Scilab Textbook Companion for Electrical Measurements Measuring Instruments
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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: Electrical Measurements Measuring Instruments

Author: K. Shinghal

Publisher: Pragati Prakashan Merruth

Edition: 1

Year: 2002

ISBN: 81-7556-393-1

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Philosophy of Measurement

Scilab code Exa 1.1 arithmetic mean average deviation standard deviation and probable error

```
//Example 1.1://ARITHEMATIC MEAN,AVERAGE DEVIATION ,
   STANDARD DEVIATION AND PROBABLE ERROR
clc;
clear;
T=[99.7,99.8,99.9,100,100.1,100.2,100.3];//VOLTS
f=[2,8,20,40,21,6,3];//frequency of occurence
q=[T(1)*f(1),T(2)*f(2),T(3)*f(3),T(4)*f(4),T(5)*f(5)
    ,T(6)*f(6),T(7)*f(7)];//
AM=(q(1)+q(2)+q(3)+q(4)+q(5)+q(6)+q(7))/100;//
    arithematic mean in mm
for i= 1:7
    qb(i)= T(i)-AM;
end
Q= [qb(1),qb(2),qb(3),qb(4),qb(5),qb(6),qb(7)];//
AV=(-qb(1)*f(1)-qb(2)*f(2)-qb(3)*f(3)-qb(4)*f(4)+qb
    (5)*f(5)+qb(6)*f(6)+qb(7)*f(7))/100;//
SD=sqrt(((qb(1)^2*f(1))+(qb(2)^2*f(2))+(qb(3)^2*f(3)
    )+(qb(4)^2*f(4))+(qb(5)^2*f(5))+(qb(6)^2*f(6))+(
    qb(7)^2*f(7)))/100);//standard deviation
r1= 0.6745*SD;//PROBABLE ERROR OF ONE READING
```

```
disp(AM,"arithmetic mean is ,(V)=")
disp(AV,"average deviation is ,(V)=")
disp(SD,"standard deviation is ,(V)=")
disp(r1,"probable error is ,(V)=")
```

Scilab code Exa 1.2 apparent value of resistance and gross error

```
//Example 1.2://APPRABET RESISTANCE AND PERCENTAGE
   GROSS ERROR
clc;
clear;
close;
disp("when current reading is 5mA")
vr=100;//voltmeter reading
ir=5;//mA
rt=vr/(ir);//in kilo ohms
disp(rt,"apparent resistance in kilo ohms is")
vm=150;//range of voltmeter
s=1;//kilo ohms per volts sensivity
rv=s*vm;//kilo ohms
rx=((rt*rv)/(rv-rt));//kilo ohms
ge=((rx-rt)/rx)*100;//percentage gross error
disp(ge,"percentage gross error is")
disp("when current reading is 50mA")
vr=100;//voltmeter reading
ir1=50;//mA
rt1=vr/(ir1);//in kilo ohms
disp(rt1,"apparent resistance in kilo ohms is")
vm=150;//range of voltmeter
s=1;//kilo ohms per volts sensivity
rv=s*vm;//kilo ohms
rx1=((rt1*rv)/(rv-rt1));//kilo ohms
ge1=((rx1-rt1)/rx1)*100;//percentage gross error
disp(ge1,"percentage gross error is")
```

Scilab code Exa 1.3 limiting error

```
//Example 1.3://limiting error
clc;
clear;
close;
fs=1.5;//full scale in percentage
vr=500;//voltmeter reading
ea=(fs/100)*vr;//volts
le=150;//limiting error voltage
lep=((ea/le)*100);//limiting error
disp(lep,"limiting error at 150 V is ,(%)=")
```

Scilab code Exa 1.4 arithematic mean average deviation standard deviation and varaiance

```
//Example 1.4://ARITHEMATIC MEAN,AVERAGE DEVIATION ,
    STANDARD DEVIATION AND PROBABLE ERROR
clc;
clear;
T=[99.7,99.8,100,100.2,100.3];//VOLTS
q=[T(1),T(2),T(3),T(4),T(5)];//
AM=(q(1)+q(2)+q(3)+q(4)+q(5))/5;//arithematic mean
    in mm
for i= 1:5
    qb(i)= T(i)-AM;
end
Q= [qb(1),qb(2),qb(3),qb(4),qb(5)];//
AV=(-qb(1)-qb(2)-qb(3)+qb(4)+qb(5))/5;//
SD=sqrt(((qb(1)^2)+(qb(2)^2)+(qb(3)^2)+(qb(4)^2)+(qb
    (5)^2))/5);//standard deviation
V=SD^2;//
```

```
disp(AM,"arithmetic mean is , (V)=")
disp(AV,"average deviation is , (V)=")
disp(SD,"standard deviation is , (V)=")
disp(V,"Variance is ,(V)=")
```

Scilab code Exa 1.5 power and error

```
//Example 1.5://error
clc;
clear;
close;
i=8.2;//in amperes
r=20;//ohms
p=i^2*r;//watts
nd=100;//divisions
ra=10;//range in amperes
rd1=ra/nd;//reading of one division
d=0.5;//divisions
per=((d*rd1)/i)*100;//possible ameter rwading error
amcr=1;//ammemeter constant error
ter=amcr+per;//total ammeter error
crr=-0.2;//construction error
ep=(((2*ter)+crr)/nd)*p;//
disp(p,"power is ,(W)=")
disp(ep,"error in power is ,(W)=")
```

Scilab code Exa 1.6 arithematic mean

```
//Example 1.6://ARITHEMATIC MEAN
clc;
clear;
T=[99.7,99.8,99.9,100,100.1,100.2,100.3];//VOLTS
f=[2,8,20,40,21,6,3];//frequency of occurence
```

```
for i=1:7
    qb(i)=T(i)-T(6);
end
prdtc=[(qb(1)*f(1))+(qb(2)*f(2))+(qb(3)*f(3))+(qb(4)
    *f(4))+(qb(5)*f(5))+(qb(6)*f(6))+(qb(7)*f(7))]
am=T(6)+(prdtc/100);//arithemetic mean
disp(am,"arithmetic mean is ,(V)=")
```

Scilab code Exa 1.7 limiting error

```
//Example 1.7:// limiting error
clc;
clear;
close;
fse=1;//full scale deflection
vr=150;//range in volts
ev=(fse/100)*vr;//voltas
v1=100;//volts
le100=((ev)/v1)*100;//in percentage
ve=100;//range in mA
ee=(fse/100)*ve;//mA
e1=55;//mA
le50=((ee/e1)*100);//in percentage
ler=le100+le50;//
disp(ler,"limiting error for power is , (%)=")
```

Scilab code Exa 1.8 volume and error in volume

```
//Example 1.8:// error
clc;
clear;
close;
fse=1;//full scale deflection
```

```
e=0.60;//meters
v=(e)^3;//volume in m^3
ev=3*fse;//error in volume
evv=(ev/100)*v;//
disp(v,"volume is,(m^3)=")
disp(ev,"percentage error in volume is,(%)=")
disp(evv,"error in volume is,(m^3)=")
```

Scilab code Exa 1.9 current and error in current

```
//Example 1.9://error
clc;
clear;
close;
v=95;//volts
r=40;//ohms
i=v/r;//amperes
err=-0.2;//error in resistance
err1=(err/r)*100;//percentage error
evv=0.95;//error in voltage
evv1=(evv/v)*100;//percentage error
x=evv1-err1;//
ei=(x/100)*i;//
disp(i,"current in the circuit is,(A)=")
disp(ei,"error in current is,(A)=")
disp(x,"percentage error in current is,(%)=")
```

Scilab code Exa 1.10 resistance and error

```
//Example 1.10://MAGNITUDE AND LIMITING ERROR
clc;
clear;
close;
```

```
disp("parralel resistance case")
r1=40;//ohms
er1=5;//percentage error
r2=80;//ohms
er2=5;//percentage error
r3=50;//ohms
er3=5;//percentage error
rp=((r1*r2*r3)/(r1*r2+r2*r3+r3*r1));//ohms
Y=(r1*r2+r2*r3+r3*r1);//ohms
ex=er1+er2+er3;//percentage error
ey1=er1+er2;//
ey2=er2+er3;//
ey3=er3+er1;//
y=(((r1*r2*ey1)/Y)+((r2*r3*ey2)/Y)+((r3*r1*ey3)/Y));//error
mer=(y+ex)*rp;//
disp(rp,"magnitude of resistance in ohms is")
disp(mer/100,"limiting error in ohms is")
disp((y+ex),"percentage error (%)")
disp("series resistance case")
rs=r1+r2+r3;//ohms
er=(((r1/rs)*er1)+((r2/rs)*er2)+((r3/rs)*er3));//
mer1=(er/100)*rs;//ohms
disp(rs,"magnitude of resistance in ohms is")
disp(er,"percentage error (%)")
disp(mer1,"limiting error in ohms is")
```

Scilab code Exa 1.11 resistance and error

```
//Example 1.11://MAGNITUDE AND LIMITING ERROR
clc;
clear;
close;
r1=50;//ohms
er1=0.5;//percentage error
```

```
r2=100;//ohms
er2=0.5;//percentage error
r3=75.5;//ohms
er3=0.5;//percentage error
x=((r2/r1)*r3);//ohms
eps=er1+er2;//
erpsq=eps-er3;//when error in both (PS) and (Q) is
    positive
erpsq1=eps+er3;//when error in (PS) is positive and
    (Q) is negetive
oer1=(erpsq/100)*x;//ohms
oer2=(erpsq1/100)*x;//ohms
disp(x,"magintude in ohm is")
disp(erpsq,"percentage error when error in both (PS)
    and (Q) is positive (%)")
disp(oer1,"error in ohms when error in both (PS) and
    (Q) is positive")
disp(erpsq1,"percentage error when error in (PS) is
    positive and (Q) is negetive (%) ")
disp(oer2,"error in ohms when error in (PS) is
    positive and (Q) is negetive")
```

Chapter 2

Analog Measurement of Electrical Quantities

Scilab code Exa 2.1 power and error

```
//Example 2.1://wattmeetr reading and error
clc;
clear;
close;
disp("for Ist method")
v=50;//volts
i=20;//amperes
pf=0.8;//power factor
pl=v*i*pf;//true power
vc=(50*pf)+%i*v*sqrt(1-pf^2);//complex form
ic=i+%i*0;//
r1=0.01;//ohms
vpl=vc+(i*r1);//voltage across pressure coil
wrlc1=real(vpl)*real(ic);//
er=(wrlc1-pl)/(pl);//
disp(wrlc1,"wattmeter reading is,(W)=")
disp(er*100,"percentage error is high (%)")
disp("for 2nd method")
r2=1000;//ohms
```

```
ic1=ic+(vc/r2);//
wrlc2=real(vc)*real(ic1)+imag(vc)*imag(ic1);//
er1=(wrlc2-pl)/(pl);//
disp(wrlc2,"wattmeter reading ,(W)=")
disp(er1*100,"percentage error is high (%)")
```

Scilab code Exa 2.2 inductance

```
//Example 2.2:// self inductance
clc;
clear;
close;
c=20;//pF
rs=10000;//ohms
l=(c*10^-12)*rs^2;//henry
disp(l*10^3,"self inductance in mH")
```

Scilab code Exa 2.3 percentage error

```
//Example 2.3:// percentage error
clc;
clear;
close;
v=100;// volts
i=10;// amperes
pf=0.45;//power factor
tp=v*i*pf;// true power in watts
f=50;//Hz
l=25;//mH
r=4000;//ohms
b=atan((2*%pi*f*l*10^-3)/r);//phase angle in radians
e=v*i*tan(b)*sqrt(1-pf^2);//
per=(e*100)/(tp);//
```

```
disp(per,"percentage error is (%)")
```

Scilab code Exa 2.4 true power

```
//Example 2.4://true power
clc;
clear;
close;
ph=45;//degree
th=90;//radians
del=-45;//radians
f=50;//Hz
l=15;//mH
r=300;//ohms
b=atan((2*%pi*f*l*10^-3)/r);//in radians
k=((cosd(ph))/(cos(b)*cosd(42)));//
nr=20;//nomianl ratio
e=-0.3;//
er=(e*nr)/100;//
ar1=nr-er;//actual ratio
nr1=100;//nomianl ratio
e1=0.9;//
er1=(e1*nr1)/100;//
ar2=nr1-er1;//actual ratio
p=450;//watts
tp=ar1*ar2*k*p;//
disp(tp*10^-3,"true power in kW is")
//answer is wrong in the textbook
```

Scilab code Exa 2.5 torque

```
//Example 2.5://torque
clc;
```

```
clear;
close;
d=2.5;//diameter in cm
n=500;//turns
b=1.1;//mWb/m^2
v=100;//volts
pf=0.7;//power factor
rp=2000;//ohms
x=((%pi*(d*10^-2)^2*n*b*10^-3*v*pf)/(4*rp));//
ang1=45;//degree
ang2=90;//degree
td1=x*sind(ang1);//
disp(td1,"torque in Nm when angle is 45 degree")
td2=x*sind(ang2);//
disp(td2,"torque in Nm when angle is 90 degree")
```

Scilab code Exa 2.6 resistance

```
//Example 2.6:// resistance
clc;
clear;
close;
la=4.78;//henry
ra=298;//ohms
lb=3;//henry
rb=190;//ohms
v=200;//volts
r=((la*100*lb*100*%pi^2)-(ra*rb))/(rb+ra);//ohm
disp(r,"unknown resistance is ,(ohm)=")
//answer is wrong in the textbook
```

Scilab code Exa 2.7 resistance

```
//Example 2.7://resistance
clc;
clear;
close;
i=20;//amperes
v=100;//volts
pf=1;//power factor
p=v*i*pf;//watts
rp=5500;//ohms
th=150;//angle
kd=((rp*th)/p);//constant
wd=20;//watts per degree
rp1=wd*kd;//in ohms
adr=rp1-rp;//
disp(adr,"addition resistance in ohm is")
```

