Scilab Textbook Companion for Electrical Measurements And Measuring Instruments
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Book Description

Title: Electrical Measurements And Measuring Instruments

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Standards units and dimensions

Scilab code Exa 1.17 Find the various parameters of measurement

```
//1.17
clc;
Y=90;
X=89;
Error_absolute=Y-X;
disp(Error_absolute,'absolute Error')
Error_relative=(Y-X)*100/Y;
disp(Error_relative,'relative Error (percent)=')
Accuracy_relative=1-Error_relative;
disp(Accuracy_relative,'Accuracy relative=')
Accuracy_percentage=100*Accuracy_relative;
disp(Accuracy_percentage,'Accuracy(percentage)=')
```

Scilab code Exa 1.18 Find the precision of the 8th reading

```
//1.18
clc;
S=98+100+102+98+100+100+104+104+105+97;
```

```
n=10;
Avg=S/n;
P=1-abs((104-Avg)/Avg);
printf("Precision for the 8th reading=%.2f",P)
```

Scilab code Exa 1.19 Find the value and limiting error of Resistance

```
//1.19
clc;
V=10;
I=20*10^-3;
RI=50;
R=(V/I)-RI;
printf("The value of Resistance=%.0f ohm",R)
dV=0.2;
dI=1*10^-3;
dRI=5;
dR=(dV/I)+(V*dI/I^2)+(dRI)
printf("\nLimiting error of resistance=%.0f ohm",dR)
```

Scilab code Exa 1.20 Find the resistance and uncertainty in resistance

```
//1.20
clc;
R0=5;
a=0.004;
T=30;
R=R0*(1+a*(T-20));
printf("Resistance of the wire=%.1f ohm",R)
//Let (dR/dR0) =b ; (dR/da)=c ; (dR/dT)=d
b=(1+a*(T-20));
c=R0*(T-20);
d=R0*a;
```

```
ur0=5*0.003;
ua=0.004*0.01;
ut=1;
uR=(b^2*ur0^2+c^2*ua^2+d^2*ut^2)^0.5;
printf("Uncertanity in resistance=%.2f ohm",uR)
```

Scilab code Exa 1.21 Find the least square line

```
//1.21
clc;
X_mean=(15+20+25+30+35+45)/6;
printf("The sample mean of the temperature=%.2f degree C",X_mean)
Y_mean=(1.9+1.93+1.97+2+2.01+2.01+1.94+1.95+1.97+2.02+2.02+2.04)/12*10^-6;
printf("\nThe sample mean of the faliure=%.6f failures/hour",Y_mean)
disp('from these values we get')
a=1.80*10^-6;
b=0.00226;
disp('Y=1.80+0.00226x    is the required least square line')
```

Scilab code Exa 1.22 Using the chi square test estimate the probability that the c

```
//1.22
clc;
n=2;
k=1;
dof=n-k;
chi_square=(3-5)^2/5+(7-5)^2/5;
disp(chi_square,'Chi square value=')
```

```
disp('From the dof and chi square value we find P =0.22')
disp('Hence there are 22% chance that the distribution is just the result of random fluctuations and the coin may be unweighted')
```

Scilab code Exa 1.23 Find the assigned value and uncertainty associated with measu

```
//1.23
clc;
X_mean=501*1/5;
printf("\nAssigned Value=%.1f V",X_mean)
sigma={(1/(5-1))*((100.2-X_mean)^2+(100.3-X_mean)^2+(100.2-X_mean)^2+(100.2-X_mean)^2+(100.1-X_mean)^2)}^0.5;
//disp('For 95% confidance level student factor t is 2.78')
t=2.78;
n=5;
Ur=t*sigma/(n^0.5);
printf("\nUncertanity=%.3f V",Ur)
```

Chapter 2

Calculation of capacitance and inductance

Scilab code Exa 2.1 Calculate the self inductance of the coil

```
//2.1
clc;
N=400;
a=4*10^-4;
MUo=4*%pi*10^-7;
MUr=800;
l=0.3;
L=(MUo*MUr*a*N^2)/l;
printf("Self inductance of the coil=%.3f H",L)
```

