dipole Moment of the Current
   Loop

//Example 34.4

clear;

clc;

i=10.0*10^-9;//Current in the Circular Loop in
   Amperes

r=5.0*10^-2;//Radius of the Circular Loop  in metres

A=%pi*r^2;//Area of Circular Loop

u=i*A;//Magnetic Dipole Moment in A-m^2

printf("Magnetic Dipole Moment = %f*10^-11 A-m^2",u
   *10^11);
```

Chapter 35

Magnetic Field Due to a Current

Scilab code Exa 35.1 To Calculate Magnetic Field due to a piece of Wire

```

//To Calculate Magnetic Field due to a 1cm piece of
    Wire

//Example 35.1

clear;

clc;

i=10;//Current in the Wire in Amperes

dl=10^-2;//Length of the wire in metres

r=2;//Distance of point P from wire in metres

theta=%pi/4;//Angle made by point P with the wire

k=1*10^-7;//Constant (u0/(4*pi))
```

```
dB=(k*i*dl*sin(theta))/r^2;//Formula for finding the
    magnetic field

printf("Magnetic Field due to a piece of Wire = %.1f
   *10^-9 T",dB*10^9);
```

Scilab code Exa 35.2 To Find Magnetic Field between two wires

```

//To Find Magnetic Field between the wires

//Example 35.2

clear;

clc;

i=10;//Current flowing through wires in Amperes

l=5*10^-2;//Seperation between two wires in metres

d=l/2;//Distance of Point P from both wires in
   metres

k=2*10^-7;// Constant k=(u0/(2*%pi))

B=k*i/d;//Magnetic Field at point P due to each wire

Bnet=2*B;//Net Magnetic Field at Point P due to both
    wires

printf("Magnetic Field at point P between the two
```

```
    wires = %.0f uT",Bnet*10^6);
```

Scilab code Exa 35.3 To Find the Magnitude of Magnetic Force

```

//To Find the Magnitude of Magnetic Force
    experienced by 10 cm of a wire

//Example 35.3

clear;

clc;

i=5;//Current in Amperes

d=2.5*10^-2;//Separation between the wires in metres

k=2*10^-7;// Constant k=(u0/(2*%pi))

B=k*i/d;//Magnetic Field at the site of one wire due
     to other in T

l=10*10^-2;//length of the wire in metres

F=i*l*B;//Magnetic force experienced by the 10 cm of
     the wire due to the other

printf("Magnetic force experienced by the 10 cm of
    the wire due to the other = %.1f*10^-5 N",F*10^5)
    ;
```

Scilab code Exa 35.4 To Calculate the Magnetic Field at the centre of Coil

```
//To Calculate the Magnetic Field at the Centre of
   Coil

//Example 35.4

clear;

clc;

i=1.5;//Current Carried by the Circular Coil in
   Amperes

n=25;//Number of turns in the coil

a=1.5*10^-2;//Radius of the Circular coil in metres

u0=4*%pi*10^-7;//Permeability of Vaccum

B=u0*i*n/(2*a);//formula for finding the magnetic
   field at the centre

printf("Magnetic Field at the Centre of Coil = %.2f
   *10^-3 T",B*10^3);
```

Scilab code Exa 35.5 To Calculate the Amount of Current

```
//To Calculate the Amount of Current

//Example 35.5

clear;

clc;

B=20*10^-3;//Magnetic field inside the solenoid in
    Tesla

n=20*10^2;//Number of turns per unit metre

u0=4*%pi*10^-7;//Permiability of Vaccum

i=B/(u0*n);//Current flowing through the solenoid in
     Amperes

printf("Current flowing through the solenoid = %.1f
   A",i);
```

Chapter 36

Permanent Magnets

Scilab code Exa 36.1 To Find the Magnetic Field on Axis of Solenoid

```

//To Find the Magnetic Field on Axis of Solenoid

//Example 36.1

clear;

clc;

i=10;//Current carried by Solenoid in Amperes

r=1*10^-2;//Radius of Solenoid in metres

A=%pi*r^2;//Area of Cross Section of Solenoid in metre^2

u=i*A;//Dipole Moment of each turn

l=10*10^-2;//Length of Solenoid in metres

R=10*10^-2;//Distance of point P from the centre of
```

```
solenoid

n=200;//Number of turns in Solenoid

d=l/n;//Seperation between two consecutive turns

m=u/d;//Pole Strength for each Current Loop

k=1*10^-7;//Constant (u0/(4*pi))