Scilab code Exa 2.8 parameters

```
//Example 2.8://resistance,impedance,power,power
    factor ,voltage and power factor
clc;
clear;
close;
v=300;//volts
i2=2.5;//amperes
r=v/i2;//ohms
disp(r,"resistance in ohm is")
i3=4;//amperes
zl=v/i3;//ohms
disp(zl,"load impedance in ohm is")
v=300;//volts
i2=2.5;//amperes
r=v/i2;//ohms
i1=5.6;//amperes
z=v/i1;//ohms
```

```
disp(z,"impedance of combination in ohm is")
i3=4;//amperes
pl=((i1^2-i2^2-i3^2)*r)/2;//in watts
disp(pl,"power absorbed by the load in W is")
pl=((i1^2-i2^2-i3^2)*r)/2;//in watts
pfl=((i1^2-i2^2-i3^2)/(2*i2*i3));//power factor
disp(pfl,"power factor of the load is")
pr=i2^2*r;//in watts
tps=pl+pr;//in watts
disp(tps,"total power supply  is ,(W)=")
tps=pl+pr;//in watts
tpf=tps/(v*i1);//power factor
disp(tpf,"total power factor is")
```

Scilab code Exa 2.9 wattmeter reading

```
//Example 2.9://wattmeter reading
clc;
clear;
close;
v=24;//volts
r1=6;//ohms
i=v/r1;//in amperes
t=0;0.005
vm=100;//volts
t0=0;//
t1=(1/100);//
f=50;//Hz
z=2*%pi*f;//
x=integrate('sin(z*t)','t',t0,(t1/2));//
p=vm*(1/t1)*i*x;//
disp(p,"average power to be read by wattmeter is,(W)
    =")
```

Scilab code Exa 2.10 impedance power and power factor

```
//Example 2.10://load impedance and combination
   impedance
clc;
clear;
close;

v3=80;//volts
i=4;//amperes
zl=v3/i;//ohms
v1=140;//volts
z=v1/i;//ohms
disp(zl,"load impedance in ohm is")
disp(z,"impedance of combination in ohm is")
v2=75;//volts (it is given 72 in the textbook)
r=v2/i;//
pl=((v1^2-v2^2-v3^2)/(2*r));//watts
pr=i^2*r;//watts
disp(pl,"power absorbed by the load is,(W)=")
disp(pr,"power absorbed by the non inductive
   resistor is,(W)=")
pfl=((v1^2-v2^2-v3^2)/(2*v2*v3));//power factor of
   the load
tp=pr+pl;//total power in watts
pfc=tp/(v1*i);//power factor
format('v',5)
disp(pfl,"power factor of load is")
format('v',4)
disp(pfc,"power factor of the whole circuit is")
```

Scilab code Exa 2.11 wattmeter reading

```
//Example 2.11:// wattmeters readings
clc;
clear;
close;
pf=0.8;//
td=(sqrt(1-pf^2))/pf;//
sr=300;//kW
df=(sr/sqrt(3))*td;//
w2=(sr+df)/2;//
w1=sr-w2;//
disp(round(w1),"wattmeter (W1) reading in kW is")
disp(round(w2),"wattmeter (W2) reading in kW is")
```

Scilab code Exa 2.12 power factor and capacitance

```
//Example 2.12:// power factor and capacitance
clc;
clear;
close;
w1=-2000;//watts
w2=4000;//watts
ph=atand((sqrt(3)*(w2-w1))/(w2+w1));//in degree
pf=cosd(ph);//
disp(pf,"power factor of the system is")
w=w1+w2;//total power
v=400;//volts
vp=(v/sqrt(3));//phase voltage
pp=w/3;//power per phase
pi=(pp)/(vp*pf);//phase current
pim=vp/pi;//phase impedance
rip=pim*pf;//resistance each phase
rep=(sqrt(pim^2-rip^2));//reactance of each phase
pfn=0.5;//power factor
pimb=rip/pfn;//impedance per phase
repn=(sqrt(pimb^2-rip^2));//reactance per phase
```

```
cp=rep-repn;//capacitive reactance
f=50;//Hz
f=50;//Hz
c=((1/(2*%pi*f*cp)));//
disp(round(c*10^6),"capacitance is,(micro-F)=")
```

Scilab code Exa 2.13 power factor

```
//Example 2.13://power factor and line current
clc;
clear;
close;
x=1;//
w2=2*x;//
w1=x;//
ph=atand((sqrt(3)*(w2-w1))/(w2+w1));//in degree
pf=cosd(ph);//power factor
disp(pf,"power factor is")
w=50;//kW
v=400;//volts
il=((w/(sqrt(3)*v*pf))*10^3;//in amperes
disp(il,"line current is,(A)=")
```

Scilab code Exa 2.14 power and power factor

```
//Example 2.14://total power and power factor
clc;
clear;
close;
disp("when both readings are positive")
w2=2300;//watts
w1=4600;//watts
p1=w2+w1;//
```

```
ph=atand((sqrt(3)*(w2-w1))/(w2+w1));//in degree
pf=cosd(ph);//power factor
disp(p1,"power is,(W)=")
disp(pf,"power factor (leading) is")
disp("when second readig is negative")
w21=-2300;//watts
w1=4600;//watts
p2=w21+w1;//
ph2=atand((sqrt(3)*(w21-w1))/(w21+w1));//in degree
pf1=cosd(ph2);//power factor
disp(p2,"power is,(W)=")
disp(pf1,"power factor (leading) is")
```

Scilab code Exa 2.15 load current

```
//Example 2.15://load current
clc;
clear;
close;
rw=3550;//reading of wattmeter
rp=806;//watts
ph=atand((sqrt(3)*rp)/rw);//in degree
pf=cosd(ph);//power factor
v=440;//volts
i=((rw)/(sqrt(3)*v*pf));//amperes
disp(round(i),"load current in amperes is")
```

Scilab code Exa 2.16 error

```
//Example 2.16://error
clc;
clear;
close;
```

```
d=87; //degree
pf=0.5; //
n=(1/4)*sind(d-60); //
nc=(1/4)*pf*sind(d); //
e=((n-nc)/nc)*100; //error
disp(-e,"error (slow) in percentage is")
```

Scilab code Exa 2.17 error

```
//Example 2.17://error
clc;
clear;
close;
i=5; //amperes
t0=0; //
t1=30/60; //
x=integrate('5','t',t0,t1); //
e=0.56; //kWh
v=(e*10^3)/x; //volts
v1=220; //volts
ae=v1*i*t1*10^-3; //actual energy
e=((e-ae)/ae)*100; //error
disp(e,"error (%) is")
```

Scilab code Exa 2.18 time and limits of accuracy

```
//Example 2.18://time and error
clc;
clear;
close;
nd=500; //dvisions
cr=0.1; //dvisions can read
re=(cr/nd)*100; //reading error
```

```
ie=0.05;//inherent error
te=re+ie;//total error
tea=0.1;//total error allowable
per=tea-te;//permissible error
cr1=0.01;//seconds
ersw=cr1*100;//error in reading stop watch
cr2=0.1;//seconds
erss=cr2*100;//error in stopping and starting
ter=ersw+erss;//total error
t=per/ter;//seconds
disp(round(1/t),"time duration in seconds is")
nd1=500/10;//
er1=(cr/nd1)*100;//new reading error
ie1=((ie*nd)/nd1);//new inherent error
ter1=er1+ie1;//
la=ter1+per;//
disp(la,"limits of accuracy (%) is")
```

Scilab code Exa 2.19 error

```
//Example 2.19://error
clc;
clear;
close;
n=40;//revolutions
rc=0.12;//registration constant
err=n/rc;//energy recorded in kWh is
e2=22000;//volts
e1=110;//volts
i2=500;//amperes
i1=5;//amperes
i=5.25;//amperes
lv=110;//volts
pf=1;//
t=61;//seconds
```

```
ae=((sqrt(3)*e2*lv*i*i2*pf*t)/(e1*i1*3600))*10^-3;//kWh
e=((err-ae)/ae)*100;//
disp(-e,"error (slow) is (%)")
```

Scilab code Exa 2.20 limit of error

```
//Example 2.20://error and limit of error
clc;
clear;
close;
format('v',5)
mc=1200;//meter constant in rev/kWh
n=40;//revolutions
err=n/mc;//energy recorded in kWh
tp=99.8;//seconds
v=240;//volts
i=5;//amperes
ae=((v*i*tp*10^-3)/3600);//actual energy in kWh
e=((err-ae)/ae)*100;//error
disp(e,"error (fast) in recording (%)")
n=500;//divisions
rn=0.1;//dvision reading accuracy
per=((rn/n)*100);//possible error
ie=0.05;//inherent error
per1=(((rn/10)/tp)*100);//possible error
her=((ie/tp)*100);//human error
tpr=per+per1+her+ie;//total possible error
li1=e-tpr;//
li2=e+tpr;//
disp("limit of error in the meter is "+string(li1)+"% or "+string(li2)+"% ")
```

Scilab code Exa 2.21 consumer monthly bill and power factor

```
//Example 2.21://consumer monthly bill ,power factor and average cost per unit
clc;
clear;
close;
format('v',9)
kwh=125000;//
kvarh=100000;//
kvah=sqrt(kwh^2+kvarh^2);//kVAh
kw=180;//
kvar=125;//
mkva=sqrt(kw^2+kvar^2);//kVA
pkva=15;//rupees
pkvah=0.1;//reupees
tmb=pkva*mkva+pkvah*kvah;//in Rs
disp(tmb,"total monthly bill in Rs")
pf=kwh/kvah;//power factor
d=30;//days
t=24;//hours a day
lf=((kwh/(d*t))/kw);//load factor
avcp=tmb/kwh;//in paisa
disp(pf,"power factor is")
disp(lf,"load factor is")
disp(avcp*100,"average cost per unit (kWh) in paisa is")
//total monthly bill and load factor is calculated wrong in the book
```

Scilab code Exa 2.22 error

```
//Example 2.22://full load sped and error
clc;
clear;
```

```
close;
format('v',9)
v=220;//volts
i=5;//in amperes
wrv=((v*i*10^-3)/(3600));//kWh
mc=((3600*10^3)/(v*i));//rev/kWh
ec=((v*i*10^-3)/(3600));//kWh
sfl=mc*ec;//rps
n=30;//revolutions
hler=n*ec;//kWh
t=59.5;//seconds
hlf=(((i/2)*v*10^-3*t)/(3600));//kWh
e=(hler-hlf)/hlf;//
disp(mc,"number of revolution per kWh is,(
    revolutions/kWh)=")
disp(sfl,"full load speed r.p.s is")
disp(e*100,"error (fast) in percentage is")
//numberof revolutions is calcultaed wrong in the
    textbook
```

Scilab code Exa 2.23 resistance

```
//Example 2.23://shunt resistance
clc;
clear;
close;
format('v',9)
ra=1000;//armature resistance in ohms
i=10;//mA
ia=500;//micro amperes
rsh1=((ra)/((i/(ia*10^-3))-1));//in ohms
i1=75;//mA
rsh2=((ra)/((i1/(ia*10^-3))-1));//in ohms
i3=100;//mA
ia3=0.4*ia;//micro amperes
```

```
rsh3=((ra)/((i3/(ia3*10^-3))-1));//in ohms
disp(rsh1,"shunt resistance when current is 10mA in
   ohm is")
disp(rsh2,"shunt resistance when current is 75mA in
   ohm is")
disp(rsh3,"shunt resistance when current is 100mA in
    ohm is")
```

Scilab code Exa 2.24 resistance and power

```
//Example 2.24://shunt resistance and series
   resistance
clc;
clear;
close;
format('v',9)
i=125;//amperes
ia=25;//armature current in mA
ish=i-(ia*10^-3);//amperes
ra=3;//ohms
rsh=((ia*ra)/ish);//milli ohms
disp(rsh,"shunt resistance in milli ohm is")
pcs=ish^2*rsh*10^-3;//watts
disp(pcs,"power consumption in shunt is,(W)=")
rv=625;//volts
rs=((rv-(ra*ia*10^-3))/(ia*10^-3))*10^-3;//killo
   ohms
disp(rs,"series resistance in kilo ohm is")
pc=(ia*10^-3)^2*rs*10^3;//watts
disp(pc,"power consumption in the series resistance
   is,(W)=")
```

Scilab code Exa 2.25 multiplying power

```
//Example 2.25:// mulitplying power
clc;
clear;
close;
format('v',9)
disp("when micro meter resistance is 25 ohm")
ra=25;//ohms
rsh=5000;//ohms
r1=1250;//ohms
n=((ra+rsh)/r1);//
r2=2500;//ohms
n2=((ra+rsh)/r2);//
disp(n,"multiplying power for the shunt for a 1250
    ohm is")
disp(n2,"multiplying power for the shunt for a 2500
    ohm is")
disp("when micro meter resistance is 2500 ohm")
ra1=2500;//ohms
rsh=5000;//ohms
r1=1250;//ohms
n1=((ra1+rsh)/r1);//
r2=2500;//ohms
n3=((ra1+rsh)/r2);//
disp(n1,"multiplying power for the shunt for a 1250
    ohm is")
disp(n3,"multiplying power for the shunt for a 2500
    ohm is")
```

Scilab code Exa 2.26 resistance

```
//Example 2.26:// resistance
clc;
clear;
close;
r1=185;//ohm
```

```
r2=205;//ohm
r3=215;//ohm
R31=195;//OHM
r4=200;//ohm
R=r1+r2+r3+r4+R31;//ohm
r5=1100;//ohm
R1=(R-r4)+((r5*r4)/(r5+r4));//
v1=85;//V
V=(v1*R1)/round(R1-(R-r4));//V
disp(round(V),"voltage is ,(V)=")
I=round(V)/R;//A
vd4=I*r4;//V
x=0.5;//% allowable
vd41=(vd4)-(vd4*x)/100;//
rv=((vd41*(R-r4)*r4))/((V*r4)-((R*vd41)));//
disp(rv*10^-3,"resistance is ,(k-ohm)=")
//resistance is calculated wrong in the textbook
```

Scilab code Exa 2.27 resistance and sensivity

```
//Example 2.27: Sensitivity
clc;
clear;
close;
//given data :
I1=0.1;// in mA
R1=50;// in ohm
I2=10;// in mA
I3=10.1;// in mA
I4=I2-I1;
Rsh=I1*R1/(I3-I1);
Im1=Rsh*I4/(R1+Rsh);
S1=(I1-Im1)/(I3-I4);
disp(S1,"(a). The sensitivity of an instrument,S1 =
  ")
```

```
I5=10;// in mA
V=2;// in Volt
R=V/(I5*10^-3);
disp(R,"(b). The resistance ,R(ohm) = ")
// formula : Im=((I3-Im)*(R-V))/R1;
Im2=(0.8*I3)-8;
Im3=(0.8*I4)-8
S2=(Im2-Im3)/(I3-I4);
S=S1/S2;
disp(S,"The relative sensitivity ,S = ")
```