Scilab code Exa 2.2 Calculate stored charge and potential gradient

```
// 2.2
clc;
P0=8.854*10^-12;
Pr1=5.5;
```

```
d1=10^-3;
b1=d1/Pr1;
Pr2=2.2;
d2=10^-3;
b2=d2/Pr2;
Pr3=1.5;
d3=10^-3;
b3=d3/Pr3;
A=100*10^-4;
C=P0*A/(b1+b2+b3);
V=5000;
Q=C*V*10^6;
printf("stored charge in the capacitor=%.2f coulombs",Q)
D=Q/A;
D=146*10^-6;
g1=D*10^-3/(P0*Pr1);
printf("\npotential gradient g1=%.2f kV/m",g1)
g2=D*10^-3/(P0*Pr2);
printf("\npotential gradient g2=%.2f kV/m",g2)
g3=D*10^-3/(P0*Pr3);
printf("\npotential gradient g3=%.2f kV/m",g3)
```

Scilab code Exa 2.3 Calculate the capacitance of the cable

```
// 2.3
clc;
a=0.5/2;
b=0.25+0.4;
Pr=4.5;
C=(0.024*Pr)/(log10(b/a))
C_total=300*C
printf("\ncapacitance of the cable=%.2f uF",C_total)
```

Chapter 3

Principles of electrical measurements and measuring instruments

Scilab code Exa 3.1 Calculate deflection for spring controlled and gravity control

```
// 3.1
clc;
disp('For spring controlled Tc is proportional to
  theta')
theta=90*(3/5)^2;
printf("Deflection for spring controlled instrument=
  %.2f degree",theta)
disp('For gravity controlled Tc is proportional to
  sin(theta)')
theta=asind((3/5)^2);
printf("\nDeflection for gravity controlled
  instrument=%.2f degree",theta)
```

Scilab code Exa 3.2 Calculate the shunt resistance

```
// 3.2
clc;
I=1000;
Ia=50*10^-3;
Is=I-Ia;
Ra=10;
Va=Ia*Ra;
Rs=10*Va/Is;
printf("The shunt resistance=%.2f ohm",Rs)
```

Scilab code Exa 3.3 Calculate the value of total resistance

```
//3.3
clc;
Is=150*10^-6;
I=50*10^-6;
R=4*10^3;
Rt=R*I/Is;
printf("\nthe value of total resistance=%.2f ohm",Rt
    )
```

Scilab code Exa 3.4 Calculate the current

```
//3.4
clc;
V=1;
R=2*10^3;
I=(V/R)*1000;
printf("Actual current=%.2f mA",I)
Rm=1000;
Rt=R+Rm;
I=(V/Rt)*1000;
printf("\nCurrent when Rm is 1000 ohm =%.2f mA",I)
```

```
Rm=100;
Rt=R+Rm;
I=(V/Rt)*1000;
printf("\nCurrent when Rm is 100 ohm =%.2f mA",I)
```

Scilab code Exa 3.5 Calculate the expected error and per cent error

```
//3.5
clc;
I=20;
E_expected=2.5*I/100;
printf("Expected error=+/-%.2f mA",E_expected)
disp('Actual reading for 5mA indication will be 4.5
   mA to 5.5mA')
disp('Actual reading for 15mA indication will be
   14.5mA to 15.5mA')
E_5mA=(0.5/5)*100;
printf("Error for 5mA reading=%.2f percent",E_5mA)
E_15mA=(0.5/15)*100;
printf("\nError for 15mA reading=%.2f percent",
   E_15mA)
```

Scilab code Exa 3.6 Calculate the resistance and maximum possible error

```
//3.6
clc;
V=20;
A=20*10^-6;
Ra=25*10^3;
Rx=((V/A)-Ra)*10^-3;
printf("The resistance=%.0f Kohm",Rx)
E_voltmeter=(2/(100*20))*20*100;
E_current=(2/(100*20))*50*100;
```

```
E_total=E_voltmeter+E_current;
printf("\nMaximum possible error=%.1f percent",E_total)
```

Scilab code Exa 3.7 `Calculate the resistance and maximum possible error`

```
//3.7
clc;
V=20;
A=20*10^-3;
Rv=10*10^3*20;
Rx=(V/(A-(V/Rv)))/1000;
printf("The resistance=%.2f Kohm",Rx)
E_total=2.5+2.5;
printf("Maximum possible error=%.0f percent",E_total)
```

Scilab code Exa 3.8 `Calculate current in the voltage coil`

```
//3.8
clc;
Sp_constant=10.5*10^-6*%pi/180;
deflection=83;
Td=Sp_constant*deflection;
I1=10;
K=0.078;
I2=(Td/(K*I1))*10^6;
printf("Current in the voltage coil=%.2f uA",I2)
```

