Scilab Textbook Companion for A Textbook of Electrical and Electronics Engineering Materials by P. l. Kapoor[1]

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June 2, 2016

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: A Textbook of Electrical and Electronics Engineering Materials

Author: P. l. Kapoor

Publisher: Khanna Publishers, New Delhi

Edition: 8

Year: 2010

ISBN: 81-7409-131-9

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 2

Conducting Materials

Scilab code Exa 2.1 Finding resistance

```
//Finding resistance
//Example 2.1(pg. 21)
clc
clear
l=300//in meters
a=25*(10^-6)//in meter square
d15=2.7//density at 15 degree C in ohm-meter
R15=d15*(l/a)
printf('The value of Resistance at 15 degree C is %3
    .2f.ohms \n',R15)
k0=0.004//temp coefficient in ohm/degree C at 0
    degree C
t=15,T=50//in degree C
k15=k0/(1+(k0*t))
R50=R15*(1+k15*(T-t))
printf('The value of Resistance at 50 degree C is %3
    .2f.ohms',R50)
```

Scilab code Exa 2.2 Finding resistance

```
//Finding resistance
//Example 2.2(pg. 21)
clc
clear
R20=400// in ohms
k0=0.0038
t=20,T=80//degree C
k1=k0/(1+(k0*t))
R80=R20*{1+k1*(T-t)}
printf('The value of Resistance at 80 degree C is %3
   .4f ohms',R80)
```

Scilab code Exa 2.3 Finding temperature

```
//Finding temperature
//Example 2.3(pg. 22)
clc
clear
t=15//degree C
R15=250,RT=300//ohms
k0=0.0038//ohm/degree C
k1=k0/(1+(k0*t))
T=[{(RT/R15)-1}/k1]+t//since RT=R15{1+k1*(T-t)}
printf('The value of Temperature at 300 ohm
   resistance is %3.1f degree C',T)
```

Scilab code Exa 2.4 Finding length

```
//Finding length
//Example 2.4(pg. 22)
clc
clear
//Part (a)
```

```
d=0.4*(10^-3)//diameter in meter
a=%pi*(d^2)/4//area in meter square
p1=100*(10^-8)//resistivity of nichrome in ohm-meter
R=40//resistance in ohms
l1=R*a/p1
printf('Thus the length of heater element with
   nichrome wire is %2.1f meter \n',l1)

//Part(b)
d=0.4*(10^-3)//diameter in meter
a=12.6*(10^-8)//area in meter square
p2=1.72*(10^-8)//resistance of copper wire in ohm-
   meter
R=40//resistance in ohms
l2=R*a/p2
printf('Thus the length of heater element with
   copper wire is %2.1f meter',l2)
```

Scilab code Exa 2.5 Finding resistance

```
//Finding resistance
//Example 2.5(pg. 23)
clc
clear
R0=80//in ohms
t=40// in degree C
k0=0.0043
R40=R0*(1+(k0*t))
printf('The value of Resistance at 40 degree C is %3
   .2f ohms',R40)
```

Scilab code Exa 2.6 Finding temperature coefficient

```
//Finding temperature coefficient
//Example 2.6(pg. 23)
clc
clear
R80=50,R28=40// resistance in ohms
t=28,T=80// temp in degrees
k28=[(R80/R28)-1]/(T-t)//since RT=Rt{1+k*(T-t)}
printf('The value of Temperature coefficient  at 28
   degree C is %3.4f ohms per degree C \n',k28)
k0=k28/(1-k28*t)// since k28=k0/(1+k0*t)
printf('The value of Temperature coefficient  at 0
   degree C is %3.4f ohms per degree C',k0)
```

Scilab code Exa 2.7 Finding resistance

```
//Finding resistance
//Example 2.7(pg. 24)
clc
clear
l=1000// length in meters
d=0.09/100// diameter in meters
p=1.724*(10^-8)// specific resistance in ohm meter
a=%pi*(d^2)/4// area in meter square
R=p*l/a//resistance in ohms
printf('The value of Resistance is %3.2f ohms',R)
```

Scilab code Exa 2.8 Finding resistance

```
//Finding resistance
//Example 2.8(pg. 24)
clc
clear
R20=50// resistance in ohms
```

```
T=60,t=20// temp in degree C
k0=0.00427//temp coefficient at zero degreeC
R0=R20/{1+(k0*t)}
printf('The value of Resistance at 0 degree C is %3
    .2f ohms \n',R0)
R60=R0*{1+(k0*T)}
printf('The value of Resistance at 60 degree C is %3
    .2f ohms',R60)
```

Scilab code Exa 2.9 Resistance and temp coeff

```
//Finding resistivity and temp coefficient
//Example 2.9(pg. 24)
clc
clear
k20=1/254.5// temperature coefficient at 20 degreeC
p0=1.6*(10^-6)// resistivity at 0 degree C in ohm-cm
t=20,T=50//temp in degree C
k0=k20/(1-(t*k20))//temperature coefficient at 0
    degreeC
p50=p0*[1+(T*k0)]// resistivity at 50 degree C in
    ohm-cm
k50=1/[T+(1/k0)]//temperature coefficient at 50
    degreeC
printf('Thus the temperature coefficient at 50
    degree C is %3.4f \n',k0)
printf('Thus the resistivity at 50 degree C is %e in
     ohm-cm',p50)
```

Scilab code Exa 2.10 Resistance and temperature

```
//Finding resistance and temperature
//Example 2.10(pg. 25)
```

```
clc
clear
R15=50,RT=58// resistance in ohms
t=15// te mp in degree C
k0=0.00425// temp coefficient at 0 degree C
R0=R15/[1+(k0*t)]// resistance at 0 degree C in ohms
T=[(RT/R0)-1]/k0// temp in degree C

printf('The value of Resistance at 0 degree C is %3
    .1f ohms \n',R0)
printf('The value of Temperature at 58 ohm
    resistance is %3.4f degree C',T)
```