Rn=R-(l/2);//Distance of point P from North Pole

Bn=k*m/Rn^2;//Magnetic Field at P due to North Pole

Rs=R+(l/2);//Distance of point P from South Pole

Bs=k*m/(Rs)^2;//Magnetic Field at P due to South
    Pole

B=Bn-Bs;//Resultant Magnetic Field at point P

printf("Magnetic field at a point on the axis of
    Solenoid at a distance of 10cm from centre = %.1f
    *10^-4 T away from the solenoid",B*10^4);
```

Scilab code Exa 36.2 To Calculate the Work Done in Rotating the Magnet

```

//To Calculate the Work Done in Rotating the Magnet

//Example 36.2

clear;
```

```
clc;

M=1.0*10^4;//Magnetic Moment of the Bar Magnet in J/T

B=4*10^-5;//Horizontal Magnetic Field in Tesla

theta1=0;//Initial Angular position of the Magnet

theta2=%pi/3;//Final Angular position of the Magnet

W=-M*B*(cos(theta2)-cos(theta1));//Work Done in Rotating the Magnet

printf("Work Done in Rotating the Magnet = %.1f J",W);
```

Scilab code Exa 36.3 To Calculate the magnitude of the Magnetic Field at a point o

```

//To Calculate the Magnitude of the Magnetic Field at a point on its Axis at a distance of 20cm from it.

//Example 36.3

clear;

clc;

m=12;//Pole Strength of Magnet in A-m

```

```
l=0.05;//Magnetic Length of Magnet in metres

d=0.2;//Distance of the given point from center of
    magnet in metres

k=1*10^-7;//Constant (u0/(4*pi))

M=2*m*l;//Magnetic Moment of the Magnet

B=k*2*M*d/((d)^2-(l)^2)^2;//Magnetic Field at the
    Point 20 cm from the centre

printf("Magnitude of the Magnetic Field at a point
    of 20 cm from the center of magnet = %.1f*10^-5 T
    ",B*10^5);
```

Scilab code Exa 36.4 To Find the Magnetic Field due to Magnetic Dipole

```

//To Find the Magnetic Field due to Magnetic Dipole

//Example 36.4

clear;

clc;

M=1.2;//Magnetic Moment of the Dipole in A-m^2

r=1;//Distance of point P from Magnetic Pole in
    metres

theta=%pi/3;//Angle made by given point with the
```

```
    Dipole Axis in radians

k=1*10^-7;//Constant (u0/(4*pi))

B=k*M*sqrt(1+3*(cos(theta))^2)/(r)^3;//Magnitude of
    Magnetic Field at the Given Point in Tesla

printf("Magnitude of Magnetic field at a point 1
    metre from the Magnetic Dipole = %.1f*10^-7 T",B
    *10^7);

alpha=atan(tan(theta)/2)*180/%pi;//Angle made by
    magnetic field with the radial line

printf("\n Magnetic field makes an angle %.2f
    degrees with the radial line",alpha);
```

Scilab code Exa 36.5 To Calculate the Magnitude of Earth Magnetic Field

```

//To Calculate the Magnitude of the Earth's Magnetic
    Field

//Example 36.5

clear;

clc;

Bh=3.6*10^-5;//Horizontal component of Earth's
    Magnetic Field in Tesla

theta=%pi/3;//Dip Angle in radians
```

```
B=Bh/cos(theta);//Resultant Magnetic Field

printf("Magnitude of the Earth magnetic field = %.1f
   *10^-5 T",B*10^5);
```

Scilab code Exa 36.6 To Calculate the True Dip

```


//To Calculate the True Dip

//Example 36.6

clear;

clc;

alpha=%pi/4;//Angle made by Dip Circle to the
   Meridian in radians

del1=%pi/6;//Apparent Dip in radians

del=atan(tan(del1)*cos(alpha))*180/%pi;//True Dip in
    degrees

printf("True dip = %f degrees",del);//Answer
   mentioned as atan(1/sqrt(6)) in the textbook
   which is same as 22.207 degrees
```

Scilab code Exa 36.7 To Calculate the Value of Horizontal Component of Earth Magne

```
//To Calculate the Value of Horizontal Component of
   Earth's Magnetic Field

//Example 36.7

clear;

clc;

n=66;//Number of turns in Tangent Galvanometer

i=0.1;//Current passing through Galvanometer in
   Amperes

d=22*10^-2;//Diameter of coil in metres

theta=%pi/4;//Defelction in Galvanometer in radians

u0=4*%pi*10^-7;//permeability of vaccum

Bh=(u0*n*i)/(d*tan(theta));//Horizontal component of
    Earths Magnetic Field

printf("Horizontal component of Earth Magnetic Field
    = %.1f*10^-5 T",Bh*10^5);
```

Scilab code Exa 36.8 `To Calculate the Shunt Resistance for Galvanometer`