Scilab code Exa 3.9 `Calculate the correction required`

```
//3.9
clc;
AH=5*1/2;
printf("AH passed in 30 minuties=%.1f percent",AH)
V_assumed=0.51*1000/AH;
V_actual=200;
Error=V_actual-V_assumed;
Correction=-Error;
Cor=Correction*100/V_actual;
printf("\nCorrection required=%.1f percent",Cor)
```

Scilab code Exa 3.10 Calculate the meter constant and power factor

```
//3.10
clc;
E_unity_pf=230*6*4*1/1000;
M_constant=2208/E_unity_pf;
printf("Meter constant=%.1f rev/kWh",M_constant)
E_consumed=1472/M_constant;
pf=(E_consumed/(230*5*4))*1000;
printf("\npower factor=%.2f",pf)
```

Scilab code Exa 3.11 Calculate the percentage error at full load

```
//3.11
clc;
phi=acosd(0.8);
alpha_actual=85-phi;
alpha_true=90-phi;
er=(alpha_true-alpha_actual)/(alpha_true)*100;
printf("percentage error at full load=%.2f",er)
```

Chapter 4

Measurement of resistance

Scilab code Exa 4.1 Calculate the Insulation resistance

```
// 4.1
clc;
t=20;
C=8*10^-10;
E=200;
e=150;
a=log10(E/e)
R=(0.4343*t)/(C*a)*10^-6;
printf("Insulation resistance=%.2f mega-ohm",R)
```

Scilab code Exa 4.2 Calculate the Insulation resistance

```
// 4.2
clc;
t=600;
C=2.5*10^-12;
E=500;
e=300;
```

```
a=log10(E/e)
R=(0.4343*t)/(C*a);
printf("Insulation resistance=%.2f mega-ohm",R)
```

Scilab code Exa 4.3 Calculate the Insulation resistance

```
//4.3
clc;
//V=Eexp(-t/tc)    where tc= RC=Time constant
t=30;
V=125;
E=200;
tc=-30/log(V/E);
R=(7/15)*tc-7;
printf("Insulation resistance=%.2f mega-ohm",R)
```

Scilab code Exa 4.4 Calculate the value of X

```
//4.4
clc;
Q=3000;
S=0.1;
M=2000;
X=Q*S/M;
printf("The value of X=%.2f ohm",X)
```

Scilab code Exa 4.5 Calculate Resistance of the field coil

```
//4.5
clc;
```

```
lx=55;
ly=100-lx;
Y=100;
X=Y*(lx/ly);
printf("Resistance of the field coil=%.2f ohm",X)
```

Scilab code Exa 4.6 Calculate Unknown resistance

```
//4.6
clc;
p=200.7;
q=400;
S=200.05*10^-6;
P=200.5;
Q=400;
r=1400*10^-6;
X=((P*S/Q)+((q*r)/(p+q))*((P/Q)-(p/q)))*10^6;
printf("Unknown resistance=%.2f micro-ohm",X)
```

Scilab code Exa 4.7 Calculate Resistance between positive earth and negative earth

```
//4.7
clc;
E=230;
V1=60;
V2=40;
Rv=50000;
R1=((E-(V1+V2))/V2)*Rv*10^-3;
printf("Resistance between positive and earth=%.2f
    Kohm",R1)
R2=((E-(V1+V2))/V1)*Rv*10^-3;
printf("\nResistance between -ve and earth=%.2f Kohm
    ",R2)
```

Scilab code Exa 4.8 Calculate Unknown resistance X

```
//4.8
clc;
Q=100.5;
M=300;
q=100.6;
m=300.25;
r=0.1;
S=0.0045;
X=((M*S/Q)+((r)/(r+m*q))*((M*q/Q)-(m)))*10^6;
printf("Unknown resistance=%.2f micro-ohm",X)
```

Chapter 5

Potentiometer

Scilab code Exa 5.1 Calculate Distance PX

```
//5.1
clc;
Ipq=4/(3+4);
Vpq=Ipq*3;
Vpq_per_cm=Vpq/100;
Dpx=1.0186/Vpq_per_cm;
printf("Distance PX=%.2f cm",Dpx)
```

Scilab code Exa 5.2 Calculate Voltage of dry cell

```
//5.2
clc;
V_per_cm=1.0186/60;
//When S is replaced by a dry cell we get PK=85 cm
   for null deflection
Dpk=85;
V_dry_cell=Dpk*V_per_cm;
printf("Voltage of dry cell=%.2f V",V_dry_cell)
```