Scilab code Exa 2.11 Finding temperature coefficient

```
//Finding temperature coefficient
//Example 2.11(pg. 25)
clc
clear
R25=50,R70=57.2// resistance in ohms
t=25,T=70// temp in degree C
//since Rt=R0(1+(k0*t))
k0=(R70-R25)/[(R25*T)-(R70*t)]
printf('The temp coefficient at 0 degree C is %3.3f'
    ,k0 )
```

Scilab code Exa 2.12 Resistance and Conductivity

```
//Finding resistance and conductivity
//Example 2.12(pg. 26)
clc
clear
R0=15.5// resistance in ohms
```

```
t=16//in degree C
k0=0.00428//temp coefficient
R16=R0*[1+(k0*t)]
G=(R0/R16)*100// since conductance=reciprocal of
   resistance
printf('The value of Resistance at 16 degree C is %3
   .4f ohms \n',R16)
printf('The value of percentage conductivity at 16
   degree C is %3.2f percent',G)
```

Scilab code Exa 2.13 Finding temperature

```
//finding temperature
//Example 2.13(pg. 26)
clc
clear
RT=144,R20=10// in ohms
t=20// in degree C
k20=5*(10^-3)//temp coefficient at 20 degree C
T={[(RT/R20)-1]/k20}+t
printf('The value of temp required for tungsten bulb
    is %4.2f degree C',T)
```

Scilab code Exa 2.14 Finding temperature

```
//Finding temperature
//Example 2.14(pg. 27)
clc
clear
V15=250,Vt=250//voltage in volts
I15=5,It=4//current in amperes
T=15//temp in degree C
R15=V15/I15//resistance in ohms at 15 degreeC
```

```
printf('Resistance at 15 degree C is %3.1f ohms \n',R15)
Rt=Vt/It//resistance at t degreeC
printf('Resistance at t degree C is %3.1f ohms \n',Rt)
k0=0.0038
R0=R15/[1+(k0*T)]
printf('Resistance at 0 degree C is %3.2f ohms \n',R0)
t=[(Rt/R0)-1]/k0
printf('Temperature t is %3.2f degree C',t)
```

Scilab code Exa 2.15 Finding resistance

```
//Finding resistance
//Example 2.15(pg. 28)
clc
clear
n=100//no of slots
c=12//conductors per slot
Lm=300// mean length of turn in cm
a=1.5*0.2//cross section of each conductor in cm^2
s=1.72*(10^-6)//specific resistance of copper at 20 degreeC
p=4// poles
t=20,T=75//temp in degreeC
k0=0.00427//temp coefficient of resistivity for copper
L=n*c*Lm//total length of conductors
Ls=L/p//length of conductors in each parallel path
s0=s*(1-(k0*t))
printf('Thus specific resistance at 0 degree C is %e ohm-cm \n',s0)
RT=(s0*Ls)/a
printf('Thus resistance at working temp of 75 degree
```

```
    C is %3.4f ohm',RT)
```

Scilab code Exa 2.16 Finding resistance

```
//Finding resistance
//Example 2.16(pg. 28)
clc
clear
a=15//cross section area in cm^2
l=100000//length in cm
p0=7.6*(10^-6)//specific resistance at 0 degree C in
    ohm-cm
k0=0.005//temp coefficient at 0 degree C
t=50//temp in degree C
p50=p0*[1+(t*k0)]//resistivity at 50 degree C
R50=p50*(l/a)
printf('Thus resistance at 50 degree C is %3.5f ohms
    \n',R50)
```

Scilab code Exa 2.17 Finding fusing current

```
//Finding fusing current
//Example 2.17(pg. 29)
clc
clear
I2=27.5//current of No.25 wire in Amperes
d=1/2//since I1/I2=1/2
I1=I2*(d^(3/2))
printf('Thus fusing current of No.33 wire is %3.3f
   amperes \n',I1)
```

Scilab code Exa 2.18 Finding ratios

```
//Finding ratios
//Example 2.18(pg. 30)
clc
clear
sAl=2.85*(10^-6),sCu=1.7*(10^-6)//specific
    resistance in ohm-cm
gAl=2.71,gCu=8.89//specific gravity
cAl=5000,cCu=10000//cost per tonne
//P=V^2/R, power is same for both so resistance must
     also be same
//so R=(p*l)/(pi*d^2)=(p*l)/(pi*d'^2)
Kd=sqrt(sAl/sCu)//Kd=d/d'
printf('Thus the ratio of diameters is %3.3f \n',Kd)
Km=(Kd^2)*(gAl/gCu)
printf('Thus the ratio of weights is %3.4f \n',Km)
Kc=Km*(cAl/cCu)
printf('Thus the ratio of costs is %3.4f',Kc)
```

Scilab code Exa 2.19 Finding resistance

```
//Finding resistance
//Example 2.19(pg. 33)
clc
clear
R1=18.6//resistacne in ohms
Kl=5//since l2=5*l1
Ka=3// since a2=3*a1
R2=R1*Kl/Ka
// resistivity is same because wires are of same
    material
printf('Thus the resistance of another conductor is
    %3.1f ohms',R2)
```

Scilab code Exa 2.20 Finding heat efficiency

```
//Finding heat efficiency
//Example 2.20(pg. 57)
clc
clear
m=1//mass in kg
S=4200//specific heat of water
T2=100,T1=15// temp in degree C
H=m*S*(T2-T1)//heat utilised in J
printf('Heat utilised is %6.2f Joules \n',H)
W=500//wattage rating of kettle in volts
t=15*60// time in sec
Hd=W*t//heat developed in J
printf('Heat developed is %6.2f Joules \n',Hd)
He=(H/Hd)*100//Heat efficiency
printf('Thus heat efficiency is %3.2f percent',He)
```