Scilab code Exa 2.28 design

```
//Example 2.28: Error
clc;
clear;
close;
//given data :
La=90*10^-6;// in micro-H
Ra=0.09;// in ohm
LsbyRs=La/Ra;
I=50;// in A
Ia=5;// in A
f=50;// in Hz
w=2*%pi*f;
Rs=Ra/9;
Ls=LsbyRs*Rs*10^6;
disp(Rs,"Shunt resistance ,Rs(ohm) = ")
disp(Ls,"Inductance ,Ls(micro-H) = ")
Ls1=0;// shunt is non-inductive
Ia1=(Rs*I)/sqrt((Ra+Rs)^2+(w^2*La^2));
disp(Ia1,"Current ,Ia1(A) = ")
Error=((Ia-Ia1)/Ia)*100;
disp(Error,"Error ,(%)(low) = ")
```

Scilab code Exa 2.29 area and error

```
//Example 2.29 :area and percentage error
clc;
clear;
close;
//given data
v1=18;//kV
c1=60;//pF
v2=2;//
q=v2*10^3*c1*10^-12;//
cs=q/(v1*10^3);//F
d=2.5;//cm
eo=8.854*10^-12;//
a=((cs*d*10^-2)/(eo));//
disp(round(a*10^4),"area is ,(cm^2)=")
c2=50;//pf
x=c1-c2;//
stf=((v2*10^3)^2*x*10^-12);//
v=sqrt(stf/(x*10^-12*2))/1000;//kV
c3=c2+(x/2);//pf
x1=c3/(cs*10^12);//
V1=(x1+1)*v//
V=10*sqrt(2);//V
er=((V-V1)/V1)*100;//
disp(er,"error is ,(%)=")
```

Scilab code Exa 2.30 error

```
//Example 2.30: % Error
clc;
clear;
```

```
close;
//given data :
Ra=2;// in ohm
Rsh=0.0004;// constant
alfa=0.004;
t1=288;// in K
t2=333;// in K
I=100;// in A
Rs=50;// in ohm
theta=t2-t1;
Ra1=Ra+(alfa*Ra*theta);
N1=1+(Ra/Rsh);
Ia=I/N1;
N2=1+(Ra1/Rsh);
Ia1=I/N2;
epsilon1=(Ia1-Ia)*100/Ia;
disp(epsilon1,"The percentage error,(%) = ")
N3=1+((Ra+Rs)/Rsh);
Ia2=I*10^3/N3;
N4=1+((Ra1+Rs)/Rsh);
Ia3=I*10^3/N4;
epsilon2=(Ia3-Ia2)*100/Ia2;
disp(epsilon2,"The percentage error,(%) = ")
```

Scilab code Exa 2.31 resistance

```
//Example 2.31: Resistance and electromotive
clc;
clear;
close;
//given data :
i1=20;// in mA
i2=400;// in mA
i3=i1/i2;
K1=i1/i3;
```

```
v1=19.5;// in mV
v2=23.4;// in mV
x1=v1/K1;//
y=100;//mV
k2=y/i3;//
x2=v2/k2;//
A=[1 -x1;1 -x2];
B=[v1;v2];//
X=A\B;//
disp(X(1,1),"electromotive force is,(mV)=")
disp(X(2,1),"resistance is ,(ohm)=")
```

Scilab code Exa 2.32 error

```
//Example 2.32: error
clc;
clear;
close;
//given data :
V=20*10^3;// in V
v1=2*10^3;// in V
R=10*10^3;// in ohm
r=R*v1/V;
f=50;// in Hz
w=2*%pi*f;
C=0.60*10^-6;// in F
v=V/((R/r)*sqrt(1+((w^2*C^2*r^2*(R-r)^2)/R^2)));
Error=((v1-v)/v1)*100;
disp(Error,"Error,(%) = ")
```

Scilab code Exa 2.33 flux actual ratio and phase angle

```
//Example 2.33: Flux, actual ratio and phase angle
```

```
clc;
clear;
close;
//given data :
I=5;// in A
r1=4;// in ohm
r2=0.2;// in ohm
Es=I*(r1+r2);
Ts=160;// in turns
F=50;// in Hz
fi=Es*10^3/(4.44*Ts*F);
disp(fi,"(i). Flux in the core,(mWb) = ")
I0=6;// in A
theta1=30;// in degree
Ie=I0*cosd(theta1);// in A
Im=I0*sind(theta1);// in A
del=0;
K=Ts+(((Ie*cosd(del))+(Im*sind(del)))/I);
disp(K,"(ii). The actual ratio,K = ")
theta=(180/%pi)*(((Im*cosd(del))-(Ie*sind(del)))/(Ts*I));
disp(theta,"(iii). The phase angle,(degree) = ")
```

Scilab code Exa 2.34 error

```
//Example 2.34: The ratio errror and phase angle error
clc;
clear;
close;
//given data :
I=5;// in A
n=1000/5;// normal ratio
sin_alfa=0.4;
cos_alfa=sqrt(1-sin_alfa^2);
```

```
Im=1;// in A
I0=Im/cos_alfa;
Ie=I0*sin_alfa;
del=0;
K=n+(((Ie*cosd(del))+(Im*sind(del)))/I);
er=(n-K)*100/K;
disp(er,"(a). The ratio error,(%) = ")
eph=(180/%pi)*(((Im*cosd(del))-(Ie*sind(del)))/(n*I));
x=round(eph);//
y=eph-x;//
disp("(b). phase angle is "+string(x)+" degree "+string(y*60)+" minutes ")
```

Scilab code Exa 2.35 error

```
//Example 2.35: The ratio errror and phase angle error
clc;
clear;
close;
//given data :
I=5;// in A
Kn=1000/I;
n=198;// in turns
L=12.5;//in VA
Zs=L/I^2;
f=50;// assume in Hz
l=1*10^-3;// in H
Re=2*%pi*f*l;// in ohm
del=asind(Re/Zs);
Ie=10;// in A
Im=15;// in A
K=n+(((Ie*cosd(del))+(Im*sind(del)))/I);
Rerror=(Kn-K)*100/K;
```

```
disp(Rerror,"The ratio error,(%) = ")
eph=(180/%pi)*(((Im*cosd(del))-(Ie*sind(del)))/(n*I)
   );
disp(eph,"The phase angle,(degree) = ")
```

Scilab code Exa 2.36 error and load

```
//Example 2.36: phase angle error load in VA
clc;
clear;
close;
//given data
v1=1000;//V
v2=100;//V
r=v1/v2;//
pf=0.4;//
sd=pf;//
csd=sqrt(1-pf^2);//
im=0.02;//A
ie=im*(pf/csd);//A
xp=65.4;//ohm
rp=97.5;//ohm
th=((ie*xp)-(im*rp))/(r*v2);//rad
thd=th*(180/%pi);//
disp("phase angle is "+string(thd*60) +"minutes")
Xp=110;//ohm
is=(r*((im*rp)-(ie*xp)))/(Xp);
va=is*v2;//VA
disp(va,"load is ,(VA)=")
```

Scilab code Exa 2.37 flux and current ratio error

```
//Example 2.37: flux and current ratio error
```

```
clc;
clear;
close;
n1=1000;//A
n2=5;//A
r=1.6;//ohm
kn=n1/n2;//
ts=kn;//
wt=1.5;//watt
es=n2*r;//v
f=50;//Hz
ph=es/(4.44*f*kn);//m Wb
ep=es/kn;//
ie=wt/ep;//A
cd1=1;//
sd=0;//
K=((kn+(ie/n2)));//
re=((kn-K)/K)*100;//
disp(ph*10^3,"flux is ,(m-Wb)=")
disp(re,"ratio error is ,(%)=")
```

Scilab code Exa 2.38 RCF ratio error and phase angle error

```
//Example 2.38: RCF ,ratio error and phase angle
   error
clc;
clear;
close;
vp=2000;//V
n=20;//
vs=vp/n;//
va1=50;//
pfl1=0.6;//lagging
is=va1/vs;//A
va2=25;//V
```

```
is2=va2/vs;//A
ie=0;//
im=0;//
cd1=0.6;//
sd1=sqrt(1-cd1^2);//
rs1=0.75;//ohm
rp1=300;//ohm
Rp1=n^2*rs1+rp1;//ohm
xs1=1.5;//ohm
xp1=600;//ohm
Xp1=n^2*xs1+xp1;//ohm
vps1=n+((is/n)*(Rp1*cd1+Xp1*sd1))/vs;//
RCF1=vps1/n;//
er1=((n-vps1)/vps1)*100;//%
per1=((is*(Xp1*cd1-Rp1*sd1))/(n^2*vs))*(180/%pi);//degree
per1a=round(per1);//
x1=per1-per1a;//
disp(RCF1,"RCF for case (a) is,=")
disp(er1,"phase error for case (a) is,(%)=")
disp("phase angle error for case (a) is "+string(x1*60)+" minutes")
cd11=1;//
sd11=sqrt(1-cd11^2);//
vps2=n+((is/n)*(Rp1*cd11+Xp1*sd11))/vs;//
RCF2=vps2/n;//
er2=((n-vps2)/vps2)*100;//%
per2=((is*(Xp1*cd11-Rp1*sd11))/(n^2*vs))*(180/%pi);//degree
per1a1=round(per2);//
x2=per1-per1a1;//
disp(RCF2,"RCF for case (b) is,=")
disp(er2,"phase error for case (b) is,(%)=")
disp("phase angle error for case (b)is "+string(per2*60)+" minutes")
cd12=0.6;//
sd12=-0.8;//
vps3=n+((is/n)*(Rp1*cd12+Xp1*sd12))/vs;//
```

```
RCF3=vps3/n;//
er3=((n-vps3)/vps3)*100;//%
per3=((is*(Xp1*cd12-Rp1*sd12))/(n^2*vs))*(180/%pi);//degree
per1a1=round(per2);//
x2=per1-per1a1;//
disp(RCF3,"RCF for case (c) is,=")
disp(er3,"phase error for case (c) is,(%)=")
disp("phase angle error for case (c)is  "+string(per3*60)+" minutes")
cd13=0.6;//
sd13=0.8;//
vps4=n+((is2/n)*(Rp1*cd13+Xp1*sd13))/vs;//
RCF4=vps4/n;//
er4=((n-vps4)/vps4)*100;//%
per4=((is2*(Xp1*cd13-Rp1*sd13))/(n^2*vs))*(180/%pi);//degree
per1a1=round(per2);//
x2=per1-per1a1;//
disp(RCF4,"RCF for case (d) is,=")
disp(er4,"phase error for case (d) is,(%)=")
disp("phase angle error for case (d)is  "+string(per4*60)+" minutes")
cd14=1;//
sd14=0;//
vps5=n+((is2/n)*(Rp1*cd14+Xp1*sd14))/vs;//
RCF5=vps5/n;//
er5=((n-vps5)/vps5)*100;//%
per5=((is2*(Xp1*cd14-Rp1*sd14))/(n^2*vs))*(180/%pi);//degree
per1a1=round(per2);//
x2=per1-per1a1;//
disp(RCF5,"RCF for case (e) is,=")
disp(er5,"phase error for case (e) is,(%)=")
disp("phase angle error for case (e)is  "+string(per5*60)+" minutes")
cd15=0.6;//
sd16=-0.8;//
```

```
vps6=n+((is2/n)*(Rp1*cd15+Xp1*sd16))/vs;//
RCF6=vps6/n;//
er6=((n-vps6)/vps6)*100;//%
per6=((is2*(Xp1*cd15-Rp1*sd16))/(n^2*vs))*(180/%pi);//degree
per1a1=round(per2);//
x2=per1-per1a1;//
disp(RCF6,"RCF for case (f) is,=")
disp(er6,"phase error for case (f) is,(%)=")
disp("phase angle error for case (f)is "+string(per6*60)+" minutes")
```

Scilab code Exa 2.39 ratio error RCF and phase angle

```
//Example 2.39: RCF ,ratio error and phase angle error
clc;
clear;
close;
vp=1000;//V
is=5;//A
n=vp/is;//
VA=25;//
vs=VA/is;//
vp=is/n;//V
wt=0.25;//W
ie=wt/vp;//A
im=15;//A
xs=1;//ohm
rs=5;//ohm
dl=atand(xs/rs);//
dlr=dl*(%pi/180);//
K=n+((ie*cosd(dl)+im*sind(dl))/is);//
re=((n-K)/K)*100;//per
RCF=K/n;//
```

```
eph=(180/%pi)*(((im*cosd(dl))-(ie*sind(dl)))/(n*is))
    ;
disp(re,"ratio error is,(%)=")
disp(RCF,"RCF is ,=")
disp(eph,"phase angle error is,(degree)=")
```

Scilab code Exa 2.40 true value of voltage current and power

```
//Example 2.40: true value of voltage ,current and
    power
clc;
clear;
close;
vs=102;//V
is=4;//A
ws=375;//W
ph=acosd(ws/(is*vs));//degree
ph1=round(ph);//
x=ph-ph1;//
y=x*60;//
angd=y+22+10;//
ang=angd/60;//
ta=ph1+ang;//
a1=2000;//
a2=100;//
nr=a1/a2;//
rcf=0.995;//
rcf1=1.005;//
avr=rcf*nr;//
pv=avr*vs;//
acr=rcf1*(a2/nr);//
pc=acr*is*is;//A
psd=pv*pc*cosd(ta)*10^-3;//
disp(pv,"true value of voltage is,(V)=")
disp(pc,"true value of current is,(A)=")
```

```
disp(psd,"true value of power is ,(kW)=")
```

Scilab code Exa 2.41 primary current and phase error

```
//Example 2.41:primary current ,phase error
clc;
clear;
close;
zs=0.433+%i*0.25;//ohm
zs1=0.15+%i*0.0;//ohm
zs2=zs+zs1;//ohm
zsa=sqrt(real(zs2)^2+imag(zs2)^2);//
zsng=atand(imag(zs2)/real(zs2));//
nt=2;//turns
l1=8;//
l2=4;//
ie=l2/nt;//
im=l1/nt;//
tnt=198;//turns
is=5;//A
K=((tnt/2)+((ie*cosd(zsng))+(im*sind(zsng)))/is);//
ip=K*is;//A
th=((im*cosd(zsng))-(ie*sind(zsng)))/((tnt/2)*is);//
disp(ip,"primary current is ,(A)=")
disp(th,"phase error is ,(radian)=")
```