Scilab code Exa 5.3 Calculate Length of PQ

```
//5.3
clc;
Vpq=(1.02*5/2500)*1000;
Lpq=1.2*100/Vpq;
printf("Length of PQ=%.2f m",Lpq)
```

Scilab code Exa 5.4 Calculate Length of wire and Ratio of resistances

```
//5.4
clc;
l2=(10/3)*(1.5/1.5)*(9/15)^2;
printf("Length of wire=%.2f m",l2)
a1=0.0004;
a2=0.0003;
R2=1;
R1=1.5*R2;
T=100;
Rp=R1*(1+a1*T);
Rq=R2*(1+a2*T);
R=Rp/Rq;
printf("Ratio of resistances=%.2f",R)
```

Scilab code Exa 5.5 Calculate emf of the cell and Perentage error of the voltmeter

```
//5.5
clc;
emf_std_cell=1.0183;
```

```
emf_cell=70/50*emf_std_cell;
printf("e.m.f. of the cell=%.2f V",emf_cell)
V_read=1.35;
V_cal=1.32379;
error_voltmeter_percent=((V_read-V_cal)/V_cal)*100;
printf("\nPerentage error of the voltmeter=%.2f",
   error_voltmeter_percent)
```

Chapter 6

Location of the faults

Scilab code Exa 6.1 Find the position of fault

```
//6.1
clc;
r=250;
s=1000;
l=1000;
x=r*l/s;
printf("Position of the fault=%.1fm",x)
```

Scilab code Exa 6.2 Find the position of fault

```
//6.2
clc;
r=600;
s=1000;
El=500*30/50;
l=450+El;
x=r*l/s;
printf("Position of the fault=%.1f m",x)
```

Scilab code Exa 6.3 Find the resistance of the armature and percentage error

```
//6.3
clc;
R_armature=0.256/16;
printf("Armature Resistance=%.2f ohm",R_armature)
R_armature_true=0.256/(16-(0.256/10));
Error=R_armature-R_armature_true;
Error_percentage=Error*100/R_armature_true;
printf("\nPercentage Error=%.2f",Error_percentage)
```

Scilab code Exa 6.4 Find the position of fault

```
//6.4
clc;
R1=45;
R2=100-R1;
l=500;
x=2*l*R1/(R1+R2);
printf("Position of the fault from the test end=%.1f
    m",x)
```

Scilab code Exa 6.5 Calculate the distance to the fault

```
clc;
//5.6
r3=300;
r2=1500;
r1=15;
```

```
R=(r3/r2)*r1;
l=4000;
r3=180;
d=(2*l/R)*(R*r2-r3*r1)/(r1+r2);
printf("Distance of the fault=%.2fm",d)
```

Chapter 7

Measurement of Capacitance and Inductance

Scilab code Exa 7.1 Calculate the resistance and inductance of the coil

```
//7.1
clc;
//The coil has resistance of R ohm and inductance L2
//ZKL=25+j(2*%pi*f)*0.05;
ZLM=100;
//ZKN=(R+2)+j(2*%pi*f)*L2;
ZNM=100;
//Now (ZKL/ZLM)=(ZKN/ZNM)
//((25+j(2*%pi*f)*0.05)/100)=((R+2)+j(2*%pi*f)*L2
    /100)
//Equating Real and imaginary parts
//we have 25=R+2
//2*%pi*f)*0.05=2*%pi*f)*L2
R=23;
L2=50;
printf("Resistance=%.0f ohm",R)
printf("\nInductance=%.0f mH",L2)
```

Scilab code Exa 7.2 Calculate the parameters of the cable

```
//7.2
clc;
C1=50*10^-12;
r2=1500/%pi;
r3=120;
Cs=C1*r2/r3*10^12;
printf("Cable capacitance=%.1f pF",Cs)
C2=0.95*10^-6;
rs=C2*r3/(C1*10^6);
printf("\nParallel loss resistance=%.2f Mega-ohm",rs
    )
w=314;
Loss_angle=atand(rs*w*Cs);
printf("\nLoss angle=%.1f degree",Loss_angle)
```

Scilab code Exa 7.3 Calculate the power factor and equivalent series resistance

```
//7.3
clc;
C3=106*10^-12;
C1=0.35*10^-6;
R1=318;
R2=130;
C2=C3*R1/R2;
Rx=R2*C1/C3;
printf("Series Resistance=%.2f ohm",Rx)
wr=314;
pf=wr*Rx*C2;
printf("\nPower factor=%.2f",pf)
```