Scilab code Exa 2.21 Finding time

```
//Finding time
//Example 2.21(pg. 58)
clc
clear
m=3.6//mass in kg
S=4200//specific heat of water
T2=95,T1=15// temp in degree C
H=m*S*(T2-T1)//heat utilised in J
printf('Heat utilised is %7.2f Joules \n',H)
e=0.84//efficiency of kettle
Ei=H/e//Energy input in J
printf('Energy input is %8.2f Joules \n',Ei)
```

```
W=1000//rating of kettle in watts
t=(Ei/W)/60//time taken in min
printf('Thus time taken is %2.1f min \n',t)
```

Chapter 4

Insulating Materials

Scilab code Exa 4.1 Finding capacitance

```
//Finding capacitance
//Example 4.1(pg 110)
clc
clear
// Let C1 and C2 be unknown capacities
//C1+C2=0.16
//(C1*C2)/(C1 + C2)=0.03
// from the above 2 equations we get the following
   polynomial
s=poly(0,"s");
p=s^2 -0.16*s +0.0048
[c1]=roots(p)
c2=0.16-c1
printf('Thus the capacitance of condensers is %3.2f
   microF \n ',c1)
```

Scilab code Exa 4.2 Finding capacitance

```
//Finding capacitance
//Example 4.2(pg 110)
clc
clear
n=9;
Ko=8.854*10^-12;
K=5;
A=12*10^-4;
d=2*10^-4;

C=(n-1)*Ko*K*A/d
printf('Thus the capacitance is %e F',C);
//The Answer in the Textbook has a calculation error
    , hence it doesn't match the answer here.
```

Scilab code Exa 4.3 Finding heat

```
//Finding heat
//Example 4.3(pg 110)
clc
clear
C=10^-6
V=10000
//here C is capacitance and V voltage
E=1/2*C*V^2
//E is the energy stored in the capacitor
// when the capacitor is discharged all this energy
    is dissipated as heat in the wire
H=E/4.2
//H is heat produced in calories since 4.2 Joules=1
    calorie
printf('Thus the heat produced is %3.4f calories',H)
```

Scilab code Exa 4.4 Finding flux density

```
//Finding electric flux density
//Example 4.4(pg 111)
clc
clear

A=0.02;//surface area of plates in meter square
d=0.001;//distance between the plates in meter
C=4.5*10^-10;//capacitance of the capacitor in farad
//for paralel plate condenser C=KoKA/d
Ko=8.854*10^-12;
//dielectric constant K is given by
K=(C*d)/(Ko*A)
V=15000;//volatage in volts
Q=C*V// charge on condenser in columb
D=Q/A// electric flux density in columb per meter
    square
printf('Thus the electric flux density is %e C/(m^2)
    ',D)
```

Scilab code Exa 4.5 Finding relative permeability

```
//Finding relative permittivity
//Example 4.5(pg 111)
clc
clear
//before inserting the second sheet
d=0.003;//distacne between plates in m^2
K1=6;// relative permittivity of air
Ko=8.854*10^-12;
// capacitance C1=Ko*K1*A/d in Farad
//after inserting the second sheet
d1=0.003;//thickness of first sheet in meter
d2=0.005;//thickness of second sheet in meter
```

```
//K2 is unknown
//C2=Ko*A/(d1/K1 + d2/K2)
// but given that C2=(1/3)*C1
//from equations 1,2,3
K2= (d2*K1)/(3*d-d1)
// since Ko*A/(d1/K1 + d2/K2)=Ko*K1*A/3*d
printf('Thus K2 is %3.4f',K2)
```

Scilab code Exa 4.6 Finding force

```
//Finding force
//Example 4.6(pg 113)
clc
clear
q1=1;// in coulomb
q2=1;// in coulomb
Eo=8.854*10^-12;// in Farad per meter
Er=1;
d=1// in meter
pi=3.14;
// F is the force between 2 charges in NEWTONS
F=(q1*q2)/(4*pi*Eo*Er*d^2)

printf('Thus the force between 2 charges is %e',F)
```

Scilab code Exa 4.7 Finding charge

```
//Finding charge
//Example 4.7(pg 114)
clc
clear
//q1=q2=q
pi=3.14;
```

```
d=0.2;// in meters
K=9*10^9;// here K=1/4*pi*Eo*Er constant
F=9.81*10^-1;// in newtons or 10^-1 kgm
q=sqrt((F*(d^2))/K)
printf('Thus charge is %e in coulomb',q)
```

Chapter 5

Dielectric Materials

Scilab code Exa 5.1 Charge and capacitance

```
//Finding charge and capacitance
//Example 5.1(pg 193)
clc
clear
t=0.25//time in sec
I=0.22//Current in A
V=220//voltage in V
Q=I*t//charge given to condenser
C=Q/V//capacitance of condenser
C1=C*(10^6)
printf('Charge given to condenser is %3.3f Coulombs
   \n',Q)
printf('Capacitance of condenser is %3.4f F',C)
printf('or %3.0f microF',C1)
```

Scilab code Exa 5.2 Charge and potential gradient

```
//Finding charge and potential gradient
```

```
//Example 5.2(pg 193)
clc
clear
C=0.0002*(10^-6)//capacitance in F
V=20000//P.D across condenser in V
t=2//thickness in mm
Q=C*V//charge on each plate in coulomb
g=(V/t)*(1/1000)// potential gradient in kV/mm
printf('Charge given to condenser is %e Coulombs \n'
    ,Q)
printf('Potential gradient of condenser is %3.0f kV/
    mm',g)
```

Scilab code Exa 5.3 Charge and energy

```
//Finding charge and energy
//Example 5.3(pg 194)
clc
clear
//Before immersion of oil
C=0.005*(10^-6)
V=500
q=C*V
E=(1/2)*(C*V*V)
printf('Charge of condenser is %e coulomb \n',q)
printf('Energy stored in condenser before immersion
    of oil is %e Joules \n',E)

//After immersion of oil
K=2.5
q1=q// since no loss of charge
C1=K*C//capacity of condenser
E1=(q1^2)/(2*C1)// energy stored in condenser
printf('Energy stored in condenser after immersion
    of oil is %e Joules',E1)
```