```

//To Calculate the Shunt Resistance for Galvanometer

//Example 36.8

clear;

clc;

i=2;//Maximumm Current in Amperes

ig=20*10^-3;//Minimum current required for one full scale deflection in Galvanometer in Amperes

Rg=20;//Resistance of Galvanometer Coil in ohms

Rs=(ig*Rg)/(i-ig);//Shunt Resistance for Galvanometer in order to pass a maximum current of 2A

printf("Shunt Resistance for Galvanometer in order to pass a maximum current of 2A = %.1f ohms",Rs);
```

Scilab code Exa 36.9 `To Compare the total Magnetic Field due to earth at the two p`

```

```

```
//To Compare the total Magnetic Field due to earth
    at the two places

//Example 36.9

clear;

clc;

T1=3;//Time period for first place in seconds

T2=2;//Time Period for second place in seconds

theta1=%pi/4;//Dip in radians at first place

theta2=%pi/6;//Dip in radians at second place

Br=(T1^2/T2^2)*cos(theta1)/cos(theta2);//Ratio of
    Magnetic Field due to earth at two places

printf("The ratio of Magnetic Field due to earth at
    the two places = %.3f",Br);
```

Chapter 37

Magnetic Properties of Matter

Scilab code Exa 37.1 To Calculate the Intensity of Magnetization of Bar Magnet

```

//To Calculate the Intensity of Magnetization of Bar
    Magnet

//Example 37.1

clear;

clc;

m=6.6*10^-3;//Mass of bar magnet (made of steel) in
   kg

rho=7.9*10^3;//Density of steel in kg/m^3

M=2.5;//Magnetic Moment of Bar Magnet in A-m^2

V=m/rho;//Volume of bar magnet in m^3

I=M/V;//Intensity of Magnetization in A/m

```

```
printf("Intensity of magnetization of bar magnet = %
    .1f*10^6 A/m",I*10^-6);
```

Scilab code Exa 37.3 To Calculate the percentage increase in Magnetic Field

```

//To Calculate the percentage increase in Magnetic
    Field

//Example 37.3

clear;

clc;

X=2.1*10^-5;//Susceptibility of Aluminium

Bin=X*100;//Percentage increase in Magnetic Field

printf("Percentage increase in the Magnetic Field =
    %.1f*10^-3",Bin*10^3);
```

Chapter 38

Electromagnetic Induction

Scilab code Exa 38.3 To Calculate the Self Inductance of the Coil

```

//To Calculate the Self Inductance of Coil

//Example 38.3

clear;

clc;

If=-5.0;//Final Current flowing through coil in
   opposite direction in Amperes

Ii=5.0;//Initial Current flowing through coil in
   Amperes

t=0.20;//Time Required for current to Change from -5
    A to 5 A in seconds

di=(If-Ii)/t;//Change in Current through the coil in
    Amperes

```

```
E=0.2;//Average Induced EMF in Volts

L=-E/di;//Self Inductance of the Coil

printf("Self Inductance of the coil (L) = %.1f mH",L
    *10^3);
```

Scilab code Exa 38.5 To find the Time Constant Maximum Current and Time

```

//To find the Time Constant Maximum Current and Time

//Example 38.5

clear;

clc;

L=20*10^-3;//Seld Inductance of Inductor

R=100;//Resistance of the Resistor in ohms

tau=L/R;//Time Constant of L-R circuit

printf("(a) Time Constant =%.2f ms",tau*10^3);

E=10;//EMF of Battery in Volts

I=E/R;//Maximum Current in Amperes

printf("\n (b) Maximum current = %.2f A",I);

iper=0.99;//Current reaches 99% of the Maximum Value
```

```
t=tau*-log(1-iper);//Time elapsed befor the current reaches 99% of the maxium value

printf("\n (c) Time elapsed before the current reaches 99 percent of the maximum value = %.2f ms ",t*10^3);
```

Scilab code Exa 38.6 To Calculate the Current in Circuit

```

//To Calculate the Current in Circuit

//Example 38.6

clear;

clc;

E=10;//EMF of Battery in Volts

R=100;//Resistance in ohms

i0=E/R;//Initial Current in Amperes

L=20*10^-3;//Self Inductance of Inductor in Henry

tau=L/R;//Time Constant of L-R Circuit

t=1*10^-3;//Time after Short-Circuiting in seconds

i=i0*exp(-t/tau);//Current in the circuit 1 ms after short circuiting
```

```
printf("Current in the circuit 1 ms after Short
    Circuiting = %.1f*10^-4 A",i*10^4);
```

Scilab code Exa 38.7 To Calculate the Energy Stored in the Inductor

```

//To Calculate the Energy Stored in the Inductor

//Example 38.7

clear;

clc;