Scilab code Exa 7.4 Calculate the capacitance and resistance

```
//7.4
clc;
Q=10;
Cs=0.2;
P=2;
Cx=Q*Cs/P;
printf("Capacitance=%.1f uF",Cx)
S=5;
rx=P*S/Q;
printf("\nResistance=%.0f Kohm",rx)
```

Scilab code Exa 7.5 Calculate the inductance and resistance of the impedance

```
//7.5
clc;
S=900;
P=1.5*10^3;
Q=2*10^3;
Cs=0.2*10^-6;
rx=S*P/Q;
printf("Resistance=%.0f ohm",rx)
Lx=P*Cs*S;
printf("\nInductance=%.2f H",Lx)
```

Scilab code Exa 7.6 Calculate the inductance and resistance

```
//7.6
```

```
clc;
R1=2;
R2=1;
R4=500;
L4=0.1
R3=R1*R4/R2;
printf("Resistance=%.0f ohm",R3)
L3=R1*L4/R2;
printf("\nInductance=%.2f H",L3)
```

Scilab code Exa 7.7 Calculate the inductance and resistance of the impedance

```
//7.7
clc;
S=0.875;
P=1.35*10^3;
Q=1*10^3;
Cs=0.1*10^-6;
rx=S*P/Q;
printf("Resistance=%.2f ohm",rx)
Lx=P*Cs*S*10^3;
printf("\nInductance=%.3f mH",Lx)
```

Scilab code Exa 7.8 Calculate the capacitance and loss resistance of the capacitor

```
//7.8
clc;
r1=250;
r4=1200;
r2=10^6;
C4=4*10^-5;
r3=r1*r4/r2;
printf("Resistance=%.2f ohm",r3)
```

```
C3=r2*C4/r1;
printf("\nCapacitance=%.2f uF",C3)
```

Scilab code Exa 7.9 Calculate the resistance and inductance of the coil

```
//7.9
clc;
R2=1000;
R4=833;
f=50;
w=2*%pi*f;
C=0.38*10^-6;
R3=16800;
R1=(R2*R3*R4*w^2*C^2)/(1+w^2*R4^2*C^2);
printf("Resistance=%.2f ohm",R1)
L=R2*R3*C/(1+w^2*R4^2*C^2);
printf("Inductance=%.2f H",L)
```

Chapter 8

Measurement of power

Scilab code Exa 8.1 Calculate the parameters of the load

```
//8.1
clc;
ZL=220/2;
printf("Load impedance=%.1f ohm",ZL)
Z_total=220/4;
printf("\nImpedance of the combination=%.2f ohm",
   Z_total)
I1=2;
I2=2.5;
I3=4;
P=(Z_total/2)*(I3^2-I1^2-I2^2);
printf("\nPower absorbed by load=%.2f W",P)
pf=P/(220*2^2);
printf("\npower factor of load=%.2f",pf)
```

Scilab code Exa 8.2 Calculate the parameters of the load and circuit

```
//8.2
```

```
clc;
I=125/10;
ZL=50/I;
printf("Load impedance=%.1f ohm",ZL)
Z_total=150/I;
printf("\nImpedance of the combination=%.2f ohm",
   Z_total)
I1=125;
I2=50;
I3=150;
P=(1/(2*10))*(I3^2-I1^2-I2^2);
printf("\nPower absorbed by load=%.2f W",P)
Pr=I^2*10;
printf("\nPower consumed by the resistor=%.2f W",Pr)
pf=P/(50*I);
printf("\npower factor of load=%.2f",pf)
```

Chapter 9

Instrument Transformers

Scilab code Exa 9.1 Calculate ratio error and phase angle

```
//9.1
clc;
n=300/1;
Z2=complex(1.5,1);
a=polar(Z2);
I2=5;
E2=I2*a;
E1=E2/n;
alpha=atand(1/1.5)
Io=complex(100,40)
delta=atand(40/100);
b=polar(Io)
sigma=-(b*sind(alpha+delta))*100/(n*I2);
printf("Ratio error=%.2f percent",sigma)
bet=(b*cosd(alpha+delta))/(n*I2);
printf("\nPhase angle=%.2f degree",bet)
```

Scilab code Exa 9.2 Calculate secondary voltage and current

```
//9.2
clc;
I_ratio=500/5;
n=1/100;
I2=300/100;
printf("Secondary current=%.2f A",I2)
V2=I2*1.5;
printf("\nSecondary voltage=%.2f V",V2)
```