Scilab code Exa 5.4 K and flux density

```
//dielectric constant and flux density
//Example 5.4(pg 194)
clc
clear
A=0.02//surface area of plate in m^2
d=0.001//distance between plates in m
C=4.5*(10^-10)//capacitance in F
V=15000//voltage in volts
K0=8.854*(10^-12)
K=(C*d)/(K0*A)
q=C*V// charge on condenser in coulombs
D=q/A//Electric flux density in Coulomb/m^2
printf('Thus dielectric constant is %3.2f \n',K)
printf('Thus Electric flux density is %e Coulombs/m
    ^2',D)
```

Scilab code Exa 5.5 Finding capacitance

```
//Finding capacitance
//Example 5.5(pg 195)
clc
clear
A=0.2//surface area of plate in m^2
t=2.5*(10^-5)//thickness of dielectric in m
K0=8.854*(10^-12)//permittivity of air  in F/m
K=5//relative permittivity of dielectric
C=(K*K0*A*(10^6))/t//capacitance of condenser in
    microF
printf('Thus the Capacitance of condenser is %3.3f
    microF',C)
```

Chapter 6

Magnetic Materials

Scilab code Exa 6.1 Finding current

```
//Finding current
//Example 6.1(pg 212)
clc
clear
f=0.01//flux in Wb
l=1//mean circumference in m
N=1000//tunrs
Ur=1000//relative permeability
Uo=4*%pi*(10^-7)//permeability of free space in H/m
a=0.001// cross section area in m^2
I=(f*l)/(N*Uo*Ur*a)// current in Amp. since f=A*T/(l/Uo*Ur*a)
printf('Thus Current required is %3.3f Amp',I)
```

Scilab code Exa 6.2 Finding relative permeability

```
//relative permeability
//Example 6.2(pg 212)
```

```
clc
clear
f=1.2*(10^-3)//flux in Wb
l=1.4//mean circumference in m
N=500//tunrs
Uo=4*%pi*(10^-7)//permeability of free space in H/m
a=0.0012// cross section area in m^2
I=2//current in Amp
Ur=(f*l)/(N*I*Uo*a)//relative permeability
printf('Thus the relative permeability of iron is %3
    .2f ',Ur)
```

Scilab code Exa 6.3 Field intensity and permeability

```
//Flux density, field intensity and permeability
//Example 6.3(pg 213)
clc
clear
l=0.4//mean circumference in m
N=200//tunrs
Uo=4*%pi*(10^-7)//permeability of free space in H/m
a=5*(10^-4)// cross section area in m^2
I=6.4//current in Amp
f=0.8*(10^-3)//flux in Wb
fd=f/a//flux density in Wb/m^2
fi=I*N/l//Field intensity in AT/m
Ur=(f*l)/(N*I*Uo*a)//relative permeability
printf('(i) The Flux density is %3.2f Wb/m^2 \n',fd)
printf('(ii) The Field intensity is %3.2f AT/m \n',
    fi)
printf('(iii) The Relative permeability of steel is
    %3.2f ',Ur)
//The answer to part(iii) has a calculation error in
     the textbook, hence it doesn't match the answer
    here.
```

Scilab code Exa 6.4 Finding loss

```
//Finding loss
//Example 6.4(pg 214)
clc
clear
Hl=250//Hysteresis loss per m^3 in J/cycle
V=1/150//Volume of specimen in m^3
N=50//No of cycles/sec
E=Hl*V*N//Energy loss per sec in J
Eh=(E*3600)/1000//Energy loss per hour in kWh
printf('Thus Energy loss per hour is %3.2f kWh',Eh)
```

Scilab code Exa 6.5 Finding loss and frequency

```
//Finding loss and frequency
//Example 6.5(pg 214)
clc
clear
P=4//no of poles
N=1600// Speed in rpm
f=P*N/120//Frequency of magnetic reversal
V=5400//volume
d=7.5//density
m=(V*d)/1000//Mass of armature in kg
L=1.76//Loss in W/kg
Cl=L*m//Core loss in Watts
printf('Thus Frequency of magnetic reversal is %3.2f
    c/s',f)
printf('\n and Core loss is %3.2f Watts',Cl)
```

Scilab code Exa 6.6 Finding core loss

```
//Finding core loss
//Example 6.6(pg 214)
clc
clear
v=76300//volume in c.c
P=8// no of poles
N=375//rpm
f=P*N/120//freqency in c/s
Bmax=12000//max. flux density in lines/cm^2
n=0.002//(assumed)
d=7.8//densityin gm/c.c
l=1.7//loss in watts per kg
Hl=n*v*f*(Bmax^1.6)*(10^-7)//Hysteresis loss in Watts
Al=v*d*l/1000//Additional loss under particular running conditions
Tl=Hl+Al//total core loss
printf('Thus the total core loss is %4.0f Watts',Tl)
```

Scilab code Exa 6.7 Finding energy loss

```
//Finding energy loss
//Example 6.7(pg 215)
clc
clear
m=12000//mass in gm
d=7.5//density of iron in gm/c.c
Hl=3000//Hysteresis loss per cc in ergs/cycle
N=50//No of cycles per sec
v=m/d//volume of specimen
```

```
E=v*Hl*N//Energy loss per cc in ergs
Eh=E/(10^10)//Energy loss per hour in kWh
printf('Thus the Loss in energy is %3.3f kWh',Eh)
```

Scilab code Exa 6.8 Finding losses

```
//Finding losses
//Example 6.8(pg 215)
clc
clear
m=10//mass in kg
T1=20//total loss in watts
f1=50//frequency in c/s
T2=35//total loss in watts
f2=75//frequency in c/s
//both have same peak flux density
//total loss=hysteresis loss+ Eddy current loss
//all quantities except frequency are constant
//so Total loss=Af+Bf^2
//let c1 and c2 be constants such that total loss=c1
    *f + c2*f^2
c2=[T2-(T1*f2/f1)]/(f2^2-f1*f2)
c1=(T1-c2*f1^2)/f1
k=c1/c2//hysteresis loss/eddy current loss
H50=T1*k/101//hysteresis loss at 50 c/s
E50=T1-H50//eddy current loss at 50 c/s
printf('Thus hysteresis loss at 50 c/s is %3.1f
    Watts \n',H50)
printf('And Eddy current loss at 50c/s is %3.1f
    Watts',E50)
```