Scilab code Exa 2.42 resistance

```
//Example 2.42: Resistance
clc;
clear;
close;
//given data :
```

```
f=50;/// in Hz
r=2000;// in ohm
L=0.5;// in H
Zm=sqrt(r^2+(2*%pi*f*L));
V=100;// in V
im=V/Zm;
Rs=(500-(im*Zm))/im;
disp(Rs,"Series resistance,Rs(ohm) = ")
//answer is wrong in the textbook
```

Scilab code Exa 2.43 percentage change in current

```
//Example 2.43 :percentage change in current
clc;
clear;
close;
//given data
r=0.5;//kilo ohm
r1=1;//kilo ohm
z1=((%i*r1*r)/(r1+%i*r));//kilo-ohm
z1m=sqrt(real(z1)^2+imag(z1)^2);//kilo-ohm
z2=((%i*r1*r)/(r+%i*r1));//kilo-ohm
z2m=sqrt(real(z1)^2+imag(z1)^2);//kilo-ohm
tz=z1m+z2m;//kilo-ohm
f=50;//Hz
V=1;//V
i=V/tz;//A
v1=i*z1m*10^-3;//V
v2=i*10^-3*z2m;//V
df=f-((f*5)/100);//Hz
rc1=((r*df)/f);//k-ohm
rc2=((r1*df)/f);//k-ohm
z1n=((%i*rc1)/(r1+%i*rc1));//
z1nm=sqrt(real(z1n)^2+imag(z1n)^2);//k-ohm
z2n=((%i*rc2*r)/(r+%i*rc2));//
```

```
z2nm=sqrt(real(z1n)^2+imag(z1n)^2);//k−ohm
znw=z1nm+z2nm;//k−ohm
in=V/znw;//
disp(in,"current is ,(mA)=")
```

Scilab code Exa 2.44 inductance and frequency

```
//Example 2.44 :Inductance
clc;
clear;
close;
//given data
c=1;//micro−F
f1=60;//Hz
f=50;//Hz
l1=((c*10^6)/(f1^2*(2*%pi)^2));//
r1=100;//ohm
z1=r1+%i*((2*%pi*f*l1)-(1/(2*%pi*f*c*10^-6)));//ohm
c2=1.5;//micro−F
l2=((-imag(z1))+(1/(2*%pi*c2)))/100;//H
f2=(1/(2*%pi))*sqrt(1/(l2*c2*10^-6));//Hz
disp(l2,"inductance is ,(H)=")
disp(f2,"frequency is ,(Hz)=")
```

Scilab code Exa 2.45 resistance and error

```
//Example 2.45: Resistance and % error
clc;
clear;
close;
//given data :
i1=.50;// in mA
r1=5000;// in ohm
```

```
r2=50;// in ohm
V=3;// in V
I=i1*10^-3/2;// mid scale deflection current in A
Rs=(V/I)-(r1+r2);
disp(Rs,"(i). The resistance,Rs(ohm) = ")
A=.5/100;
In=30/100;
Me=A*1000;
Fsr=In*1000;
P_error=Me*100/Fsr;
disp(P_error,"Percentage inaccuracy,(%) = ")
```

Scilab code Exa 2.46 inductance and capacitance

```
//Example 2.46: inductance and capacitance
clc;
clear;
close;
//given data :
c1=1.5;//micro-farad
f=50;//Hz
f1=55;//Hz
f2=45;//Hz
l1=((1/((2*%pi*f)^2)*c1*10^-6));//H
v1=1.211*0.428;//V
i1=v1/1;//mA
v2=1.211*.441;//V
i2=v2/0.95;//mA
v=0.527;//V
pec=((i1-v)/v)*100;//
pec1=((i2-v)/v)*100;//
disp(-pec,"percentage change (decrease) in coil-1
    current is,(%)=")
disp(-pec1,"percentage change (decrease) in coil-2
    current is,(%)=")
```

```
x1=((1/(2*%pi*f2)^2));//
x2=((314*x1)-(0.318*10^-2))/370;//
disp(x2*10^6,"capacitance is ,(micro-F)=")
l2=x1/(x2);//
disp(l2,"inductance is  ,(H)=")
```

Chapter 3

Measurement of parameters

Scilab code Exa 3.1 resistance and percentage error

```
//Example 3.1: Resistance and percentage error
clc;
clear;
close;
//given data :
V=3.2;// in V
I=0.4;// in A
Rv=500;// in ohm
Xt=V/(I*(1-(V/(I*Rv))));
Xm=V/I;
Pe=((Xm-Xt)/Xt)*100;
disp(Xt,"(a). True value of unknown resistance,Xt(
    ohm) = ")
disp(Pe,"(b). % error,(%) =")
disp(" i.e."+string(-Pe)+"% 10w")
```

Scilab code Exa 3.2 resistance

```
//Example 3.2: Measured value of resistance
clc;
clear;
close;
//given data :
a=1;// in ohm
b=5;// in ohm
A=(1/a)+(1/b);
r=1/A;
I=0.1;// in A
V=r*I;
Mr=V/I;
disp(Mr,"Measured value of resistance ,(ohm) = ")
```

Scilab code Exa 3.3 resistance

```
//Example 3.3: Resistor
clc;
clear;
close;
//given data :
S=0.02;// in ohm
Vs=0.98;// in V
Vx=0.735;// in V
X=(S*Vx)/Vs;
disp(X,"Resistance of resistor under test ,X(ohm) = "
   )
```

Scilab code Exa 3.4 power loss

```
//Example 3.4: Resistor ,current and power loss
clc;
clear;
```

```
close;
//given data :
S=0.1;// in ohm
Vs=1.0235;// in V
Vr=0.4211;// in V
R=(Vr/Vs)*S;
disp(R,"Resistance of unknown resistor ,R(ohm) = ")
I=Vs/S;
disp(I,"Current through the resistor ,I(A) = ")
P=I^2*R;
disp(P,"Power loss in the unknown resistance ,P(W) =
    ")
```

Scilab code Exa 3.5 error

```
//Example 3.5: Magnitude of error
clc;
clear;
close;
//given data :
p=100.31;// in ohm
q=200;// in ohm
P=100.24;// in ohm
Q=200;// in ohm
S=100.03*10^-6;// in ohm
r=700*10^-6;// in ohm
Y=50;// in micro-ohm
X=(((P/Q)*S)+(((q*r)/(p+q))*((P/Q)-(p/q))))*10^6;
Error=Y-X;
disp(Error,"Magnitude of error ,(micro-ohm) = ")
```

Scilab code Exa 3.6 resistance

```
//Example 3.6: Unknown resistance
clc;
clear;
close;
//given data :
p=100.6;// in ohm
q=300.25;// in ohm
P=100.5;// in ohm
Q=300;// in ohm
S=0.0045;// in ohm
r=0.1;// in ohm
X=(((P/Q)*S)+(((q*r)/(p+q+r))*((P/Q)-(p/q))))*10^3;
disp(X,"Unknown resistance ,X(m-ohm) = ")
```

Scilab code Exa 3.7 resistance

```
//Example 3.7: Unknown resistance
clc;
clear;
close;
//given data :
s=0.5;//Mega ohms
g=10;//killo ohms
d1=41;//divisions
d2=51;//divisions
r=(((s*10^6)+(g*10^3))*(d1/d2))-(g*10^3);//ohms
disp(r*10^-6,"unknown resistance is ,(Mega-ohm)=")
```

Scilab code Exa 3.8 resistance

```
//Example 3.8: Unknown resistance
clc;
clear;
```

```
close;
//given data :
P=100;// in ohm
Q=10;// in ohm
S=46;// in ohm
R=((P/Q)*S);
disp(R," Unknown resistance ,R(ohm) = ")
```

Scilab code Exa 3.9 resistance

```
//Example 3.9: limiting value of unknown resistance
clc;
clear;
close;
//given data :
P=1000;// in ohm
Q=1000;// in ohm
S=3154;// in ohm
R=((P/Q)*S);
dp=0.05;//percentage error
dq=0.05;//percentage error
ds=0.1;//percentage error
dr=dp+dq+ds;//percentage error
x=R+((dr*10)*R)/100;//
disp("limiting value of resistance is "+string(R)+"
    "+string(dr)+"% to "+string(round(x))+" ohm")
```

Scilab code Exa 3.10 resistance

```
//Example 3.10: value of unknown resistance
clc;
clear;
close;
```

```
ra=1200;//ohms
rb=ra/1600;//ohms
r1=800*rb;//ohms
r2=r1/1.25;//ohms
r3=0.5*rb;//ohms
rx=((r2/r1)*r3);//ohms
disp(rx,"unknown resistance is,(Ohm)=")
```

Scilab code Exa 3.11 resistance

```
//Example 3.11: Unknown resistance
clc;
clear;
close;
//given data :
AB=25;// in ohm
BC=75;// in ohm
S=6;// in ohm
R=((AB/BC)*S);
disp(R," Unknown resistance,R(ohm) = ")
```

Scilab code Exa 3.12 arm ratio

```
//Example 3.12: length
clc;
clear;
close;
r=0.0250;//ohms
l=100;//cm
d=100;//divisions
r1=r/l;//ohm/cm
p=10;//ohms
q=10;//ohms
```

```
x=p/q;//
r2=1.0125;//ohms
r3=1;//ohms
l1=((r3+r)-r2)/(2*r1);//cm
l2=100-l1;//cm
disp("In case 1 balance is obtained at "+string(l1)+
   " and "+string(l2)+" scale divisions")
p1=9.95;//ohms
q1=10.05;//ohms
x1=p1/q1;//
r2=1.0125;//ohms
r3=1;//ohms
l11=((p1*(r3+r))-(q1*r2))/((p1*r1)+(q1*r1));//cm
l21=100-round(l11);//cm
disp("In case 2 balance is obtained at "+string(
   round(l11))+" and "+string(l21)+" cm")
```

Scilab code Exa 3.13 resistance

```
//Example 3.13: Insolution resistance
clc;
clear;
close;
//given data :
V1=125;// in V
V2=100;// in V
t=25;// in sec
C=600*10^-12;// in F
R=t*10^-6/(C*log(V1/V2));
disp(round(R),"Insolution resistance,R(M-ohm) = ")
```

Scilab code Exa 3.14 resistance

```
//Example 3.14: Insolution resistance of the cable
clc;
clear;
close;
y=10;//Mega ohms
d=200;//divisioms
d1=126;//divisions
d2=100;//divisions
c=1;//assume
t=30;//seconds
x=0.4343
r=((x*t)/(c*log10(d/d1)));//
rd=((x*t)/(c*log10(d/d2)));//
x=rd/r;//
ro=((y-(10*x))/x);//Mega ohms
disp(round(ro),"Insolution resistance ,R(M-ohm) = ")
```

Scilab code Exa 3.15 resistance

```
//Example 3.15:High resistance
clc;
clear;
close;
//given data :
V1=500;// in V
V2=300;// in V
t=60;// in sec
C=2.5*10^-6;// in F
R=t*10^-6/(C*log(V1/V2));
disp(R,"Unknown resistance ,R(M-ohm) = ")
```

Scilab code Exa 3.16 resistance

```
//Example 3.16: Insolution resistance of the cable
clc;
clear;
close;
US=2.5;//SHUNT
SD=250;//DIVISIONS
x=US*SD;//
sr=350;//scale readomh
sd1=1000;//shunt
y=sr*sd1;//
r=1;//Mega ohms
ro=(y/x)*r;//mega ohms
disp(round(ro),"Insolution resistance ,R(M-ohm) = ")
```

Scilab code Exa 3.17 balanced bridge

```
//Example 3.17: Bridhe Balanced
clc;
clear;
close;
z1m=400;//ohms
z1a=50;//degree
z2m=200;//ohms
z2a=40;//degree
z3m=800;//ohms
z3a=-50;//degree
z4m=400;//ohms
z4a=20;//degree
x=z1m*z4m;//ohms
y=z2m*z3m;//ohms
a=z1a+z4a;//degree
b=z2a+z3a;//degree
disp("As "+string(x)+"="+string(y)+" (Z1*Z4=Z2*Z3)
    firts condition is satisfied")
disp("As "+string(a)+"           "+string(b)+"    (Sum of
```

```
angles) second condition is not staisfied (so
bridge is not balanced)")
```

Scilab code Exa 3.18 impedence

```
//Example 3.18:Resistance
clc;
clear;
close;
//given data :
R2=100;// in ohm
R3=32.7;// in ohm
R4=100;// in ohm
R=1.36;// in ohm
L=47.8;// in mH
R1=(R2*R3/R4)-R;
disp(R1,"Resistance,R1(ohm) = ")
L1=(R2/R4)*L;
disp(L1,"inductance,L1(mH) = ")
```

Scilab code Exa 3.19 resistance and inductance

```
//Example 3.19:Resistance and Inductance
clc;
clear;
close;
f=1;//assume
r1=25;//ohms
i=50;//MH
x=r1+%i*(2*%pi*f*(i*10^-3));//
r2=2;//ohms
r=real(x)-r2;//ohms
l=imag(x)/(2*%pi*f);//henry
```

```
disp(r,"resistance is ,(ohm)=")
disp(l*10^3,"inductance is ,(mH)=")
```

Scilab code Exa 3.20 resistance

```
//Example 3.20:Resistance
clc;
clear;
close;
//given data :
R2=600;// in ohm
R3=400;// in ohm
R4=1000;// in ohm
R1=(R2*R3/R4);
disp(R1,"Unknown resistance ,R1(ohm) = ")
```

Scilab code Exa 3.21 impedence

```
//Example 3.21:Resistance and inductance
clc;
clear;
close;
//given data :
S=900;// in ohm
P=1.5*10^3;// in ohm
Q=2*10^3;// in ohm
Cs=0.2*10^-6;// in F
rx=S*P/Q;
disp(rx,"Resistance ,rx(ohm) = ")
L=P*Cs*S*10^3;
disp(L,"Inductance ,L(mH) = ")
```