Scilab code Exa 9.3 Calculate secondary voltage and current in line

```
//9.3
clc;
V_line=200*33000/220;
printf("Voltage on line=%.0f V",V_line)
I_line=4*100/5;
printf("Current in line=%.0f A",I_line)
```

Scilab code Exa 9.4 Calculate the ratio error

```
//9.4
clc;
n=1000/5;
Ie=0.7*1000/100;
Tp=1;
n=200;
Ts=200;
R_actual=Ts+(7/5);
Error_ratio=(200-R_actual)*100/R_actual;
printf("Ratio error=%.2f percent",Error_ratio)
Ts=200-(0.5*200/100);
n=199/1;
R_actual=Ts+(7/5);
```

```
Error_ratio=(200-R_actual)*100/R_actual;
printf("\nRatio error=%.2f percent",Error_ratio)
```

Scilab code Exa 9.5 Calculate phase angle error at no load

```
//9.5
clc;
Vp=1000;
Vs=100;
n=Vp/Vs;
pf_no_load=0.4;
sina=0.4;
cosa= (1-sina^2)^0.5;
tana=sina/cosa;
Im=0.02;
Ie=Im*tana;
xp=66.2;
rp=94.5;
//At no load Is=0 so
theta=((Ie*xp)-(Im*rp))/(n*Vs);
printf("Phase angle error at no load=%.4f",theta)
```

Scilab code Exa 9.6 Calculate the ratio error

```
//9.6
clc;
E2=((1.8+5*0.16)^2+(2.4+5*0.195)^2)^0.5;
pf2=2.6/E2;
AT_sec=600;
sina=3.375/E2;
AT_pri=600+10.1*pf2+13.4*sina;
I1=AT_pri/40;
Ratio_error=(15-I1)*100/I1;
```

```
printf("Ratio error=%.2f percent",Ratio_error)
```

Chapter 10

Magnetic Measurements

Scilab code Exa 10.1 Calculate relative permeability

```
//10.1
clc;
K=0.1*10^-3;
d=60;
N2=200;
phi2=K*d/(2*N2);
a2=25*10^-6;
B=phi2/a2;
N=300;
I=10;
l=0.1;
H=N*I/l;
Permability_absolute=4*%pi*10^-7;
Permability_relative=B/(Permability_absolute*H)
printf("Relative permability of iron=%.2f",
   Permability_relative)
```

Scilab code Exa 10.2 Calculate galvanometer constant

```
//10.2
clc;
N1=2500;
I1=2;
l1=1;
a2=3*10^-4;
Permability_absolute=4*%pi*10^-7;
phi2=Permability_absolute*N1*I1*a2/(l1);
N2=50;
theta=1;
l=10;
K=2*N2*phi2/(theta*l);
a=60*%pi*10^-7;
printf("Galvanometer Constant=%.6f Wb turns/division
    ",K)
```

Chapter 12

Basic Transducers

Scilab code Exa 12.1 `Calculate change in resistance`

```
//12.1
clc;
K=4;
strain=1*10^-6;
R=150;
dR=K*strain*R*10^6;
printf("Change in resistance=%.1f micro-ohm",dR)
```

Scilab code Exa 12.2 `Calculate change in length`

```
//12.2
clc;
d=0.03;
a=%pi*d^2/4;
f=40000;
l=0.5;
E=3*10^10;
dl=f*l/(E*a);
printf("Change in length=%.6f m",dl)
```

Scilab code Exa 12.3 Calculate capacitance

```
//12.3
clc;
d=10^-4;
A=6*10^-3;
permitivity_absolute=8.854*10^-12;
permitivity_relative=1
C=permitivity_absolute*permitivity_relative*A*10^12/d;
printf("capacitance=%.2f pF",C)
```

Scilab code Exa 12.4 Calculate the displacement

```
//12.4
clc;
disp('1.5 cm core displacement produces 6V so')
d_15=6;
d_18=1.8*d_15/1.5
printf("1.8 cm core displacement produces=%.2f V",d_18);
d_08=(-0.8)*(-d_15)/(-1.5);
printf("\n-0.8 cm core displacement produces=%.2f V",d_08);
d_06=(-0.6)*(-d_15)/(-1.5);
printf("\n-0.6 cm core displacement produces=%.2f V",d_06);
```

Scilab code Exa 12.5 Calculate the acceleration in g and natural frequency

```
//12.5
clc;
k=4*10^3;
dx=0.04;
m=0.1;
acc=k*dx/m;
accg=acc/9.8;
printf("acceleration=%.2f g",accg)
fn=(1/2*%pi)*(k/m)^0.5;
printf("\nNatural Frequency=%.2f Hz",fn)
```