Chapter 15

Miscellaneous Solved Numerical Problems

Scilab code Exa 15.1 Voltage and energy loss

```
//consumer voltage and energy loss
//Example 15.1(pg 392)
clc
clear
R=0.2//total resistance of cable in ohms
I=200//current in A
t=100//time in hours
V=240//voltage in volts
c=0.8//cost of electrical energy in Rs per unit
V1=I*R//voltage drop in the cable
//(i)consumer voltage
Vc=V-V1
//(ii)Power loss in the cable
P=I*I*R//in watts
E=P*t/1000//energy loss in kWh
C=E*c//cost of energy loss in Rs.
printf('(i)Consumer voltage is %3.1f Volts \n',Vc)
printf('(ii)cost of energy loss is Rs %3.2f ',C)
```

Scilab code Exa 15.2 Resistance and BOT units

```
//Resistance and BOT units
//Example 15.2(pg 393)
clc
clear
Vi=220//voltage in volts supplied by dynamo
Vo=200//voltage in volts required for lighting
I=40//current in Amperes
Pi=Vi*I//power output of dynamo
Po=Vo*I//power consumed for lighting
L=Pi-Po//line losses
R=L/(I^2)//resistance of lines since line losses=I^2*R
t=10//time in hrs
N=(Po*t)/1000//no of units of consumed in B.O.T units
Nw=(L*t)/1000//No of units wasted in B.O.T units
printf('(i)Resistance of lines is %3.1f Ohms \n',R)
printf('(ii)No. of B.O.T units consumed in 10hrs is %3.2f B.O.T units\n',N)
printf('(iii)No. of B.O.T units wasted in 10hrs is %3.2f B.O.T units\n',Nw)
```

Scilab code Exa 15.3 Finding current

```
//Finding current
//Example 15.3(pg 393)
clc
clear
M=250000//weight of water lifted per hr in kg
h=50//height in metres
```

```
g=9.81//gravitational const.
WD=M*h*g//work done by pump per hr in watt-sec
P=WD/3600//Power output of pump per sec in watts
V=500//supply voltage in volts
Ep=0.8//efficiency of pump
Em=0.9//efficiency of motor
E=Em*Ep//overall efficiency
I=P/(V*E)//current in amperes
printf('Current drawn by the motor is %3.2f Amperes'
    ,I)
```

Scilab code Exa 15.4 Finding torque

```
//Finding torque
//Example 15.4(pg 394)
clc
clear
P=10//Power developed by motor in H.P
N=600//Speed of motor in rpm
//1HP=735.5Nw-m/sec=75kgm/sec
a=75
b=735.5
//Torque in kg-m
Tkgm=(P*a*60)/(2*%pi*N)//since P=2*pi*NT/60
//Torque in Nw-m
TNwm=(P*b*60)/(2*%pi*N)//since P=2*pi*NT/60
printf('(i)Torque in kg.meter is %3.2f kg-m \n',Tkgm
    )
printf('(ii)Torque in Newton.meter is %3.2f Nw-m',
    TNwm)
```

Scilab code Exa 15.5 Finding mass and energy

```
//finding mass and energy
//Example 15.5(pg 395)
clc
clear
P=25//Output of diesel engine in kW
s=12500//calorific value of fuel oil in k-cal/kgm
e=0.35//overall efficiency of diesel set
P1=P/e//input energy required in 1 hour in kWh
P2=P1*860//input energy in kcal
m=P2/s//mass of oil needed per hr in kgm
w=1000//weight of 1 ton of oil in kgm
Eg=(P*w)/m//Energy generated by 1ton of oil in kWh
printf('(i)Mass of oil required per hr is %3.3f kgm
   \n',m)
printf('(ii)Eletrical energy generated per ton of
   fuel is %4.1f Kwh',Eg)
```

Scilab code Exa 15.10 Finding resistance

```
//Finding resistance
//Example 15.10(pg 398)
clc
clear
rho=1.7*(10^-6)//resistivity of copper in ohm-cm
l=5//length in metres
t=0.005//thickness in m
D=0.08//external diameter in m
d=D-(2*t)//internal diameter in m
a=%pi*(D^2-d^2)/4//cross section area in cm^2
R=rho*l/a//resistance of copper tube in ohm
R1=R/(10^-4)//resistance in micro-ohm
printf('Thus the resistance of copper tube is %3.2f
   micro-ohm',R1)
```

Scilab code Exa 15.11 Conductivity and conductance

```
//Conductivity and conductance
//Example 15.11(pg 399)
clc
clear
rho=1.7*(10^-8)//resistivity in ohm-m
K=1/rho//conductivity in mho/m
a=0.125*(10^-4)//cross sectional area of cable in m
    ^2
l=2000//length of cable in meters
G=K*a/l//conductance
printf('Thus conductivity of cable is %e mho/metres
    \n',K)
printf('and conductance of cable is %3f mho',G)
```

Scilab code Exa 15.12 Finding resistivity

```
//Finding resistivity
//Example 15.12(pg 399)
clc
clear
V=0.05//volume in m^3
l=300//length in m
R=0.0306//resistance of conductor in ohm
rho=R*V/(l^2)//resistivity of conducting material
printf('Thus resistivity of conducting material is
    %e ohm-m',rho)
```

Scilab code Exa 15.13 Finding resistivity

```
//Finding resistivity
//Example 15.12(pg 399)
clc
clear
rho=0.67*(10^-6)//resistivity in ohm-inch
m=39.4//1meter = 39.4inch
m2=1525//1 meter2=1525 square inch
rhoc=rho*m/m2//resistivity of copper in ohm/m^3
rho1=rhoc/(10^-6)
printf('Thus resistivity of copper is %e ohm/m^3',
   rhoc)
printf('/n which is equal to %2.4f micro-ohm/m^3',
   rho1)
```