Scilab code Exa 3.22 resistance and inductance

```
//Example 3.22:Resistance and inductance
clc;
clear;
close;
//given data :
S=2000;// in ohm
P=1000;// in ohm
Q=S;// in ohm
C=1*10^-6;// in F
r=200;// in ohm
R=P*Q/S;
disp(R,"Resistance ,R(ohm) = ")
L=(C*P/S)*(r*(Q+S)+(Q*S));
disp(L,"Inductance ,L(H) = ")
```

Scilab code Exa 3.23 resistance and inductance

```
//Example 3.23:Resistance and inductance
clc;
clear;
close;
//given data :
R2=250;// in ohm
R3=100;// in ohm
R4=200;// in ohm
r1=43.1;// in ohm
R1=(R2*R3/R4)-r1;
r=229.7;// in ohm
C=1*10^-6;// in F
disp(R1,"Resistance ,R1(ohm) = ")
```

```
L1=(C*R3/R4)*(r*(R4+R2)+(R2*R4));
disp(L1,"inductance,L1(H) = ")
```

Scilab code Exa 3.24 inductance and resistance

```
//Example 3.24:Resistance and inductance
clc;
clear;
close;
//given data :
R2=1000;// in ohm
R3=500;// in ohm
R4=1000;// in ohm
R1=(R2*R3/R4);
r=100;// in ohm
C=3*10^-6;// in F
disp(R1,"Resistance,R1(ohm) = ")
L=(C*R2/R4)*(r*(R4+R3)+(R3*R4));
disp(L,"inductance,L(H) = ")
```

Scilab code Exa 3.25 resistance and inductance

```
//Example 3.25:Resistance and inductance
clc;
clear;
close;
//given data :
R2=1000;// in ohm
R3=16800;// in ohm
R4=833;// in ohm
C4=0.38*10^-6;// in F
f=50;// in Hz
w=2*%pi*f;
```

```
L1=(R2*R3*C4)/(1+w^2*C4^2*R4^2);
disp(L1,"Inductance,L1(H) = ")
R1=(R2*R3*R4*w^2*C4^2)/(1+w^2*C4^2*R4^2);
disp(R1,"Resistance,R1(ohm) = ")
```

Scilab code Exa 3.26 resistance and inductance

```
//Example 3.26:Resistance and inductance
clc;
clear;
close;
//given data :
R2=2410;// in ohm
R3=750;// in ohm
R4=64.9;// in ohm
C4=0.35*10^-6;// in F
f=500;// in Hz
w=2*%pi*f;
L1=(R2*R3*C4)/(1+w^2*C4^2*R4^2);
disp(L1,"Inductance,L1(H) = ")
R1=(R2*R3*R4*w^2*C4^2)/(1+w^2*C4^2*R4^2);
disp(R1,"Resistance,R1(ohm) = ")
```

Scilab code Exa 3.27 resistance and inductance

```
//Example 3.27:Resistance and inductance
clc;
clear;
close;
//given data :
R3=16800;// in ohm
R2=1000;// in ohm
R4=833;// in ohm
```

```
C4=0.38*10^-6;// in F
f=50;// in Hz
w=2*%pi*f;
L1=(R2*R3*C4)/(1+w^2*C4^2*R4^2);
disp(L1,"Inductance,L1(H) = ")
R1=(R2*R3*R4*w^2*C4^2)/(1+(w^2*C4^2*R4^2));
disp(R1,"Resistance,R1(ohm) = ")
//resistance is calculated wrong in the textbook
```

Scilab code Exa 3.28 resistance and inductance

```
//Example 3.28:Resistance and Inductance
clc;
clear;
close;
r3=100;//ohms
c4=0.1;//micro-farads
r2=834;//ohms
c2=0.124;//micro farads
la=r2*r3*c4*10^-3;//mH
r1=(r3)*(c4/c2);//ohms
disp(la,"inductance is,(mH)=")
disp(r1,"resistance is,(ohm)=")
```

Scilab code Exa 3.29 capacitance

```
//Example 3.29: Phase angle error and Capacitance
clc;
clear;
close;
//given data :
C1=1*10^-6;// in F
R1=1000;// in ohm
```

```
R2=1000;// in ohm
f=1000;// in Hz
r1=10;// in ohm
R3=2000;// in ohm
R4=2000;/// in ohm
C2=C1*R1*10^6/R2;
w=2*%pi*f;
disp(C2,"Unknown capacitance,C2(micro-F) = ")
r2=(R2*(R3+r1)-(R1*R4))/R1;
del1=w*r1*C1*(180/%pi);
del2=r2*w*C2*10^-6*(180/%pi);
disp(del1,"Phase angle error,del1(degree) = ")
disp(del2,"Phase angle error,del2(degree) = ")
```

Scilab code Exa 3.30 capacitance and loss angle

```
//Example 3.30: Series resistance and loss angle
clc;
clear;
close;
//given data :
R2=100;// in ohm
R4=309;// in ohm
C3=100*10^-12;// in F
C4=0.5*10^-6;// in F
f=50;// in Hz
w=2*%pi*f;
Rs=C4*R2*10^-6/C3;
disp(Rs,"Series resistance,Rs(M-ohm) = ")
Cs=R4*C3*10^12/R2;
del=atand(w*Cs*Rs*10^-6);
disp(Cs,"capacitance is,(micro-F)=")
disp(del,"Loss angle,del(degree) = ")
```

Scilab code Exa 3.31 capacitance and angle

```
//Example 3.31: Capacitance , power loss , loss resistance and loss angle
clc;
clear;
close;
//given data :
r2=1500/%pi;// in ohm
r3=120;// in ohm
C2=0.95*10^-6;//F
C1=50*10^-12;// F
Cs=round(C1*r2*10^12/r3);
f=50;
w=round(2*%pi*f);
disp(Cs," Cable caacitance ,Cs(PF) = ")
rs=(r3/(w^2*C1*10));
disp(rs*10^-6,"Parallel loss resistance ,rs(M-ohm) = ")
del=atand(100*%pi*C2*r2);//
disp(del,"loss angle is ,(degree)=")
v=100;//kV
pl=(v*10^3)^2;//
disp(pl,"power loss is ,=")
```

Scilab code Exa 3.32 resistance

```
//Example 3.32:frequency and resistance
clc;
clear;
close;
r1=400;//ohms
```

```
c1=1;//micro farads
r2=1000;//ohms
r3=800;//ohms
c3=0.5;//micro farads
f=((1/((2*%pi)*sqrt(r1*r3*c1*10^-6*c3*10^-6))));//Hz
x=((c3/c1)+(r1/r3));//
r4=r2*x;//ohms
disp(round(f),"frequency is ,(Hz)=")
disp(r4,"resistance is ,(ohm)=")
```

Scilab code Exa 3.33 resistance and frequency

```
//Example 3.33:frequency and resistance
clc;
clear;
close;
r1=200;//ohms
c1=1;//micro farads
r3=400;//ohms
r4=1000;//ohms
c2=2;//micro farads
x=((r4/r3)-(c1/c2));//
r2=r1*x;//ohms
f=((1/((2*%pi)*sqrt(r1*r2*c1*10^-6*c2*10^-6))));//Hz
disp(r2,"resistance is ,(ohm)=")
disp(round(f),"frequency is ,(Hz)=")
```

Scilab code Exa 3.34 voltmeter

```
//Example 3.34:percentage error and voltmeter
   readings
clc;
clear;
```

```
close;
v=180;//volts
i=2;//amperes
rm2=v/i;//ohms
rv=2000;//ohms
iv=v/rv;//amperes
ir=i-iv;//amperes
r=v/ir;//ohms
per=((rm2-r)/r)*100;//
ra=0.01;//ohms
vr=i*(ra+r);//volts
disp(per,"percentage error is,(%)=")
disp(vr,"voltmeter reading is,(V)=")
```

Scilab code Exa 3.35 resistance

```
//Example 3.35:unknown resistance
clc;
clear;
close;
P=100.24;//ohms
Q=200;//ohms
S=100.03;//ohms
x=(P/Q)*S*10^-6;//ohms
q=200;//ohms
r=700;//micro ohms
p=100.31;//ohms
y=((q*r*10^-6)/(p+q+(r*10^-6)));//ohms
z=((P/Q)-(p/q));//ohms
R=x+(y*z);//micro ohms
disp(R*10^6,"unknown resistance is ,(micro-ohm)=")
```

Scilab code Exa 3.36 sensitivity

```
//Example 3.36:deflection of galvanometer and the
    sensivity
clc;
clear;
close;
P=1000;//ohms
Q=100;//ohms
S=200;//ohms
R1=((P/Q)*S);//ohms
R=2005;//ohms
dr=R-R1;//ohms
e=5;//volts
eo=e*((R/(R+S))-(P/(P+Q)));//volts
ro=(((R*S)/(R+S))+((P*Q)/(P+Q)));//ohms
G=100;//ohms
ig=eo/(ro+G);//amperes
si=10;//mm/micro-ampere
th=si*(ig*10^6);//mm
sb=th/dr;//mm/ohm
disp(th,"deflection of the galvanometer is,(mm)=")
disp(sb,"sensivity of bridge is,(mm/ohm)=")
```

Scilab code Exa 3.37 resistance

```
//Example 3.37: Insolution resistance of the cable
clc;
clear;
close;
v1=200;//volts
v2=125;//volts
t=30;//seconds
cr=t/(log(v1/v2));//
v21=100;//volts
cr1=t/(log(v1/v21));//
y=cr1/cr;//
```

```
x=10;//mega ohms
R=((x/y)-x);//mega ohms
disp(R,"resistance is ,(M-ohm)=")
```

Scilab code Exa 3.38 resistance and inductance

```
//Example 3.38:resistance and inductance
clc;
clear;
close;
r2=400;//ohms
r3=400;//ohms
r4=400;//ohms
r=500;//ohms
c=2;//micro farads
rX=((r2*r3)/r4);//ohms
l=(((c*10^-6*r2)/r4)*((r*(r3+r4))+(r3*r4)));//H
disp(rX,"resistance is ,(ohm)=")
disp(l,"inductance is ,(H)=")
```

Scilab code Exa 3.39 resistance and inductance

```
//Example 3.39:resistance and inductance
clc;
clear;
close;
r2=1000;//ohms
r3=15000;//ohms
r4=500;//ohms
c4=1.59;//micro farads
f=50;//Hz
w=2*%pi*f;//
```

```
l=((r2*r3*c4*10^-6)/((1+(w^2*(c4*10^-6)^2*r4^2))));//H
r=((r2*r3*r4*w^2*(c4*10^-6)^2)/((1+(w^2*(c4*10^-6)^2*r4^2))));//ohms
disp(l,"inductance is ,(H)=")
disp(r,"resistance is ,(ohm)=")
//resistance is calculated wrong in the textbook
```

Scilab code Exa 3.40 impedence

```
//Example 3.40:resistance and capacitance
clc;
clear;
close;
r2=1000;//ohms
r4=100;//ohms
c4=0.1;//micro farads
c3=1000;//pF
rs=((c4/(c3*10^-6))*r2);//M-ohm
cs=((r4/r2)*(c3*10^-6));//micro farads
disp(rs*10^-7,"resistance is ,(M-ohm)=")
disp(cs*10^6,"capacitance is ,(micro-F)")
```

Scilab code Exa 3.41 resistance and capacitance

```
//Example 3.41:resistance and capacitance
clc;
clear;
close;
r1=140;//ohms
c1=0.0115*10^-6;//F
r2=1000;//ohms
r4=1000;//ohms
```

```
w=7500;//
x=((1/(w^2*r1*c1)));//
c3=c1;//
r3=x/c3;//
disp(c3*10^6,"capaciatnce is ,(micro-F)=")
disp(r3*10^-6,"resistance is ,(M-ohm)=")
```

Scilab code Exa 3.42 limits

```
//Example 3.42:resistance
clc;
clear;
close;
dp=0.08;// % error
ds=0.05;// % error
dq=dp;//
dx=dp+ds+dq;// % percentage error
x=250;//ohms
dx1=dx*x;//
disp("Upper and lower limits of X are "+string(x+dx1
    )+" ohm and "+string(x-dx1)+" ohm")
```

Scilab code Exa 3.43 resistance

```
//Example 3.43:resistance
clc;
clear;
close;
Q=100.5;//ohms
M=300;//ohms
S=0.0045;//ohms
x=(Q/M)*S;//ohms
r=0.1;//ohms
```

```
m=300.25; //micro ohms
q=100.6; //ohms
y=((r*m)/(r+m+q)); //ohms
z=((Q/M)-(q/m)); //ohms
R=x+(y*z); // milli ohms
disp(R*10^3,"unknown resistance is ,(milli-ohm)=")
```

Scilab code Exa 3.44 sensitivity

```
//Example 3.44:balance current and bridge sensivity
clc;
clear;
close;
P=100; //ohms
Q=1000; //ohms
S=857; //ohms
X=((P/Q)*S); //ohms
E=1.5; // volts
dx=1/X; //
rg=50; //ohms
a1=((rg+(X*(Q+S))/(X+S))); //ohms
dig=((E*S*X*dx)/((X+S)^2*a1)); //
D=100; //M-ohm
sb=((dig*D*10^6)/dx); //
disp(dig*10^6,"balance current is ,(micro-A)=")
disp(sb*10^-1,"bridge sensivity is,(cm-(ohm/ohm))=")
//sensivity is calculated wrong in the book
```

Scilab code Exa 3.45 insulation resistance

```
//Example 3.45:insulation resistance
clc;
clear;
```

```
close;
x=0.4343;//
t=60;//seconds
e=350;//volts
v=150;//volts
c=8*10^-4;//micro-F
x1=((x*t)/(c*log10(e/v)))*10^-3;//M-ohm
l=1000;//m
l2=500;//m
xo=((x1*10^3*l2)/l);//M-ohm
disp(xo*10^-3,"resistance is ,(M-ohm)=")
```

Scilab code Exa 3.46 resistance

```
//Example 3.46:insulation resistance
clc;
clear;
close;
v=170;//volts
e=250;//volts
t=20;//seconds
cr1=t/(log(e/v));//
v1=110;//volts
e=250;//volts
t=20;//seconds
cr2=t/(log(e/v1));//
x=cr1/cr2;//
r1=25;//M-ohm
r2=70;//M-ohm
y=((r1*r2)/(r1+r2));//
R=((x*r2*(r1*r2))-(r2*r1*r2))/((r2*(r1+r2))-((r1*r2*
    x)));//
disp(R,"resistance is ,(M-ohm)=")
```