Chapter 14

Cathode Ray Oscilloscope

Scilab code Exa 14.1 Calculate the rms value of current

```
//14.1
clc;
R=3;
V_pp =10*6;
Vrms=V_pp/(2*2^0.5);
Irms=Vrms/R;
printf("R.M.S. value of current=%.2f A",Irms)
```

Scilab code Exa 14.2 Calculate the frequency of the voltage applied

```
//14.2;
clc;
T=3*10^-3;
f=1/T;
printf("frequency of the voltage applied=%.2f m",f)
```

Scilab code Exa 14.3 Calculate the time constant capacitance and maximum frequency

```
//14.3
clc;
tc=2*2.5;
printf("time constant=%.6f ms",tc)
R=5*10^3;
C=(tc*10^-3/R)*10^6;
printf("\nCapacitance=%.2f uF",C)
Tmax=10*R*C*10^-6;
fmax=1/Tmax;
printf("\nMaximum frequency=%.2f m",fmax)
```

Chapter 16

Polyphase systems

Scilab code Exa 16.1 Calculate Line and phase current

```
//16.1
clc;
disp('For star connected load')
Il=50000/((3^0.5)*440*0.85);
printf("\nLine current=%.2f A",Il)
Iph=Il;
printf("\nPhase current=%.2f A",Iph)
disp('For Delta connected load')
Il=50000/((3^0.5)*440*0.85);
printf("\nLine current=%.2f A",Il)
Iph=Il/(3^0.5);
printf("\nPhase current=%.2f A",Iph)
```

Scilab code Exa 16.2 2Calculate line current and total power

```
//16.2
clc;
disp('For star connection')
```

```
Zph=(12^2+5^2)^0.5;
Eph=440/(3^0.5);
Iph=Eph/Zph;
Il=Iph;
printf("\nLine current=%.2f A",Il)
P_total=(3^0.5)*440*Il*12/(Zph*1000);
printf("\nTotal Power=%.2f kW",P_total)

disp('For Delta connection')
Zph=(12^2+5^2)^0.5;
Eph=440;
Iph=Eph/Zph;
Il=Iph*(3^0.5);
printf("\nLine current=%.2f A",Il)
P_total=(3^0.5)*440*Il*12/(Zph*1000);
printf("\nTotal Power=%.2f kW",P_total)
```

Scilab code Exa 16.3 Calculate the resistance and inductive reactance of the load

```
//16.3
clc;
pf=(1.8*1000)/(1100*(3^0.5));
Z=1100/100;
R=Z*pf;
printf("\nResistance of the load=%.2f ohm",R)
Xl=(121-108)^0.5;
L=Xl/314;
printf("\nInductive reactance of the load=%.2f H",L)
```

Scilab code Exa 16.4 Calculate phase voltage and total power

```
//16.4
clc;
```

```
Eph=400/(3^0.5);
printf("\nPhase voltage=%.2f V",Eph)
P_total=(3^0.5)*400*30*cosd(30)/1000;
printf("\nTotal power=%.2f kW",P_total)
```

Scilab code Exa 16.5 Calculate current in each generator and motor phase

```
//16.5
clc;
Out_motor=80*735.5;
Input_motor=Out_motor/0.8;
I_alternator_phase=120.64;
I_motor_phase= I_alternator_phase/(3^0.5);
printf("\nCurrent in each motor phase=%.2f A",
   I_motor_phase)
printf("\nCurrent in each generator phase=%.2f A",
   I_alternator_phase)
```

Scilab code Exa 16.6 Calculate the circuit parameters

```
//16.6
clc;
El=400;
Eph=El;
Impedance_per_phase= (10^2+15^2)^0.5;
Iph= 400/Impedance_per_phase;
printf("\nPhase current=%.2f A",Iph)
Il=Iph*3^0.5;
printf("\nLine current=%.2f A",I1)
pf=10/Impedance_per_phase;
printf("\nPower factor=%.2f ",pf)
P_total=(3^0.5)*El*Il*pf/1000;
printf("\nTotal Power=%.2f kW",P_total)
```

```
VAR=(3^0.5)*El*Il*15/(Impedance_per_phase*1000);
printf("\nReactive volt ampers=%.2f KVAR",VAR)
VA=(3^0.5)*El*Il/1000;
printf("\nTotal Volt ampers=%.2f kVA",VA)
```