Scilab code Exa 15.14 Finding resistance

```
//Finding resistance
//Example 15.14(pg. 400)
clc
clear
R1=0.12//old conductor resistance in ohm
d1=15//diameter of old conductor in cm
d2=0.4*d1//diameter of new conductor in cm
a1=%pi*(d1^2)/4//area of cross section of old
   conductor
a2=%pi*(d2^2)/4//area of cross section of new
   conductor
//R=rho*l/a=rho*V/a^2
//Henec R is proportional to 1/a^2
R2=R1*((a1/a2)^2)//resistance of new conductor
printf('Thus resistance of new conductor is %2.4f
   ohm',R2)
```

Scilab code Exa 15.15 Finding resistance

```
//Finding resistance
//Example 15.15(pg. 401)
clc
clear
lab=10//la=10*lb ratio of length of A to length of B
    .
Aab=1/2//Aa=1/2*Ab ratio of area of A to area of B
RHOab=1/2//RHOa=2*RHOb ratio of resistivity of A to
    resistivity of B
Ra=2//resistance of A in ohm
Rb=(Ra*Aab)/(lab*RHOab)//resistance of B in ohm
//Since Ra=RHOa*la/Aa and Rb=RHOb*lb/Ab so from
    ratio of two we get Rb
printf('Thus resistance of resistor B is %2.2f ohm',
    Rb)
```

Scilab code Exa 15.16 Finding resistance

```
//Finding resistance
//Example 15.16(pg. 402)
clc
clear
RHOo=10.3*(10^-6)//resistivity of platinum wire at 0
    degree in ohm-cm
d=0.0074//diameter of platinum wire
a=%pi*(d^2)/4//area of cross section of platinum
    wire in sq cm
Ro=4//resistance of wire in ohm
l=Ro*a/RHOo//length of wire in cm
alphao=0.0038
```

```
t=100//temp in degree C
R100=Ro*(1+(alphao*t))
printf('Thus length of wire required is %3.2f cms\n'
    ,l)
printf('and Resistance of wire at 100 degreeC is %2
    .2f ohms',R100)
```

Scilab code Exa 15.17 Finding resistance

```
//Finding resistance
//Example 15.17(pg. 403)
clc
clear
Ra=1//resistance of A in ohm
lab=20//ratio of length of A to length of B
Aab=1/3//ratio of area of A to area of B
//resistivity is same for both wires
Rb=Ra*(Aab/lab)//resistance of wire B in ohm
//since Ra=rho*la/Aa and Rb=rho*lb/Ab so from ratio
    of both we get Rb
printf('Thus resistance of wire B is %2.4f omhs',Rb)
```

Scilab code Exa 15.19 Finding potential difference

```
//Finding potential difference
//Example 15.19(pg. 405)
clc
clear
I1=2/(2+3)//current across 2V battery in circuit EBD
    in A
Vbe=3*I1//voltage dropp across BE in V
I2=4/(5+3)//current across 4V battery in circuit AFC
    in A
```

```
Vaf=3*I2//voltage dropp across AF in V
V=Vbe+4-Vaf//sum of potential drops starting from E
    and ending at F
//V is the P.D. between E and F
printf('Thus the P.D. between E and F is %2.1f Volts
    ',V)
```

Scilab code Exa 15.20 Finding current

```
//Finding current
//Example 15.20(pg. 405)
clc
clear
//Let current in XA=I, in XY=I1, in AY=I-40, in YB=I
    -40+I1-60, in BX=I+I1-150.
//By Kirchhoff's second law, in circuit XAYA I-I1=20
// and in circuit XAYBX 25I+15I1=1950
I1=(1950-500)/(15+25)//in Amperes
printf('Thus the current in branch XY is I1=%2.2f
    Amps',I1)
```

Scilab code Exa 15.21 Finding loss

```
//Finding loss
//Example 15.21(pg. 407)
clc
clear
A=30//area of hysteresis material in cm^2
s1=0.4//scale is 1cm=0.4Wb/m^2
s2=400// and 1cm=400AT/m
V=1.2*(10^-3)
f=50//frequency in Hz
H=A*s1*s2//hysteresis loss/m^3/cycle in joules
```

```
Hp=H*V*f//hysteresis power loss in Watts
printf('Thus hysteresis power loss is %3.2f Watts',
   Hp)
```

Scilab code Exa 15.22 Finding energy loss

```
//Finding energy loss
//Example 15.22(pg. 407)
clc
clear
d=7500//density of iron in kg/m^3
w=12//weight of iron in kgm
V=w/d//volume of iron in m^3
f=25//frequency in Hz
N=3600*f//number of cycle per hour
A=300//area in joules/m^3
E=A*V*N//Total energy loss per hour in joules
printf('Thus total energy loss per hour is %5.2f
   Joules',E)
```

Scilab code Exa 15.23 Finding inductance and energy

```
//Finding inductance and energy
//Example 15.23(pg. 407)
clc
clear
l=0.5//length of coil in meters
d=0.1//diameter of coil
N=1500//no of turns of coil
a=%pi*(d^2)/4//cross sectional area of coil in m^2
Ur=1//relative permeability
Uo=4*%pi*(10^-7)//permeability
I=8//current in A
```

```
L=((N^2)*a*Uo*Ur)/l//self inductance of coil in H
E=(1/2)*L*(I^2)//Energy stored in Joules
printf('Thus Self Inductance of coil is %2.3f H\n',L
    )
printf('and Energy stored is %1.2f Joules',E)
```