L=50*10^-3;//Self Inductance of Inductor in Henry

i=2;//Cuurent passed through inductor in Amperes

U=0.5*L*i^2;//Energy stored in the Inductor

printf("Energy stored in the inductor = %.2f J",U);
```

Chapter 39

Alternating Current

Scilab code Exa 39.1 To Calculate the rms value of Current and time required to re

```

//To Calculate the rms value of Current and time
    required to reach the Peak Value

//Example 39.1

clear;

clc;

i0=5;//Peak Value of Alternating Current in Amperes

Irms=i0/sqrt(2);//RMS Value of Alternating Current
    in Amperes

f=60;//Frequency of Alternating Current in Hz

T=1/f;//Time period of Alternating Current in
    seconds

t=T/4;//Time required to reach the Peak Value of
```

```
   Current in seconds

printf("RMS Value of the Alternating Current = %.1f
   A",Irms);

printf("\n Time required to reach the Peak Value of
   Current = %f s",t);
```

Scilab code Exa 39.2 To Calculate the Reactance of Capacitor for different frequen

```

//To Calculate the Reactance of Capacitor for
   different frequencies of Alternating Currents

//Example 39.2

clear;

clc;

C=200*10^-6;//Capacitance of the Capacitor in
   Faraday

f1=10;//Frequency of first AC source in Hz

f2=50;//Frequency of Second AC Source in Hz

f3=500;//Frequency of Third AC Source in Hz

Xc1=1/(2*%pi*f1*C);//Reactance of the Capacitor when
    connected to 10 Hz AC source

printf("(a) Reactance of capacitor for 10 hz source
```

```
   = %.0f ohms",Xc1);

Xc2=1/(2*%pi*f2*C);//Reactance of the Capacitor when
    connected to 50 Hz AC source

printf("\n (b) Reactance of capacitor for 15 hz
   source= %.0f ohms",Xc2);

Xc3=1/(2*%pi*f3*C);//Reactance of the Capacitor when
    connected to 500 Hz AC source

printf("\n (c) Reactance of capacitor for 500 hz
   source = %.1f ohms",Xc3);
```

Scilab code Exa 39.3 To Find the Peak Value of Current and the Instantaneous Volta

```

//To Find the Peak Value of Current and the
   Instantaneous Voltage of the source when the
   current is at its peak value

//Example 39.3

clear;

clc;

f=50;//Frequency of AC source in Hz

L=200*10^-3;//Self Inductance of Inductor in Henry

Xl=2*%pi*f*L;//Reactance of the Inductor in ohms

```

```
E0=210;//Peak EMF Value of AC source in Volts

i0=E0/Xl;//Peak Value of Current in Amperes

printf("Peak Value of current = %.1f A",i0);

i=i0;//Instantaneous Value of Current when current attains its peak value

phi=-%pi/2;//Phase Difference in Radians for a purely Inductive Circuit

t=(asin(i/i0)-phi)/(2*%pi*f);//Time at which current attains its peak value

E=E0*sin(2*%pi*f*t);//Instantaneous Voltage for a purely inductive circuit

printf("\n Instantaneous voltage at peak value of Current = %.0f V",E);
```

Scilab code Exa 39.4 To find the Impedance the Peak Current and the Resonant Frequ

```

//To find the Impedance the Peak Current and Resonant Frequency of the LCR Series Circuit

//Example 39.4

clear;

clc;

```

```
L=100*10^-3;//Self Inductance of Inductor inHenry

C=100*10^-6;//Capacitance of Capacitor in Farads

R=120;//Resitance of Resistor in ohms

E0=30;//Peak Value of EMF  of AC source in Volts

w=100;//Angular Frequency of the AC source

X=(1/(w*C))-(w*L);//Reactance of the Circuit in ohms

Z=sqrt(R^2+X^2);//Total Impedance of the Circuit

printf("Impedance of the LCR Series Circuit = %.0f
   ohms",Z);

i0=E0/Z;//Peak Value of Current in Amperes

printf("\n Peak current Value of the LCR Series
   Circuit = %.1f A",i0);

f=(1/(2*%pi))*sqrt(1/(L*C));//Resonant Frequency of
   the Circuit

printf("\n Resonant Frequency of the LCR Series
   Circuit = %.0f Hz",f);
```

Scilab code Exa 39.5 To Calculate the Number of Turns in the Primary Coil

```

//To Calculate the Number of Turns in the Primary
   Coil
```

```
//Example 39.5

clear;

clc;