Scilab code Exa 16.7 Calculate the reduction in power

```
//16.7
clc;
disp('Star connections')
R=20;
Iph=440/(3^0.5*R);
P_total=3*Iph^2*R;
disp('when one of the resistor get disconnected')
Iph=440/(2*20);
P_total_new=2*Iph^2*R;
P_reduction=(P_total-P_total_new)*100/P_total;
printf("\nReduction in Power=%.2f percent",
    P_reduction)
disp('Delta connections')
R=20;
Iph=440/(R);
P_total=3*Iph^2*R;
disp('when one of the resistor get disconnected')
Iph=440/(20);
P_total_new=2*Iph^2*R;
P_reduction=(P_total-P_total_new)*100/P_total;
printf("\nReduction in Power=%.2f percent",
    P_reduction)
```

Scilab code Exa 16.8 Calculate the circuit parameters

```
//16.8
```

```
clc;
R=3;
XL=4;
Z=(R^2+XL^2)^0.5;
Iph1=440/(3^0.5*Z);
IL1=Iph1;
printf("\nLine current=%.1f A",IL1)
P=3*Iph1^2*R;
printf("\nPower=%.0f W",P)
pf1=R/Z;
printf("\npower factor=%.2f (lag)",pf1)
IL2=IL1*(4/5);
Iph2=IL2/3^0.5;
XL2=440/Iph2;
C2=1*10^6/(2*50*28.755);
printf("\nCapacitance=%.1f uF",C2)
```

Scilab code Exa 16.9 Calculate the circuit parameters

```
//16.9
clc;
IL=11000;
Eph=IL/3^0.5;
printf("\nLine to neutral voltage=%.2f V",Eph)
E_Each_phase=Eph;
printf("\nVoltage induced in Each phase winding=%.2f
    V",E_Each_phase)
T=(242/360)*(1/50)*1000;
printf("\nTime interval=%.2f ms",T)
IL_peak=(2^0.5)*IL;
printf("\nPeak line voltage=%.2f V",IL_peak)
```

Scilab code Exa 16.10 Calculate the current in each line and value of each resista

```
//16.10
clc;
P_consumed=3000/3;
E_per_phase=440/(3^0.5);
IL=P_consumed/E_per_phase;
printf("\nCurrent in each line=%.2f A",IL)
R=E_per_phase/IL;
printf("\nResistance of resistor=%.2f ohm",R)
```

Scilab code Exa 16.11 Calculate circuit constants of load per phase

```
//16.11
clc;
VL=1100;
IL=100;
pf=150*1000/(3^0.5*VL*IL);
E_per_phase=VL/3^0.5;
Zph=E_per_phase/100;
Rph=pf*Zph;
Xc=(Zph^2-Rph^2)^0.5;
C=10^6/(2*%pi*50*Xc);
disp('Circuit Constants are')
printf("\nR=%.2f ohm",Rph)
printf("\nC=%.2f uF",C)
```

Scilab code Exa 16.12 Calculate the readings of watt meters

```
//16.12
clc;
//P_input=W1+W2=15000........(i)
pf=0.4
phi=acosd(0.4);
a=tand(phi);
```

```
//tand(phi)=(3^0.5)*(W1-W2)/(W1+W2)
//on solving  W1-W2=3464.2 ...............(ii)
//From (i) and (ii) we can calculate
W1=9.232;
W2=5.768;
printf("\nW1=%.2f kW",W1)
printf("\nW2=%.2fkW ",W2)
```

Scilab code Exa 16.13 Calculate the value of power and power factor

```
//16.13
clc;
W1=10;
W2=-1.2;
P_absorbed=W1+W2;
printf("\nPower=%.2f kW",P_absorbed)
phi=atand((3^0.5)*(W1-W2)/(W1+W2));
pf=cosd(phi);
printf("\nPower Factor=%.2f ",pf)
```

Scilab code Exa 16.14 Calculate the readings of watt meters

```
//16.14
clc;
P_input=10*735.5/0.82;
//P_input=W1+W2=8974........(i)
pf=0.4
phi=acosd(0.83);
a=tand(phi);
//tand(phi)=(3^0.5)*(W1-W2)/(W1+W2)
//on solving  W1-W2=3482 ...............(ii)
//From (i) and (ii) we can calculate
W1=6.228;
```

```
W2=2.746;
printf("\nW1=%.2f  kW",W1)
printf("\nW2=%.2fkW  ",W2)
```