Scilab code Exa 15.24 Flux and field strength

```
//Finding flux and field strength
//Example 15.24(pg. 408)
clc
clear
N=600//number of turns on the coil
I=2//current passing through solenoid in A
l=0.6//length of solenoid in meter
H=N*I/l//magnetic field at the centre in AT/m
Ur=1//relative permeability
Uo=4*%pi*(10^-7)//permeability
d=0.025//diameter in meters
a=%pi*(d^2)/4//cross sectional area of coil in m^2
phi=Uo*Ur*H*a//flux in Wb
printf('Thus Magenetic field at centre is %3.2f AT/m
    ',H)
printf('\n and Flux is %e Wb',phi)
```

Scilab code Exa 15.25 Finding AmpereTurns

```
//Finding Ampere-Turns
//Example 15.25(pg. 408)
clc
clear
Ur=1//relative permeability
B=1.257//flux density in Wb/m^2
```

```
Uo=4*%pi*(10^-7)//permeability
H=B/(Uo*Ur)//magnetising force in AT/m
l=0.004//length of air gap in meter
AT=H*l//AT required for the air gap
printf('Thus AT required for the air gap is %3.1f ',
   AT)
```

Scilab code Exa 15.26 Finding flux

```
//Finding flux
//Example 15.26(pg. 409)
clc
clear
D=0.3//diameter of anchor ring in m
l=%pi*D//length of iron ring in m
N=400//number of turns on the iron ring
a=0.0012//area of cross section of iron path in m^2
Ur=1000//relative permeability
Uo=4*%pi*(10^-7)//permeability
I=2//current in A
phi=(N*I)/(l/(Uo*Ur*a))//flux through iron path in
   WB
phi1=phi/(10^-3)//flux in mWb
printf('Thus flux through iron path is %2.2f mWb',
   phi1)
```

Scilab code Exa 15.27 Finding magnetising current

```
//Finding magnetising current
//Example 15.27(pg. 409)
clc
clear
a=0.01//crosssectional area of ring in m^2
```

```
Uo=4*(%pi)*(10^-7)//absolute permeability
lf=1.25//leakage factor
Ur=400//permeability
N=175//no of turns
phig=0.8*(10^-3)//flux through air gap in Wb
Bg=phig/a//Flux density in air gap in Wb/m^2
Hg=Bg/Uo//magnetising force in air gap in AT/m
Lg=0.004//length of air gap in m
ATg=Hg*Lg//AT required for air gap in AT
phii=phig*lf//flux through iron path in Wb
Bi=phii/a//Flux density in iron path in Wb/m^2
Hi=Bi/(Uo*Ur)//magnetising force in iron path in AT/
   m
Li=1.5//length of iron path in m
ATi=Hi*Li//At required for iron path in AT
AT=ATi+ATg//total AT required
I=ATg/N//Magnetising current required in A
printf('Thus the magnetising current required is %2
   .2f Amps',I)
```

Scilab code Exa 15.28 Finding charge and capacity

```
//Finding charge and capacity
//Example 15.28(pg. 411)
clc
clear
SI=0.2//steady current in A
t=0.2//time in sec
Q=SI*t//charge given to condenser in Coulomb
V=220//PD across condenser in Volts
C=Q/V//Capacitance of condenser in F
C1=C*(10^6)//Capacitance in mircoF
printf('Thus the Charge of condenser is %2.2f
   Coulomb\n',Q)
printf('And the Capacitance of condenser is %3.2f
```

```
microF',C1)
```

Scilab code Exa 15.29 Finding heat

```
//Finding heat
//Example 15.29(pg. 411)
clc
clear
C=2*(10^-6)//capacitance of condenser in F
V=10000//PD across condenser in Volts
E=(1/2)*C*(V^2)//energy stored in condenser in
    Joules
H=E/4.2//heat produced in the wire in calories
printf('Thus heat produced in the wire is %2.2f
    calories',H)
```

Scilab code Exa 15.30 Finding K and flux density

```
//Finding K and flux density
//Example 15.30(pg. 411)
clc
clear
V=15*(10^3)//potential difference applied in V
A=0.02//surface area of plate in m^2
d=0.001//distance between plates in m
C=4.5*(10^-10)//Capacitance of capacitor in F
Ko=8.854*(10^-12)//constant
K=(C*d)/(Ko*A)//dielectric constant
q=C*V//charge on condenser in C
D=q/A//Electric flux density in C/m^2
printf('Thus the Charge of condenser is %e Coulomb\n
    ',q)
```

```
printf('And the electric flux density of condenser
    is %e microF',D)
```

Scilab code Exa 15.31 Finding resistance

```
//Finding resistance
//Example 15.31(pg. 412)
clc
clear
m=0.6//mass of water in kgm
S=4200//specific heat of water
T1=100//temperature in degreeC
T2=10//temperature in degreeC
t=5*60//time in sec
V=230//Supply voltage in Volts
H=m*S*(T1-T2)//Heat required to raise the temp of
    water from 0 to 100 degree. in J
e=0.78//efficiency of kettle
Ei=H/e//Energy input in Joules
Ei1=Ei/(100*3600)//Energy input in kWh
W=Ei/t//Rating of kettle in watts
R=(V*V)/W//Resistance of heating element in ohms
printf('Thus Resistance of heating element is %2.1f
    ohms',R)
```

Scilab code Exa 15.32 Finding time

```
//Finding time
//Example 15.32(pg. 413)
clc
clear
m1=120//mass of water to be heated in kg
m2=20//mass of copper tank in kg
```

```
S1=1//specific heat of water
S2=0.095//specific heat of copper
T1=10//temp in degreeC
T2=60//temp in degreeC
H=(m1*S1*(T2-T1))+(m2*S2*(T2-T1))//heat required to raise the temp of water  and tank in kcal
H1=H*4200//heat required in Joules
e=0.8//thermal efficiency
E=H1/e//Energy input in joules
E1=E/(1000*3600)//energy input in kWh
r=3//rating of heater in kW
t=E1/r//time taken in hours
printf('Thus the time taken to raise the temp is %2.3f hours',t)
```