E1=220;//Input Voltage to the Transformer in Volts

E2=6;//Output Voltage by the Transformer in Volts

N2=18;//Number of Turns in the Secondary Coil

N1=(E1/E2)*N2;//Number of Turns in the Primary Coil

printf("Number of turns in the primary coil = %.0f",
    N1);
```

Chapter 40

Electromagnetic Waves

Scilab code Exa 40.2 To Find the Maximum Magnetic Field in the wave and its Direct

```
//To Find the Maximum Magnetic Field in the wave and its Direction

//Example 40.2

clear;

clc;

E0=600;//Maximum Electric Field in a plane electromagnetic wave in N/C

c=3*10^8;//Speed of light in m/s

B0=E0/c;//Maximum Magnetic Field in Tesla

printf("The maximum Magnetic Field = %.0f*10^-6 T in the z direction",B0*10^6);
```

Scilab code Exa 40.3 To Find the Energy due to an Electromagnetic Wave

```
//To Find the Energy due to an Electromagnetic Wave

//Example 40.3

clear;

clc;

E0=50;//Maximum Electric Field in N/C

x=50*10^-2;//Length of Cylinder in metres

A=10*10^-4;//Cross-Sectional Area of Cylinder in m^2

e0=8.85*10^-12;//Permittivity of free space

Uav=0.5*e0*E0^2;//Average Energy Density

V=A*x;//Volume of Cylinder

U=Uav*V;//Energy contained in the Volume of Cylinder

printf("Energy contained in the volume of the
    cylinder = %.1f*10^-12 J",U*10^12);
```

Scilab code Exa 40.4 To Find the Intensity of the Wave

```

//To Find the Intensity of Wave discussed in example
    40.3

//Example 40.4

clear;

clc;

Uav=1.1*10^-8;//Average Energy Density in J/m^3

c=3*10^8;//Speed of Light in m/s

I=Uav*c;//Intensity of the Wave in W/m^2

printf("Intensity of the wave = %.1f W/m^2",I);
```

Chapter 41

Electric Current through Gases

Scilab code Exa 41.1 To Calculate the Factor Increase in the Value of Thermionic C

```

//To Calculate the Factor Increase in the Value of
   Thermionic Current

//Example 41.1

clear;

clc;

T1=1500;//Initial Temperature in Kelvin

T2=2000;//Final Temperature in Kelvin

k=1.38*10^-23;//Boltzmann Constant

phi=4.5*1.6*10^-19;//Work Function in electron-volts

Ir=(T2/T1)^2*exp((-phi/k)*((1/T2)-(1/T1)));//Factor
   Increase in the Value of Thermionic Current

```

```
printf("Thermionic current increases %.d times when
   temperature is increased from 1500 K to 2000 K",
   Ir);
```

Scilab code Exa 41.2 To Calculate the Dynamic Plate Resistance at the operating co

```

//To Calculate the Dynamic Plate Resistance at the
   operating condition

//Example 41.2

clear;

clc;

V1=40;//Initial Plate Voltage in Volts

V2=42;//Final Plate Voltage in Volts

delVp=V2-V1;//Change in Plate Voltage in Volts

I1=50*10^-3;//Initial Plate Current in Amperes

I2=60*10^-3;//Final Plate Current in Amperes

delIp=I2-I1;//Change in Plate Current in Amperes

Rp=delVp/delIp;//Dynamic Plate Resistance in ohms

printf("Dynamic Plate Resistance = %d ohm",Rp);
```

Chapter 42

Photoelectric Effect and Wave Particle Duality

Scilab code Exa 42.1 To Calculate the Energy and linear Momentum and number of pho

```

//To Calculate the Energy  and linear Momentum and number of photons

//Example 42.1

clear;

clc;

h=4.14*10^-15;//Plank's Constant in eV-s

c=3*10^8;//Speed of Light in m/s

l=600*10^-9;//Wavelength of Light in metres

E=h*c/l;//Energy of each photon in eV

printf("(a) Energy of each photon = %.2f eV",E);
```

```
p=E/c;//Linear Momentum of each photon in eV-s/m

printf("\n      Linear Momentum of each photon = %.2f
   *10^-8 eV-s/m",p*10^8);

A=1*10^-4;//Area of cross section in m^2

e=1.6*10^-19;//Charge on an electron

I=100;//Intensity of light in W/m^2

t=1;//Duration for which beam passes in seconds

E1=I*A*t;//Energy crossing 1 cm^2 in 1 second

n=E1/(E*e);//Number of photons crossing 1 cm^2 in 1
   second

printf("\n (b) Number of photons crossing 1 cm^2 in
   1 second = %.1f*10^16",n*10^-16);
```

Scilab code Exa 42.2 To Find the Maximum Wavelength of Light that can cause Photoe

```

//To Find the Maximum Wavelength of Light that can
   cause Photooelectric Effect in Lithium