Scilab code Exa 3.47 insulation resistance

```
//Example 3.47: resistance
clc;
clear;
close;
em=500;//volts
ep=50;//volts
en=150;//volts
rv=50;//k-ohm
rp=((em-ep-en)/en)*rv*10^3;//ohm
rn=((em-ep-en)/ep)*rv*10^3;//
disp(rp*10^-6,"Rp is ,(M-ohm)=")
disp(rn*10^-6,"Rn is ,(M-ohm)=")
```

Scilab code Exa 3.49 reading

```
//Example 3.49: readings
clc;
clear;
close;
rp=1;//M-ohm
rn=2;//M-ohm
r=50;//killo ohms
x=((rp*10^6)/(r*10^3));//
v=500;//volts
ep=(v)/((rn*x+(rn+rp)));//volts
en=2*ep;//
disp(ep,"Ep is ,(V)=")
disp(en,"En is ,(V)=")
```

Scilab code Exa 3.50 resistance and inductance

```
//Example 3.50:Resistance and Inductance
clc;
clear;
close;
R2=600;//OHMS
R4=400;//OHMS
R3=1000;//OHMS
C3=0.5;//MICRO-f
r=((R2*R4)/R3);//ohms
l=R2*R4*C3*10^-6;//H
disp(r,"resistance is,(ohm)=")
disp(l,"inductance is,(H)=")
```

Scilab code Exa 3.51 percentage error

```
//Example 3.51:Resistance
clc;
clear;
close;
p=100;//ohms
q=1000;//ohms
s=518.8;//ohms
ep=0.1;//
eq=0.1;//
es1=0.05;//
es2=0.05;//
es3=0.1;//
es4=0.5;//
tes=0.267;//
pes=(tes/s)*100;//
```

```
ds=0.008;//ohms
pds=(ds/s)*100;//
ttos1=pes+pds;//
ttos2=-pes+pds;//
m1=ep+eq+ttos1;//
m2=-ep-eq+ttos2;//
disp(m1,"The maximum (+ve) percentage error in X,=")
disp(m2,"The maximum (-ve) percentage error in X,=")
disp("Therefore limits of percentage error in X is +
    "+string(m1)+" to "+string(m2)+" ")
```

Scilab code Exa 3.52 capacitance and resistance

```
//Example 3.52:loss angle
clc;
clear;
close;
r2=2000;//ohms
r3=2850;//ohms
r4=0.4;//ohms
c4=0.5;//micro-F
R4=4.8;//ohms
r1=((r2*(R4+r4))/r3);//ohms
c1=((r3*c4)/r2);//micro-F
f=450;//Hz
w=2*%pi*f;//
d=f*c1*10^-6*r1;//
ad=atand(d);//
x=round(ad);//
disp("loss angle is "+string(x)+" degree and "+
    string(round(ad*60))+" minutes ")
```

Scilab code Exa 3.53 resistance

```
//Example 3.53: resistance
clc;
clear;
close;
em=500;//volts
i1=0.8;//mA
r=30;//killo ohms
i2=0.4;//mA
ep=i1*r;//volts
en=i2*r;//volts
rv=50;//k-ohm
rp=((em-ep-en)/en)*r*10^3;//ohm
rn=((em-ep-en)/ep)*r*10^3;//
disp(rp*10^-6,"R1 is ,(M-ohm)=")
disp(rn*10^-6,"R2 is ,(M-ohm)=")
```

Scilab code Exa 3.54 capacitance and resistance

```
//Example 3.54: resistance and capacitance
clc;
clear;
close;
r2=100;//ohms
r4=1000;//ohms
r1=50;//ohms
f=50;//Hz
l=0.1;//H
r3=((r2*r4)/r1)+((r1*r2*r4)/((2*%pi*f)^2*l^2));//ohms
c3=r1/((2*%pi*f)^2*l*r3);//F
disp(r3,"resistance is ,(ohm)=")
disp(c3*10^6,"capacitance is ,(micro-F)=")
//resistance is wrong in the textbook
```

Scilab code Exa 3.56 resistance

```
//Example 3.54: resistance and inductance
clc;
clear;
close;
r2=16800;//ohms
r3=950;//ohms
r4=1000;//ohms
f=50;//Hz
c3=1.57;//micro-F
x=((r2*r3*r4*(2*%pi*f)^2*(c3*10^-6)^2));//
y=(1+(((2*%pi*f)^2)*(c3*10^-6)^2*r3^2));//
r1=x/y;//ohms
l1=((r2*r4*c3*10^-6)/y);//
disp(r1,"resistance is ,(ohm)=")
disp(l1,"inductance is ,(H)=")
//resistance is wrong in the textbook
```

Scilab code Exa 3.57 capacitance and power factor

```
//Example 3.57: resistance , capacitance AND POWER
   FACTOR
clc;
clear;
close;
f=50;//Hz
r2=120;//ohms
c3=0.4;//micro-F
c4=106;//pF
r3=318;//ohms
r1=((r2*c3*10^-6)/(c4*10^-12));//ohms
```

```
c1=((c4*10^-12*r3)/r2);//pF
pf=((r1)/(sqrt(r1^2+(1/(2*%pi*f*c1)^2))));//
disp(round(r1*10^-3),"resistance is,(k-ohm)=")
disp(round(c1*10^12),"capacitance is ,(p-F)=")
disp(pf,"power factor is,=")
```

Scilab code Exa 3.58 value of X

```
//Example 3.58: resistance
clc;
clear;
close;
l1=26;//cm
l2=24;//cm
l1d=25.8;//cm
l2d=23.5;//cm
s=545;//ohm
sg=65;//ohm
sd=((s*sg)/(s+sg));//ohm
X=((sd*(l1-l2))-s*(l1d-l2d))/(l1-l2-l1d+l2d);//
disp(X,"X is ,=")
```

Scilab code Exa 3.59 capacitance and resistance

```
//Example 3.59: capacitance and resistance
clc;
clear;
close;
e1=5000;//volts
r1=500;//ohm
l1=0.18;//H
r2=1000;//ohm
r4=r2;//ohms
```

```
x=(r1/(e1^2*l1));//
y=((r2*r2)/(1+((e1^2)*x^2)));//
c3=((l1/y));//F
r3=(x/c3);//
disp(c3*10^6,"capacitance is,(micro-F)=")
disp(r3,"resistance is,(ohm)=")
```

Scilab code Exa 3.60 capacitance and resistance

```
//Example 3.60 capacitance and resistance
clc;
clear;
close;
r2=1000;//ohm
w=7500;//
c4=0.0115;//micro-F
r4=140;//ohms
r3=1000;//ohms
x=(1+(w^2*(c4*10^-6)^2*(r4^2)));//
r1=((r2*x)/(r3*r4*w^2*(c4*10^-6)^2));//ohms
c1=((r3/r2)*(c4*10^-6))/x;//F
disp(r1*10^-3,"resistance is ,(k-ohm)=")
disp(c1*10^6,"capacitance is,(micro-F)=")
```

Scilab code Exa 3.61 inductance

```
//Example 3.61;resistance and inductance
clc;
clear;
close;
p=0;//
r2=10;//ohms
r4=900;//ohms
```

```
c3=0.9;//micro-F
c4=0.15;//micro-F
r=((r2*c3*10^-6)/(c4*10^-6));//ohms
l=r2*r4*c3*10^-3;//mH
disp(r,"resistance is ,(ohm)=")
disp(l,"inductance is ,(mH)=")
```

Scilab code Exa 3.62 resistance

```
//Example 3.62;resistance
clc;
clear;
close;
d2=350;//
f2=1000;//Hz
s=1;//M-ohm
d1=250;//
f1=2.5;//Hz
X=((d2*f2*s)/(d1*f1));//M-ohm
l=400;///m
l1=1000;//m
x=(X*l)/l1;//M-ohm
disp(x,"resistance is ,(M-ohm)=")
```

Scilab code Exa 3.63 resistance and inductance

```
//Example 3.63:resistance and inductance
clc;
clear;
close;
r2=50;//ohms
r3=100;//ohms
r4=100;//ohms
```

```
r=2500; //ohms
c=1; //micro farads
rX=((r2*r3)/r4); //ohms
l=(((c*10^-6*r2)/r4)*((r*(r3+r4))+(r3*r4))); //H
disp(rX,"resistance is ,(ohm)=")
disp(l,"inductance is ,(H)=")
```

Scilab code Exa 3.64 permittivity and power factor

```
//Example 3.64: permittivity and power factor
clc;
clear;
close;
r3=350; //ohms
f=50; //Hz
r2=250; //ohms
c3=0.4; //micro-F
c4=100; //pF
r1=((r2*c3*10^-6)/(c4*10^-12)); //ohms
c1=((c4*10^-12)*(r3/r2)); //F
l=5; //mm
l1=10; //cm
e=((c1*l*10^-3)/((%pi/4)*(l1/100)^2)); //
pf=r1*2*%pi*f*c1; //
disp(e,"permittivity is,=")
disp(pf,"power factor is,=")
```

Scilab code Exa 3.65 constant

```
//Example 3.65: resistance and capacitance
clc;
clear;
close;
```

```
rab=2000;//ohms
f=1;//kHz
cab=0.047;//micro-farad
zab=(1/((1/rab)+(%i*2*%pi*f*10^3*cab*10^-6)));//
rbc=1000;//ohms
cbc=0.47;//micro-F
zbc=rbc-(%i/(2*%pi*f*10^3*cbc*10^-6));//
cda=0.5;//micro-F
zda=(-%i/(2*%pi*f*10^3*cda*10^-6));//
zx=(zda*zbc)/zab;//
rx=real(zx);//ohms
cx=-1/(2*%pi*f*10^3*imag(zx));//
disp(round(rx),"resistance is ,(ohm)=")
disp(cx*10^6,"capacitance is ,(micro-F)=")
```

Scilab code Exa 3.66.a capacitance

```
//Example 3.66.a:capacitance
clc;
clear;
close;
zbc=1000;//ohms
f=1;//kHz
cda=0.2;//micro-F
zab=500;//ohms
zda=(-%i/(2*%pi*f*10^3*cda*10^-6));//
zcd=(zbc*zda)/zab;//
cx=-1/(2*%pi*f*10^3*imag(zcd));//
disp(cx*10^6,"capacitance is ,(micro-F)=")
```

Scilab code Exa 3.66.b voltage

```
//Example 3.66.b:voltage
```

```
clc;
clear;
close;
zbc=1000;//ohms
f=1;//kHz
cda=0.2*10^-6;//micro-F
zab=500;//ohms
zda=(-%i/(2*%pi*f*10^3*cda));//
zcd=(zbc*zda)/zab;//
cx=-1/(2*%pi*f*10^3*imag(zcd));//
rba=1002;//ohms
v1=10;//volts
iab=v1/(rba+zab);//amperes
ibc=iab;//amperes
ida=v1*%i*2*%pi*f*10^3*((cda*cx)/(cda+cx));//amperes
icd=ida;//amperes
vab=(v1*zab)/(rba+zab);//volts
vab1=icd/(%i*2*%pi*10^3*cda);//volts
vbd=vab1-vab;//volts
disp(vbd*10^3,"voltage across the detector is,(mV)="
  )
```

Scilab code Exa 3.66.c voltage

```
//Example 3.66.c:voltage
clc;
clear;
close;
zbc=1000;//ohms
f=1;//kHz
cda=0.2*10^-6;//micro-F
zab=500;//ohms
zda=(-%i/(2*%pi*f*10^3*cda));//
zcd=(zbc*zda)/zab;//
cx=-1/(2*%pi*f*10^3*imag(zcd));//
```

```
rba=1002;//ohms
v1=10;//volts
iba=v1/(zab-(%i/(2*%pi*10^3*cda)));//
vba=zab*iba;//
v2=sqrt(real(vba)^2+imag(vba)^2);//volts
ibc=v1/(rba-(%i/(2*%pi*10^3*cx)));//
vbc=rba*ibc;//
v3=sqrt(real(vbc)^2+imag(vbc)^2);//volts
vac=v3-v2;//
disp(vac*10^3,"voltage across the detector is,(mV)="
    )
```

Scilab code Exa 3.67 frequency and resistance

```
//Example 3.67:frequency and resistance
clc;
clear;
close;
rab=800;//ohm
cab=0.4;//micro-F
rbc=500;//ohms
cbc=1;//micro-F
rcd=1200;//ohm
x=cab*10^-6*rab;//
y=cbc*10^-6*rbc;//
w=sqrt(1/(x*y));//rad/s
f=w/(2*%pi);//
zab=(rab/((1+(%i*w*cab*10^-6*rab))));//ohms
zbc=rbc+(1/((1+(%i*w*cbc*10^-6*rbc))));//ohms
zda=(zab*rcd)/zbc;//ohms
disp(round(f),"frequency is,(Hz)=")
disp(round(real(zda)),"resistance is,(ohm)=")
```

Scilab code Exa 3.68.a constant

```
//Example 3.68.a:resistance and inductance
clc;
clear;
close;
cab=0.01;//micro-F
rbc=2.5;//k-ohms
cbc=1;//micro-F
rda=7.5*10^3;//ohm
cda=0.02;//micro-F
w=50*10^3;//Hz
zab=(-1/(((%i*w*cab*10^-6*1))));//ohms
zbc=rbc*10^3;//ohms
zda=rda+(1/(((%i*w*cda*10^-6))));//ohms
zcd=(zbc*zda)/zab;//
r=-real(zcd);//ohms
l=-imag(zcd)/w;//H
disp(round(r),"resistance is,(ohm)=")
disp(l,"inductance is,(H)=")
```

Scilab code Exa 3.68.b resistance

```
//Example 3.68.B:resistance and inductance
clc;
clear;
close;
cab=0.01;//micro-F
rbc=2.5;//k-ohms
cbc=1;//micro-F
rda=7.5*10^3;//ohm
cda=0.02;//micro-F
w=50*10^3;//Hz
zab=(-1/(((%i*w*cab*10^-6*1))));//ohms
zbc=rbc*10^3;//ohms
```

```
zda1=rda+(1/(((%i*w*cda*10^-6))));//ohms
zda=zda1/(1+(zda1*%i*w*100*10^-12));//
zcd=(zbc*zda)/zab;//
r=-real(zcd);//ohms
l=-imag(zcd)/w;//H
disp((r),"resistance is,(ohm)=")
disp(l,"inductance is,(H)=")
```