Scilab code Exa 15.33 Finding frequency

```
//Finding frequency
//Example 15.33(pg. 414)
clc
clear
rho=5*(10^-5)//specific resistance for steel in ohm-cm
U=1//relative permeability
d=0.15//depth of penetration in cm
f=(rho*(10^9))/(U*d*d*4*(%pi^2))//frequency required in cycles per sec
f1=f/1000//frquency in k.cycles/sec
printf('Thus the frequency required is %3.3f k.cycles/sec',f1)
```

Scilab code Exa 15.34 Current Voltage and power

```
//Finding current,voltage and power
//Example 15.34(pg. 414)
clc
clear
v=50*20*2//Volume of board to be heated in cm^3
Mw=0.56//weight of wood in gm/cm^3
m=Mw*v/1000//mass of wood in kgm
S=0.35//specific heat of wood
t=15/60//time in hrs
f=30*(10^6)//frequency in cycles/sec
t2=150,t1=30//temp in degreeC
H=m*S*(t2-t1)//heat required to raise the temp in
    kcal
Hw=H*1000/860//heat required in kW
P=Hw/t//power required in Watts
e=0.5//efficiency of dielectric heating process
Pi=P/e//power input required in Watts
Ko=8.854*(10^-12)//absolute permittivity
K=5//relative permittivity
A=0.5*0.2//area in m
i=0.02
C=Ko*K*A/i//capacitance of parallel plate capacitor
    in F
Xc=1/(2*%pi*f*C)//capacitive reactance in ohms
cosx=0.05
tanx=19.97
R=Xc*tanx//resistance
V=sqrt(Pi*R)//voltage in volts
Ic=V/Xc//current through the board in Amps
printf('Thus the power required is %2.1f Watts\n',Pi
    )
printf('And Voltage across the board is %3.2f volts\
    n',V)
printf('And the current through the board is %2.3f
    Amps',Ic)
```

Scilab code Exa 15.35 Finding efficiency

```
//Finding efficiency
//Example 15.35(pg. 416)
clc
clear
m=2//quantity of aluminium to be melted in kg
t1=15,t2=660//temp in degreeC
S=0.212//specific heat of aluminium
L=78.8//latent heat of aluminium in kcal/kg
H=(m*S*(t2-t1))+(m*L)//total heat required to melt
    Al in kcal
i=5//input to furnace in kW
E=i*(1000*10*60)//Energy input to furnace in watt-
    sec
E1=E/4180//energy input in kcal
e=H*100/E1//efficiency of furnace
printf('Thus the efficiency of furnace is %2.3f
    percent',e)
```

Scilab code Exa 15.36 Finding cost

```
//Finding cost
//Example 15.36(pg. 417)
clc
clear
O=5*735.5//output of motor in W
e=0.85//efficiency of motor
c=2//cost of energy per unit in Rs
I=O/e//input of motor in Watts
t=4//time in hrs
E=I*t/1000//energy consumed in kWh
```

```
C=c*E//cost of using the motor in Rs
printf('Thus the cost of using the motor is %2.3f Rs
    ',C)
```

Scilab code Exa 15.37 Finding no of electrons

```
//Finding no of electrons
//Example 15.37(pg. 417)
clc
clear
I=2.5*(10^-3)//current in Amp
t=30*(10^-3)//time in sec
Q=I*t//charge passing through the person in Coulumbs
e=1.602*(10^-19)//charge of 1 electron in C
N=Q/e//no of electrons passing through the person
printf('Thus the no of electrons passing through the
    person is %e electrons',N)
```

Scilab code Exa 15.38 Finding resistance

```
//Finding resistance
//Example 15.38(pg. 417)
clc
clear
//(a)Finding resistance between 2 ends
l=1//length in m
a=2.5*(10^-2)*0.05*(10^-2)//area of cross section in
    m^2
rho=1.724*(10^-8)//specific resistance of copper in
    ohm-m
R=rho*l/a//resistance of the strip in ohm
//(b) Finding resistance between 2 faces
l1=0.05*(10^-2)//length in m
```

```
a1=2.5*(10^-2)*1//area of cross section in m^2
R1=rho*l1/a1//resistance in ohm
printf('Thus the resistance of the strip is %e ohms\
   n ',R)
printf('And the resistance between the faces is %e
   ohms',R1)
```

Scilab code Exa 15.39 Resistance and cost

```
//Finding resistance and cost
//Example 15.39(pg. 418)
clc
clear
m=2//weight of water to be heated in kg
t2=98,t1=15//temp in degreeC
s=1//specific heat of water
V=200//voltage in volts
H=m*s*(t2-t1)//energy required to raise the temp of
   water in kcal
H1=H*4200//energy in Watt-sec or Joules
e=0.85//efficiency of kettle
E=H1/e//energy input required in watt-sec
E1=E/(1000*3600)//energy input in kWh
c=35//cost per unit in paise
C=c*E1//ocst of energy used in paise
t=10/60//time in hrs
W=E1*1000/t//wattage of kettle in watts
R=V*V/W//resistance of heating element in ohms
printf('Thus the resistance of heating element is %2
   .0f ohms\n',R)
printf('And the cost of energy used is %2.0f paisa',
   C)
```

Scilab code Exa 15.40 Finding current

```
//Finding current
//Example 15.40(pg. 418)
clc
clear
phi=70000/(10^8)//flux to be set up in Wb since 10^8
   lines =1Wb
d=0.03//diameter in m
a=%pi*d*d/4//area of cross section in m^2
B=phi/a//flux density in Wb/m^2
Lg=0.002//length of air gap in m
Ls=(%pi*0.2)-Lg//length of steel path
Uo=4*%pi*(10^-7)//absolute permitivity
Ur=800//relative permitivity of steel
Hg=B/Uo
Hs=B/(Uo*Ur)
AT=(Hg*Lg)+(Hs*Ls)//total ampere turns required
N=500// no of turns
I=AT/N//exciting current in amps
printf('Thus the value of exciting current is %2.3f
   A',I)
```