//Example 42.2

clear;

clc;
```

```
h=4.14*10^-15;//Plank's Constant in eV-s

c=3*10^8;//Speed of Light in m/s

phi=2.5;//Work Function of Lithium in eV

l=h*c/phi;//Threshold Wavelength in metres

printf("Maximum Wavelength of Light to cause
   Photoelectric Effect in Lithium = %.0f nm",l
   *10^9);
```

Scilab code Exa 42.3 To Calculate the Time required by the Electron to receive suf

```

//To Calculate the Time required by the Electron to
   receive sufficent energy to come out of the metal

//Example 42.3

clear;

clc;

r=1.0*10^-9;//Radius of Circle in metres on the
   surface occupied by a single electron

d=5.0;//Distance between Monochromatic Light source
   and Metal Surface in metres

std=%pi*r^2/d^2;//Solid Angle subtended at the
   source by the Circular Area in sterdian
```

```
P=1*10^-3;//Power of monochromatic light source in
    Watts

E=std*P/(4*%pi);//Energy heading towards the
    Circular Area per second

phi=2*1.6*10^-19;//Work Function of Metal in Joules

t=phi/(E*3600);//Time required by the electron to
    recieve sufficient energy to cmome out of the
    metal in hours

printf("Time required by the electron to recieve
    sufficient energy to come out of the metal =%.2f
    hours",t);
```

Chapter 43

Bohr Model and Physics of the Atom

Scilab code Exa 43.1 Calculate the Energy of Helium ion its first excited state

```
//Calculate the Energy of Helium ion its first
   excited state

//Example 43.1

clear;

clc;

Rhc=13.6;//Product of Rydberg's Constant, Plancks
   Constant and Speed of Light (Rhc) in eV

Z=2;//Atomic Number for Helium Ion

n=2;//First Excited State

E=-Rhc*Z^2/n^2;//Energy of Helium Ion in the first
   excited state in eV

```

```
printf("Energy of Helium Ion in the first excited state = %.1f eV",E);
```

Scilab code Exa 43.2 To Calculate the Wavelength of Radiation for Helium Ion

```
//To Calculate the Wavelength of Radiation for Helium Ion

//Example 43.2

clear;

clc;

n=2;//Final State of the electron

m=3;//Initial State of the Electron

R=1.0973*10^7;//Rydberg's Constant

Z=2;//Atomic Number for Helium Ion

L=1/(R*Z^2*((1/n^2)-(1/m^2)));//Wavelength of radiation emitted when Helium ion make a transition from the state n=3 to n=2

printf("Wavelength of radiation emitted when Helium ion makes a transition from the state n=3 to n=2 is = %.0f nm",L*10^9);
```

Scilab code Exa 43.3 To Calculate the Energy needed to remove the electron from th

```
//To Calculate the Energy needed to remove the
   electron from the ion

//Example 43.3

clear;

clc;

E1=40.8;//Excitation Energy of Hydroen like ion
   inits first excited state in eV

K=13.6;//Value of constant Rhc = 13.6 eV

n1=1;//n=1 for the first orbit

n2=2;//n=2 for the second orbit

Z=sqrt(E1/(K*((1/n1^2)-(1/n2^2))));//Atomic Number
   of Hydrogen like ion

E=-K*Z^2;//Energy needed to remove the electron from
    the ion in eV

printf("Energy required to remove the electron from
   the ion = %.1f eV",E);
```

Chapter 45

Semiconductors and Semiconductor Devices

Scilab code Exa 45.1 To Find the Electric Field which gives 1eV average energy to

```

//To Find the Electric Field which gives 1eV average
    energy to a conduction electron

//Example 45.1

clear;

clc;

e=1.6*10^-19;//Charge on an electron in Coloumbs

Eav=1*e;//Energy to the Conduction Electron in
   Joules

l=4*10^-8;//Mean Free Path of Conduction Electrons
   in Copper

E=Eav/(e*l);//Electric field which can give , on an
```

```
   average, 1eV to a conduction electron

printf("Electric field which can give, on an average
   , 1eV to a conduction electron = %.1f*10^7 V/m",E
   *10^-7);
```

Scilab code Exa 45.2 To Calculate the Resistivity of n type semiconductor

```


//To Calculate the Resistivity of n type
   semiconductor

//Example 45.2

clear;

clc;

e=1.6*10^-19;//charge on an electron in Coloumbs

ne=8*10^19;//Density of Conduction Electron per
   metre^3

ue=2.3;//Mobility of Conduction Electron in m^2/V-s

nh=5*10^18;//Density of holes per metre^3

uh=10^-2;//Mobility of holes per m^2/V-s

c=e*((ne*ue)+(nh*uh));//Conductivity of the
   Semiconductor in C/(m-V-s)

```

```
rho=1/c;//Resistivity of Semiconductor in ohm-metre

printf("Resistivity of the n-type semiconductor = %.3f ohm-m",rho);//The answer provided in the textbook is wrong
```

Scilab code Exa 45.3 To calculate the Approximate value of Dynamic Resistance of P