Scilab code Exa 3.69.a resistance and capacitance

```
//Example 3.69.a:resistance and capacitance
clc;
clear;
close;
zab=521;//ohms
zbc=1200;//ohms
rda=12.1;//ohms
f=10;//kHz
cda=0.045;//micro-F
zda=rda-(%i/(2*%pi*f*10^3*cda*10^-6));//
zcd=(zbc*zda)/zab;//
disp(real(zcd),"resistance is,(ohm)=")
c=1/(2*%pi*f*10^3*imag(zcd));//
disp(-c*10^6,"capcitance is,(micro-F)=")
```

Scilab code Exa 3.69.b error

```
//Example 3.69.b:resistance and capacitance
clc;
clear;
close;
rab=521;//ohms
lab=2;//micro-H
```

```
cab=550; //pF
rbc=1200; //ohms
lbc=5; //micro-H
cbc=250; //pF
rda=12.1; //ohms
rda1=1.5; //m-ohms
f=10; //kHz
cda=0.045; //micro-F
zab=1/((1/(rab+(%i*2*%pi*f*10^4*lab*10^-6))+(%i*2*
    %pi*f*10^3*cab*10^-12)); //
zbc=1/((1/(rbc+(%i*2*%pi*f*10^4*lbc*10^-6))+(%i*2*
    %pi*f*10^3*cbc*10^-12)); //
zda=rda+((1/((1/rda1*10^-6)+(%i*2*%pi*f*10^3*cda
    *10^-6)))); //;//
zcd=(zbc*zda)/zab; //
zab1=521; //ohms
zbc1=1200; //ohms
rda1=12.1; //ohms
f1=10; //kHz
cda1=0.045; //micro-F
zda1=rda1-(%i/(2*%pi*f1*10^3*cda1*10^-6)); //
zcd1=(zbc1*zda1)/zab1; //
c1=1/(2*%pi*f*10^3*imag(zcd1)); //
c=1/(2*%pi*f*10^3*imag(zcd)); //
per=((real(zcd1)-real(zcd))/real(zcd))*100; //
pec=((imag(zcd1)-imag(zcd))/imag(zcd))*100; //
disp(per,"error in R is,(%)=")
disp(pec,"error in C is,(%)=")
//answer is wrong in the textbook
```

Scilab code Exa 3.70 resistance

```
//Example 3.70:resistance
clc;
clear;
```

```
close;
w=5000;//rad/s
cab=0.2;//micro-F
zab=(-%i/(w*cab*10^-6));//ohms
zbc=500;//ohm
l=0.1;//H
rcd=50;//ohm
zcd=rcd+%i*w*l;//ohm
cda=0.4;//micro-F
izda=-%i/(w*cda*10^-6);//
zda=(zab*zcd)/zbc;//
rs=real(zda);//ohms
disp(rs,"resistance is ,(ohm)=")
```

Scilab code Exa 3.71.a capacitance

```
//Example 3.71.a:resistance and capacitance
clc;
clear;
close;
c2=0.004;//micro-F
c3=0.001;//micro-F
r3=10;//killo ohms
r4=5;//killo ohms
f=1;//kHz
rx=(c3/c2)*r4;//killo ohms
cx=(r3/r4)*c2;//micro-F
disp(rx,"resistance is ,(k-ohm)=")
disp(cx,"capacitance is ,(micro-F)=")
```

Scilab code Exa 3.71.b capacitance

```
//Example 3.71.b:resistance and capacitance
```

```
clc;
clear;
close;
c1=10^-4;//micro-F
c2=0.004;//micro-F
c3=0.001;//micro-F
r3=10;//killo ohms
r4=5;//killo ohms
f=1;//kHz
rx=((c3+c1)/c2)*r4;//killo ohms
cx=(r3/r4)*c2;//micro-F
disp(rx,"resistance is ,(k-ohm)=")
disp(cx,"capacitance is ,(micro-F)=")
```

Scilab code Exa 3.72 inductance resistance and impedance

```
//Example 3.72:resistance and inductance
clc;
clear;
close;
r2=100;//ohm
r4=834;//ohm
c3=0.1;//micro-F
l1=r2*r4*c3*10^-3;//mH
c4=0.124;//micro-F
r1=(c3/c4)*r2;//
f=2;//kHz
z1=sqrt(r1^2+(2*%pi*f*10^3*l1*10^-3)^2);//
disp(l1,"inductance is ,(mH)=")
disp(r1,"resistance is ,(ohm)=")
disp(z1,"impedence is ,(ohm)=")
```

Scilab code Exa 3.73 value of M

```
//Example 3.73: inductance
clc;
clear;
close;
l1=4;//H
r1=1;//ohm
r2=1;//ohm
r3=2;//ohm
l4=2;//H
r4=2;//ohm
M=((r3*l1)-(r2*l4))/(r2+r3);//H
disp(M,"M is ,(H)=")
```

Scilab code Exa 3.74 resistance and inductance

```
//Example 3.74.a:resistance and inductance
clc;
clear;
close;
r2=500;//ohms
r3=300;//ohms
r4=500;//ohms
r=150;//ohms
c=2.5;//nano farads
rX=((r2*r3)/r4);//ohms
l=(((c*10^-9*r3)/r4)*((r*(r2+r4))+(r2*r4)));//H
disp(rX,"resistance is ,(ohm)=")
disp(l*10^2,"inductance is ,(mH)=")
```

Scilab code Exa 3.75 current and iron loss

```
//Example 3.75:iron loss
clc;
```

```
clear;
close;
r2=18;//ohm
r4=550;//ohm
r3=1250;//ohm
r1=(r2*r4)/r3;//ohm
c3=0.5;//micro-F
l1=r2*r4*c3*10^-3;//mH
r4=550;//ohm
r31=1125;//ohm
r11=(r2*r4)/r31;//ohm
c31=3.85;//micro-F
l11=r2*r4*c31*10^-3;//mH
v=50;//volts
w=4000;//rad/s
i1=v/(sqrt((r1+r11)^2+(w^2*(l11*10^-3)^2)));//
tl=i1^2*r11;//W
cl=i1^2*r1;//W
il=tl-cl;//
disp(i1,"current is ,(A)=")
disp(il,"iron loss is ,(W)=")
```

Scilab code Exa 3.77 resistance and capacitance

```
//Example 3.77:parameters
clc;
clear;
close;
rab=1000;//ohm
f=1;//kHz
cab=0.5;//micro-F
zab=1/((1/rab)+(%i*2*%pi*f*10^3*cab*10^-6));//
rbc=1000;//ohm
zbc=rbc-(%i/(2*%pi*f*10^3*cab*10^-6));//
rcd=200;//ohm
```

```
lcd=30;//mH
zcd=rcd+(%i*2*%pi*f*10^3*lcd*10^-3);//
zda=(zab*zcd)/zbc;//ohm
R=real(zda);//
cda=1/(2*%pi*f*10^3*imag(zda));//
disp(R,"resistance is ,(ohm)=")
disp(-cda*10^6,"capacitance is ,(micro-F)=")
x=sqrt(real(zda)^2+imag(zda)^2);//
rp=x;//ohms
cp=(((-imag(zda))/real(zda))*10^3)/(2*%pi*rp);//
disp(rp,"Rp is ,(ohm)=")
disp(cp,"Cp is ,(micro-F)=")
//Rp and Cp is calculated wrong in the textbook
```

Chapter 4

Potentiometer

Scilab code Exa 4.1 resistance

```
//Example 4.1: Unknown resistor
clc;
clear;
close;
//given data :
Vd=0.83942;// volt-drop in V
emf=23*10^-6;// in V
Vds=1.01575;// volt-drop in V
Rs=0.10014;// in ohm
Vdt=Vd-emf;// in V
I=Vds/Rs;
R=Vdt/I;
disp(R,"Unknown resistor ,R(ohm) = ")
```

Scilab code Exa 4.2 emf and percentage error

```
//Example 4.2: emf and % error
clc;
```

```
clear;
close;
//given data :
l=50;// in cm
l1=70;// in cm
l2=65;// in cm
l3=43.5;// in cm
I=0.45;// in A
V=1.0183;// in V
V1=1.35;// in V
R=2;// in ohm
Vpl=V/l;// in V/cm
emf=Vpl*l1;
disp(emf,"(a). emf of the cell,(V) = ")
Vr=Vpl*l2;
P_error1=((V1-Vr)/Vr)*100;
disp(P_error1 ,"(b). % error (high),(%) = ")
Ir=(Vpl*l3)/R;// in A
P_error2=((I-Ir)/Ir)*100;
disp(P_error2,"(c). % error (high),(%) = ")
```

Scilab code Exa 4.3.a current and resistance

```
//Example 4.3.a: current and resistance
clc;
clear;
close;
e1=1.0191;//V
r1=100;//ohms
l=2;//m
I=l/r1;//A
e2=4;//V
rh=(e2/I)-r1;//
disp(I,"current is ,(A)=")
disp(rh,"resistance is ,(ohm)=")
```

Scilab code Exa 4.3.b current and resistance

```
//Example 4.3.B: current and resistance
clc;
clear;
close;
e1=4;//V
e2=1.0191;//V
R1=100;//OHM
R2=49.045;//OHMS
r3=R1-R2;//ohms
rg=50;//ohms
r4=200;//ohms
A=[r4 -r3;-r3 (r4+rg+r3)];//
B=[e1;e2];//
X=A\B;//
I2=X(2,1)*10^3;//
disp(I2,"current is ,(mA)=")
I1=((e1+(r3*10^-5))/r4);//mA
rp=((e2+(r3*I1)-(r4+rg+r3)*10^-5)/10^-5);//
disp(rp*10^-2,"resistance is ,(k-ohm)=")
//resistance is calculated wrong innthe textbook
```

Scilab code Exa 4.4 resistance

```
//Example 4.4: Resistance
clc;
clear;
close;
//given data :
emf=1.01892;// in V
```

```
R=1;// in M-ohm
V=1.01874;// in V
Ic=V/R;
Vd=emf-V;
Ri=Vd/(Ic*10^-6);
disp(Ri,"internal resistance,Ri(ohm) = ")
```

Scilab code Exa 4.5 resistance

```
//Example 4.5: Resistance
clc;
clear;
close;
//given data :
l=65;// in cm
V=0.1;// in V
V1=5.5;// in V
R=20;// in ohm
E=V*l;
I=V1/R;
Ri=(E-V1)/I;
disp(Ri,"Internal resistance,Ri(ohm) = ")
```

Scilab code Exa 4.6 resistance

```
//Example 4.6: Resistance
clc;
clear;
close;
vr=5;//V
r=10;//k-ohm
x=vr*r*10^3;//
R=x;//
```

```
disp(R*10^-3,"resistance is ,(k-ohm)=")
```

Scilab code Exa 4.7 length of slide wire

```
//Example 4.7: Length
clc;
clear;
close;
//given data :
l=40;// in cm
r=0.5;// ion ohm
R=r*l/1;// in ohm
V=1.2;// in V
V1=6;// in V
I=V/R;
x=V1/(r*I);
disp(x,"The length of slide wire,x(cm) = ")
```

Scilab code Exa 4.8 design

```
//Example 4.8: design
clc;
clear;
close;
vab=1;//V
vr=2-vab;//V
i=50;//mA
R=vr/(i*10^-3);//ohm
R1=(vr/10)/(i*10^-3);//ohm
n=10;//
tr1=n*R1;//ohm
r2=2*R1;//
l=100;//cm
```

```
x=R1/l;//
disp(R,"resistance R is,(ohm)=")
disp(R1,"resistance R1 is,(ohm)=")
disp(r2,"resistance R2 is,(ohm)=")
disp(x,"resistance per cm of slide wire is ,(ohm/cm)
   =")
```

Scilab code Exa 4.9.a resistance

```
//Example 4.9.a:resistance
clc;
clear;
close;
st=15;//steps
r=5;//ohm
rsw=5.5;//ohm
tr=(st*r)+rsw;//ohm
vr=1.61;//V
i=vr/tr;//A
e2=1.61;//V
e1=2.40;//V
rh=(e1-e2)/i;//ohm
disp(rh,"resistance is,(ohm)=")
```

Scilab code Exa 4.9.b resolution

```
//Example 4.9.b:resolution
clc;
clear;
close;
st=15;//steps
r=5;//ohm
rsw=5.5;//ohm
```

```
tr=(st*r)+rsw;//ohm
vr=1.61;//V
i=vr/tr;//A
e2=1.61;//V
e1=2.40;//V
rh=(e1-e2)/i;//ohm
trn=11;//turns
slwr=rsw/trn;//ohm
vd=slwr*i;//V
dv=100;//divisions
vedv=(1/dv)*vd;//
rs=vedv/5;//
disp(rs*10^6,"resolution of the instrument is,(micro
   -V)=")
```

Scilab code Exa 4.9.c error

```
//Example 4.9.c:error
clc;
clear;
close;
st=15;//steps
r=5;//ohm
rsw=5.5;//ohm
tr=(st*r)+rsw;//ohm
vr=1.61;//V
i=vr/tr;//A
e2=1.61;//V
e1=2.40;//V
rh=(e1-e2)/i;//ohm
trn=11;//turns
slwr=rsw/trn;//ohm
vd=slwr*i;//V
dv=100;//divisions
vedv=(1/dv)*vd;//
```

```
rs=vedv/5;//
ig=0.05;//micro-A
vlt=1.1;//V
ir=50;//ohm
em=((ig*ir));//
disp(em,"error is,(micro-V)")
```