```

//To calculate the Approximate value of Dynamic Resistance of P N Junction under Forward Bias

//Example 45.3

clear;

clc;

//(a)Case-I: Forward Bias of 1 V is applied
//////////////////////////////////////////////////////////////////

i1=10*10^-3;//Current in Amperes at 1 Volt

i2=15*10^-3;//Current in Amperes at 1.2 Volts

delI=i2-i1;//Net Change in Current in Amperes

v1=1;//Voltage at the Initial Point

v2=1.2;//Voltage at the Final point

```

```
delV=v2-v1;//Net Change in Voltage

R=delV/delI;//Dynamic Resitance in ohms

printf("(a) Dynamic Resistance when a forward bias
   of 1 V is applied at the p-n junction = %.0f ohms
   ",R);


//(b)Case-II: Forward Bias of 2 V is applied
//
   ///////////////////////////////////////////////////////////////

v3=2;//Voltage at the Initial Point

v4=2.1;//Voltage at the Final point

delV1=v4-v3;//Net Change in Voltage

i3=400*10^-3;//Current in Amperes at 2 Volt

i4=800*10^-3;//Current in Amperes at 2.1 Volt

delI1=i4-i3;//Net Change in Current in Amperes

R1=delV1/delI1;//Dynamic Resitance in ohms

printf("\n (b) Dynamic Resistance when a forward
   bias of 2 V is applied at the p-n junction = %.2f
    ohms",R1);
```

Chapter 46

The Nucleus

Scilab code Exa 46.1 To Calculate the radius of Nucleus of Germanium atom

```


//To Calculate the radius of Nucleus of Germanium
   atom

//Example 46.1

clear;

clc;

A=70;//Mass Number of Germanium Atom

R0=1.1;//Constant R0 in fetometers

R=R0*A^(1/3);//Radius of Nucleus of Germanium atom

printf("Radius of Nucleus of Germanium atom = %.2f
   fm",R);
```

Scilab code Exa 46.2 To Calculate the Binding Energy of an Alpha Particle

```

//To Calculate the Binding Energy of an Alpha
    Particle
//Example 46.2

clear;

clc;

u=931;//1 Atomic Mass Unit in MeV/c^2

mH=1.007825*u;//Mass of Hydrogen atom in MeV/c^2

mn=1.008665*u;//Mass of Neutron in MeV/c^2

mHe=4.00260*u;//Mass of Helium atom in MeV/c^2

np=2;//Number of protons in Alpha Particle

nn=2;//Number of Neutrons in Alpha Particle

B=(np*mH+nn*mn-mHe);//Binding Energy of an Alpha
    Particle in MeV

printf("Binding energy of an Alpha particle = %.1f
    MeV",B);
```

Scilab code Exa 46.3 To calculate the mass excess of Hydrogen

```

//To calculate the mass excess of Hydrogen
//Example 46.3

clear;

clc;

u=931;//1 Atomic Mass Unit in MeV/c^2

m=1.00783;//Mass of Hydrogen atom in atomic mass
    unit

A=1.0;//Atomic Mass of Hydrogen atom in atomic mass
    unit

Me=u*(m-A);//Mass excess of Hydrogen

printf("The mass excess of Hydrogen = %.2f MeV",Me);
```

Scilab code Exa 46.4 To calculate the Activity of Copper

```

//To calculate the Activity of Copper
//Example 46.4

```

```
clear;

clc;

Na=6*10^23;//Avagadro's Number

m=1*10^-6;//Mass of the Copper Sample in grams

M=63.5;//Atomic Weight of Copper

N=Na*m/M;//Number of Atoms in i microgram of Copper

l=1.516*10^-5;//Decay Constant for Copper

Act=l*N;//Activity of the Copper Sample in
    disintegrations/s

printf("Activity of 1 microgram of Copper Sample = %
    .3f Ci",Act/(3.7*10^10));//1Ci = 3.7*10^10
    disintegrations/s
```

Scilab code Exa 46.5 To Calculate the fraction of Orignal Activity remaining after

```

//To Calculate the fraction of Orignal Activity
    remaining after 40 hours
//Example 46.5

clear;

clc;

t=40;//Duration of Radioactive Decay in hours
```

```
thalf=20;//Half Life of Radioactive Nuclide in hours

Ar=1/2^(t/thalf);//Fraction of Orignal Activity
    remaining after 40 hours

printf("Fraction of Orignal Activity remaining after
     40 hours = %.2f",Ar);
```

Scilab code Exa 46.6 To calculate the energy released when a Nucleus breaks