Scilab code Exa 4.10 power dissipated and mean stored energy

```
//Example 4.10:power dissipated
clc;
clear;
close;
r1=0.6-%i*0.24;//V
r2=0.6+%i*0.4;//V
r3=-0.1-%i*0.4;//V
f=50;//Hx
ir=1000;//ohm
i1=r1/ir;//A
pdr=(real(r1)*real(i1))+(imag(r1)*imag(i1));//W
disp(pdr*10^3,"power dissipated in the resistor is,(
    mW)=")
pdC=(real(r1)*real(i1))+(imag(r2)*imag(i1));//W
disp(pdC*10^3,"power dissipated in the coil is,(mW)=
    ")
pdc=(real(r3)*real(i1))-(imag(r2)*imag(i1));//W
disp(pdc*10^3,"power dissipated in the capacitor is
    ,(mW)=")
imp=(r2/r1)*10^3;//ohm
rc=imag(imp);//ohm
indu=rc/(2*%pi*f);//H
ersl=(1/2)*(imag(i1)^2+real(i1)^2)*indu;//joules
disp(ersl*10^6,"energy stored in the coil is,(micro-
    J)=")
admc=(r1*10^-3)/r3;//ohm^-1
```

```
C=imag(admc)/(2*%pi*f);//
ersc=(1/2)*(imag(r3)^2+real(r3)^2)*C;//
disp(ersc*10^6,"energy stored in capacitor is,(micro
    -J)=")
```

Scilab code Exa 4.11 measuring range resolution working current and setting

```
//Example 4.11:measuring range,resulution,working
    current,setting of the rheostata
clc;
clear;
close;
sd=18;//steps
v1=0.1;//V
mr=(sd*v1)+v1;//V
disp(mr,"measuring range of the potentiometer is,(V)
    =")
dv=100;//divisions
rs=(v1/dv)*(1/2);//mV
disp(rs*10^3,"resolution is,(mV)=")
dr=10;//ohm
cdd=v1/dr;//A
disp(cdd*10^3,"current through the dial is,(mA)=")
wbc=6;//V
rsv=wbc-mr;//V
sh=rsv/cdd;//ohm
disp(sh,"setting of the rheostat is,(ohm)=")
```

Scilab code Exa 4.12 voltage and percentage error

```
//Example 4.12:voltage and percentage error
clc;
```

```
clear;
close;
st=15;//steps
r1=10;//ohm
v1=0.1;//V
r2=10;//ohm
r3=9.9;//ohm
v2=0.0185;//V
acr=(r1*r3)+((r2*v2)/v1);//ohm
v3=1.0185;//V
I=v3/acr;//
n=6;//
acr1=(n*r3)+(r2*0.0525)/v1;//ohm
tvr=I*acr1;//V
vg=0.6525;//
er=((tvr-vg)/tvr)*100;//
disp(tvr,"true value of drop across the resistance
    is ,(V)=")
disp(er,"percentage error is ,(%)=")
```

Scilab code Exa 4.13 resistanc and reactance

```
//Example 4.13:resistance and reactance
clc;
clear;
close;
r1=2;//ohm
r2=9;//
imp=r1+%i*r2;//ohm
mg=sqrt(r1^2+r2^2);//
th=atand(r2/r1);//
vm=85;//V
va=40;//degree
vm1=90;//V
va1=45;//degree
```

```
ccm=vm/mg;//A
cca=va-th;//degree
impm=vm1/ccm;//ohm
impa=va1-cca;//degree
reac=impm*sind(impa);//ohm
rc=sqrt(impm^2-reac^2);//ohm
f=50;//Hz
ind=reac/(2*%pi*f);//
disp(rc,"reactance is,(ohm)=")
disp(fix(ind*10^3),"inductance of the coil is,(mH)="
    )
```

Scilab code Exa 4.14 limit of error and deflection

```
//Example 4.14:limit of error,deflection
clc;
clear;
close
x=17.5;//mm/micro-A
r1=850;//ohm
lr=r1*(1/x);//micro V
disp("limit of error in the reading is   "+string(lr
    )+" micro-V")
v1=2;//V
r2=80;//
i1=v1/r2;//A
v2=0.1;//V
r3=v2/i1;//ohm
v3=1.43;//V
r4=v3/i1;//ohm
l=50;//cm
l1=2;//mm
r5=((l1/10)/l)*r3;//ohm
fr=r4+r5;//ohm
fr1=22.784;//
```

```
R=(fr*fr1)/r2;//ohm
e=i1*fr;//V
ig=(e-v3)/(r1+R);//A
dg=ig*x*10^6;//mm
disp(dg,"deflection of the galvanometer is ,(mm)=")
```

Scilab code Exa 4.15 current

```
//Example 4.15: Current
clc;
clear;
close;
//given data :
V1=4.2;// in V
V2=1.43;// in V
r1=21.0;// in ohm
r2=1;// in ohm
r3=15;// in ohm
I=V1/r1;// in A
R=V2/I;// in ohm
R1=R+r2;
R2=R-r2;
R3=round(R1*(r1-R1)/r1);
R4=R2*(r1-R2)/r1;
e1=R1*I;
e2=R2*I;
I1=(e1-V2)*10^3/(R3+r3);
I2=(V2-e2)*10^3/(R4+r3);
disp(I1,"Current in one direction,I1(mA) = ")
disp(I2,"Current in another direction,I2(mA) = ")
```

Chapter 5

Magnetic Measurement

Scilab code Exa 5.1 capacity of capacitor

```
//Example 5.1: Capacity of the capacitor
clc;
clear;
close;
//given data :
Ig=0.0001;// in A
T0=3;// in sec
theta0=200;
theta=45;
V=100;// in V
Q=(Ig*T0*theta0)/(theta*2*%pi);
C=(Q/V)*10^6;
disp(C,"Capacity of the capacitor,C(micro-F) = ")
```

Scilab code Exa 5.2 coulomb sensivity

```
//Example 5.2: Coulomb sensitivity
clc;
```

```
clear;
close;
//given data :
C=1.5*10^-6;// in F
V=15;// in V
d1=20;// in cm
Q=C*V;
Sb=(d1/Q)*10^-5;
disp(Sb,"Coulomb sensitivity ,Sb(mm/micro-C)")
```

Scilab code Exa 5.3.a logarithmic decrement

```
//Example 5.3.a: Logarithmic increment
clc;
clear;
close;
//given data :
theta1=12.5;
theta2=10;
lamda=log(theta1/theta2);
disp(lamda,"Logarithmic increment , = ")
```

Scilab code Exa 5.3.b frequency

```
//Example 5.3.b:frequency
clc;
clear;
close;
//given data :
theta1=12.5;
theta2=10;
lamda=log(theta1/theta2);
x=lamda^2;//
```

```
y=x/(%pi^2-x);//
y1=sqrt(y);//
f=0.125;//Hz
fo=f/(sqrt(1-y1^2));//Hz
disp(fo,"undamped frequency is,(Hz)=")
```

Scilab code Exa 5.4 flux density

```
//Example 5.3.b: Flux density
clc;
clear;
close;
//given data :
I1=5;// in A
I2=10;// in A
N1=100;// number of turns
N2=200;//number of turns
l=30*10^-2;// in m
R=200;// in ohm
theta1=45;// in degree
theta2=30;// in degree
As=0.3*10^-4;// in m^2
M=100*10^-3;// in H
k=(2*M*I1)/(R*theta1);
H=(N1*I2)/l;
fi=(R*k*theta2)/(2*N2);
B=fi/As;
mu=H/B;
disp(B,"Flux density,B(Wb/m^2) = ")
disp(mu,"permeability,mu(H/m) = ")
//flux density is calculed wrong in the textbook
```

Scilab code Exa 5.5 flux density

```
//Example 5.5: Flux density and relative
   permeability
clc;
clear;
close;
//given data :
format('v',4)
A=5*10^-4;// in m^2
d=25*10^-2;// in m
l=%pi*d;
N1=150;// turns
N2=300;// turns
k=2*10^-6;// coulomb per division
R=2500;// in ohm
I=10;// in A
theta=75;// in division
mu_0=4*%pi*10^-7;
B=(k*theta*R)/(2*N2*A);
disp(B,"Flux density,B(Wb/m^2) = ")
H=(N1*I)/l;
mu_r=(B/(mu_0*H));
disp(mu_r,"Relative permeability, = ")
```

Scilab code Exa 5.6 flux per pole and leakage coefficient

```
//Example 5.6 //flux per pole and leakage cofficient
clc;
clear;
close;
k=0.15;//micro-C
th=120;//divisions
th1=135;//divisions
r=4500;//ohm
n=3;//turns
ft=(k*10^-6*th*r)/n;//Wb
```

```
n1=4;//
ft1=(k*10^-6*th1*r)/n1;//Wb
disp(ft,"In case of total flux is,(Wb)=")
disp(ft1,"In case of useful flux is,(Wb)=")
lk=ft/ft1;//
disp(lk,"leakage coefficient is,=")
```

Scilab code Exa 5.7 relative permeability

```
//Example 5.7 //relative permeability
clc;
clear;
close;
n1=320;//turns
n2=250;//turns
i=10;//A
l=32;//cm
N=(n1*i)/(l*10^-2);//AT/m
fl=2.5*10^-4;//Wb
sd=100;//
k=(fl*i)/sd;//
sd1=270;///
mo=4*%pi*10^-7;//
A=0.35;//cm^2
ur=((k*sd1)/(2*mo*N*A*10^-4*n2));//
disp(ur,"relative permeability is,=")
```

Scilab code Exa 5.8 resistance

```
//Example 5.7 // Shunt resistance
clc;
clear;
close;
```

```
//given data :
N=800;// turns
I=10;// in A
reluctance=150000;// in AT per Wb
fi=(N*I)/reluctance;
K=.15*10^-3;// in Wb turns/ division
rs=0.025;// in ohm
Ns=1;
theta=120;//divisions
S=(K*rs*theta)/((fi*Ns)-(K*theta));
disp(S,"The shunt resistance,S(ohm) = ")
```

Scilab code Exa 5.9 magnetic potential difference

```
//Example 5.9 // Magnetic pole difference
clc;
clear;
close;
//given data :
format('v',4)
N=150;// turns
I=1.2;// in A
theta=300;// divisions
t=155;//change in mmf in division
mmf=N*I;
r=2*mmf;// du to reversal
K=360/t;
M=(K*theta);
disp(M,"The magnetic potential difference between
    two points,(AT) = ")
```

Scilab code Exa 5.10 relative permeability

```
//Example 5.10 //relative permeability
clc;
clear;
close;
n1=600;//turns
i=3;//A
d=30;//cm
H=(n1*i)/(%pi*d*10^-2);//
mo=4*%pi*10^-7;//
x=mo*H;//
as=6;//cm^2;//
y=as*10^-4*x;//
t1=500;//turns
z=t1*y;//
z1=2*z;//
r=250;//ohms
it=z1/r;//
k=3000;//micro-C
ur=(k*10^-6)/it;//
disp(round(ur),"relative permeability is,=")
```

Scilab code Exa 5.11 fluxmeter deflection

```
//Example 5.11 // Fluxmeter deflection
clc;
clear;
close;
//given data :
l=5*10^-2;// in m
N=40;// turns
B=5*10^-3;// in Wb/m^2
b=1.5*10^-2;// in m
cs=2*10^-4;// in  m^2
B1=0.05;// in Wb/m^2
fi=B1*cs;
```

```
del_fi=2*fi;
theta=(del_fi*10)/(N*B*l*b);
disp((theta*(180/%pi)),"Fluxmeter deflection,(degree
    ) = ")
```

Scilab code Exa 5.12 hysteresis and eddy current loss

```
//Example 5.12 //hysteresis and eddy current
    components
clc;
clear;
close
w1=132;//W
f1=20;//Hz
x=w1/f1;//
w2=425;//W
f2=50;//Hz
y=w2/f2;//
A=[1 f1;1 f2];//
B=[x;y];//
X=A\B;//
Wh=X(1,1)*f2;//W
We=X(2,1)*f2^2;//W
disp(Wh,"hysteresis current component of the loss is
    ,(W)=")
disp(We,"Eddy current component of the loss is,(W)="
    )
```

Scilab code Exa 5.13 hysteresis loss

```
//Example 5.13 //hysteresis loss
clc;
clear;
```

```
close
Hx=125;//AT/m
ah=200;//cm^2
ba=0.15;//Wb/m^2
le=ah*Hx*ba;//J/m^3
lo=50;//loos
po=lo*le;//W/m^3
kg=8.5*10^3;//kg/m^3
lkg=po/kg;//watt
disp(lkg,"hysteresis loss is ,(W)=")
```

Scilab code Exa 5.14 flux density

```
//Example 5.14 // flux density
clc;
clear;
close;
//given data :
R=200+50;// in ohm
k=100*10^-6;// in coulomb
theta=80;// divisions
A=55*10^-4;// in m^2
N=1500;// turns
B=(R*k*theta)/(2*A*N);
disp(B,"The flux density,B(Wb/m^2) = ")
```

Scilab code Exa 5.15 loss

```
//Example 5.15 //loss
clc;
clear;
close
f=50;//Hz
```

```
k=2.3*10^-2;//
x=1.7;//
wi=0.6;//W
bm=0.5;//Wb/m^2
kd=((wi-(k*bm^x*f))/(bm^2*f^2));//
f1=20;//Hz
bm1=1;//
wi1=((k*bm1^x*f1)+(kd*bm1^2*f1^2));//
disp(wi1,"loss is ,(W)=")
```

Scilab code Exa 5.16 magnetic force flux density and relative permeability

```
//Example 5.16 //MAGNETIC FORCE ,FLUX DENSITY AND
    RELATIVE PERMEABILITY
clc;
clear;
close
k=1;//micro-C
th=100;//turns
r=5000;//ohm
n2=350;//turns
as=10;//cm^2
b=((k*th*r*10^-6)/(2*n2*as*10^-4));//Wb/m^2
disp(b,"magnetic flux is ,(Wb/m^2)=")
n1=100;//turns
i=4;//A
l=100;//cm
H=(n1*i)/(l*10^-2);//AT/m^2
disp(H,"flux density is ,(AT/m^2)=")
mo=4*%pi*10^-7;//
ur=b/(mo*H);//
disp(ur,"relative permeability is ,=")
```

Scilab code Exa 5.17 constant

```
//Example 5.17 // fluxmeter
clc;
clear;
close;
//given data :
N1=800;// turns
I=5;// in A
l=1;// in m
A=5*10^-4;// in m^2
N=500;// turns
theta=25;// divisions
H=(N1*I)/l;
B=(4*%pi*10^-7*H);
fi=B*A*10^8;
K=((2*N*fi*10^-8)/(theta));
disp(K*10^-3,"Constant is ,(Wb-turn/scale-div)=")
```