```

//To calculate the energy released in the process
    when a Nucleus breaks

//Example 46.6

clear;

clc;

A=240;//Mass Number for First Nucleus

Be1=7.6;//Binding Energy in MeV per nucleon for A
    =120

Be2=8.5;//Binding Energy in MeV per nucleon for A
    =240

E=A*(Be2-Be1);///Energy released when a nucleus of A
    =240 breaks into two nuclei of nearle equal mass
```

```
    numbers

printf("Energy released when a nucleus of A=240
    breaks into two nuclei of nearly equal mass
    numbers = %.0f MeV",E);
```

Scilab code Exa 46.7 To Calculate the Temperature of Deutrons for a specific Avera

```

//To Calculate the Temperature of Deutrons for a
    specific Average Kinetic Energy
//Example 46.7

clear;

clc;

e=1.6*10^-19;//Charge on an electron in Coloumbs

E=9*10^9;//Value of Constant (1/(4*%pi*e0)) in N-m
    ^2/C^2

d=2*10^-15;//Closest Seperation between 2 deutrons
    in metres

K=e^2*E/(2*d);//Initial Kinetic Energy of each
    deuteron

printf("Kinetic Energy of each deuteron so that the
    closest seprations between them becomes 2 fm = %
    .1f*10^-14 J",K*10^14);

k=1.38*10^-23;//Boltzmann Constant

T=K/(k*1.5);//Temperature needed for the deutrons to
```

```
have the Average Kinetic Energy

printf("\n Temperature needed for the deutrons to
  have the Average Kinetic Energy = %.1f*10^9 K",T
  *10^-9);
```

Chapter 47

The Special Theory of Relativity

Scilab code Exa 47.1 To Calculate the time for which the Person slept according to

```
//To Calculate the time for which the Person slept according to clocks

//Example 47.1

clear;

clc;

delt=6;//Duration of Sleep according to person's watch

v=3*10^7;//Speed of the train(in which the person is sitting) in m/s

c=3*10^8;//Speed of light in m/s

delt1=delt/sqrt(1-(v/c)^2);//Duration of sleep in
```

```
    the ground frame

delt1h=int(delt/sqrt(1-(v/c)^2));//Duration of sleep
     (in whole number of hours) in the ground frame

printf("Duration of sleep according to the clocks =
    %.0f hours ",delt1h);

delt1m=(delt1-delt1h)*60;//Duration of sleep (in
    remaining ) in the ground frame

printf("%.1f minutes",delt1m);
```

Scilab code Exa 47.2 To Calculate the height of Passenger in the Ground Frame

```

//To Calculate the height of Passenger in the Ground
     Frame

//Example 47.2

clear;

clc;

L=6;//Height of Passenger in the train frame

v=3*10^7;//Speed of the train(in which the person is
     sitting) in m/s

c=3*10^8;//Speed of light in m/s

L1=L*sqrt(1-(v/c)^2);//Height of Passenger in the
```

```
Ground Frame

L1f=int(L1);//Height of Passenger (in whole number of feets) in the Ground Frame

printf("Height of the passenger in the Ground Frame = %.0f feet ",L1f);

L1i=(L1-L1f)*12;//Height of Passenger (in remaining inches) in the Ground Frame

printf("%.1f inches",L1i);
```

Scilab code Exa 47.3 To Calculate the Time Elapsed between Door Openings

```

//To Calculate the Time Elapsed between Door Openings

//Example 47.3

clear;

clc;

c=3*10^8;//Speed of Light in m/s

v=0.8*c;//Speed of Train T1 in m/s

y=1/sqrt(1-(v/c)^2);//Speed of Box in the frame of T1 in m/s

rl=30*c;//Rest Length of the box in metres
```

```
t=(rl*v*y)/(c^2);//Time elapsed between the openings of the Door in seconds

printf("Time elapsed between the openings of the Door = %.0f s",t);
```

Scilab code Exa 47.5 To Calculate the amount of Electrical Energy obtained in kilo

```

//To Calculate the amount of Electrical Energy obtained in kilowatt-hour

//Example 47.5

clear;

clc;

c=3*10^8;//Speed of light in m/s

m=3.6*10^-3;//Mass of the object in kilograms

E=m*c^2/(3.6*10^6);//Amount of Electrical Energy obtained in kWh

printf("Electrical Energy obtained when a mass of 3.6 g is fully converted into energy = %.0f*10^7 kWh",E*10^-7);
```