# Scilab Textbook Companion for Circuits and Networks by A. Sudhakar[1]

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# Book Description

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

**Exa** Example (Solved example)

**Eqn** Equation (Particular equation of the above book)

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

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

# Contents

# List of Scilab Codes

# Chapter 1

# CIRCUITS ELEMENTS AND KIRCHOFFS LAW

**Scilab code Exa 1.a.1** current calculation and voltage calculation

```
//Example 1_1 page no:20
clc;
Rt=1.7*10^3;
R=3*10^3;
It=6/Rt;
It=It*1000;//converting to milli Ampere
I10k=6/(10*10^3);
I10k=I10k*1000;//converting to milli Ampere
I3k=6/(3*10^3);
I3k=I3k*1000;//converting to milli Ampere
I4k=It-(I3k+I10k);
I4_7k=I4k*(5/(5+4.7));
V3k=I3k*R*10^-3;
disp(It,"the total current is (in mA)");
disp(I10k,"the current through 10k resistor is (in
    mA)");
disp(I3k,"the current through 3k resistor is (in mA)
    ");
disp(I4k,"the current through 4k resistor is (in mA)
```

```
");
disp(I4_7k,"the current through 4.7k resistor is (in mA)");
disp(V3k,"the voltage across 3k resistor is (in V)");
```

**Scilab code Exa 1.a.2** voltage calculation

```
//Example 1_2 page no:21
clc;
I8=20/8;
I15=(2.5*11)/(11+28);
V28=0.71*28;
V19=2.5*19;
emf=V28+V19;//calculating the emf
disp(I8,"the current flowing through 8 ohm resistor is (in A)");
disp(I15,"the current flowing through 15 ohm resistor is (in A)");
disp(V28,"the voltage across 28 ohm resistor is (in V)");
disp(V19,"the voltage across 19 ohm resistor is (in V)");
disp(emf,"the emf of the battery is (in V)");
```

**Scilab code Exa 1.a.3** current calculation

```
//Example 1_3 page no:22
clc;
V=10;
R1=1;
I1=V/R1;
I2=V/(2+((7*5)/(7+5)));
```

```
It=I1+I2;//calculating the total current
V2=2*2;
I5=(2*7)/(5+7);//calculating the current flowing
    through 5 ohm resistor
disp(I1,"the current flowing through 1 ohm resistor
    is (in A)");
disp(I2,"the current flowing through series parallel
     branch between terminals A and C is (in A)");
disp(It,"the total current is (in A)");
disp(V2,"the voltage across 2 ohm resistor is (in V)
    ");
disp(I5,"the current flowing through 5 ohm resistor
    is (in A)");
```

**Scilab code Exa 1.a.4** `power calculation`

```
//Example 1_4 page no:22
clc;
I3=2;
I6=6;
V2=12;
V3=6;
V=20
I4=I3+I6;
V4=4*I4;
V=V4-V2;
Vs=V4-V;
Vin=-(30-V-V3);
P4=V4*I6;//dependent power source
disp(Vs,"the voltage Vs is (in V)");
disp(Vin,"the voltage Vin is (in V)");
disp(P4,"the power provided by dependent source is (
    in W)");
```

**Scilab code Exa 1.a.5** power calculation

```
//Example 1_5 page no:23
clc;
//applying kirchoff law
V=-20*10^-3/(-4.25*10^-3);
P3=66.55;
P20=-20*V;
P4=V*V/(4);
P=V*V/1;
disp(P3,"the power absorbed by 3i current source is
   (in mW)");
disp(P20,"the power absorbed by 20mA current source
   is (in mW)");
disp(P4,"the power absorbed by 4 kilo ohm current
   source is (in mW)");
disp(P,"the power absorbed by 1 kilo ohm current
   source is (in mW)");
//in text book V value is rounded off but here the
   value is not rounded and used directly
//so power result varies slightly
//in text book V is rounded to 4.71 V
```

**Scilab code Exa 1.a.6** current calculation

```
//Example 1_6 page no:24
clc;
Vs=30;
R1=5;
R2=4;
R3=2;
R4=4;
```

```
R5=1/((1/(R2))+(1/(R3))+(1/(R4)));
Rt=R1+R5;
It=Vs/Rt;//calculating the total current
disp(It,"the total current is (in A)");
```

**Scilab code Exa 1.a.7** voltage calculation

```
//Example 1_7 page no:25
clc;
I5=4;
I6=1;
V=30;
R6=6;
V6=24;
V10=50;
I10=I5+I6;
Vc=-V6;
V1=V10-Vc;
disp(I10,"the current through 10 ohm resistance is (in A)");
Vs=I10-V+Vc;//calculating the source voltage
disp(Vs,"the source voltage Vs is (in V)");
```

**Scilab code Exa 1.a.8** voltage calculation

```
//Example 1_8 page no:25
clc;
R1=6;
R2=4;
R3=10;
V1=6;
V2=12;
I1=V1/(R1+R2);
```

```
I2=V2/(R2+R3);
Va=I1*R2;
Vb=I2*R2;
Vab=-Va+V2+Vb;
disp(Vab,"the voltage across a and b is (in V)");
//value of I2 is rounded off in text book so result
    varies slightly
```

**Scilab code Exa 1.a.9** `current calculation`

```
//Example 1_9 page no:26
clc;
V=30;
R1=2;
R2=2;
R3=2;
R4=2;
R5=1;
R6=1;
R7=2;
R8=2;
R9=4;
R10=R2+R3;
R11=R4+R3;
R12=1/((1/R10)+(1/R9));
R13=1/((1/R11)+(1/R8));
R14=1/((1/(R12+R13))+(1/R7));
Rt=1/((1/(R14+R6))+(1/R1));
I=V/Rt;
disp(I,"the current delivered by the sourve is (in A
    )");
//in text book Rt value is rounded to 1.05 here the
    value is not rounded so result varies slightly
```

**Scilab code Exa 1.a.10** voltage calculation

```
//Example 1_10 page no:28
clc;
It=4;
Rt=7;
R2=2;
R10=10;
I10=It*(Rt/(Rt+R10));
disp(I10,"the current flowing through 10 ohm
   resistor is (in A)");
I5=It*(R10/(R10+Rt));
V=I5*R2;//the voltage across 2 ohm resistor Vs
disp(V,"the voltage across 2 ohm resistor Vs is (in
   V)");
```

---

**Scilab code Exa 1.a.11** resistance calculation

```
//Example 1_11 page no:28
clc;
R1=5;
R2=25;
R3=10;
V=50;
It=6;
//current in branch ADB
I30=V/(R2+R1);
disp(I30,"the current in branch ADB is (in A)");
//current in branch ACB
I10=It-I30;
disp(I10,"the current in branch ACB is (in A)");
R=(V/I10)-R3;
```

```
disp(R,"the resistance R is (in ohm)");
```

**Scilab code Exa 1.a.12** resistance calculation

```
//Example 1_12 page no:29
clc;
V=10
R1=3;
R2=6;
R3=5;
R4=5;
R5=4;
R6=2.5;
R7=2;
R8=1/((1/R3)+(1/R4));//calculating the resistance
    values
R9=1/((1/R2)+(1/R7));
R10=1/((1/R6)+(1/R8));
R11=R1+R9;
R12=R5+R10;
Rt=1/((1/R11)+(1/R12));
I=V/Rt;
P=V*I;//calculating the power delivered by the
    source
disp(P,"the power delivered by the source (in W)");
```

**Scilab code Exa 1.a.13** voltage calculation

```
//Example 1_13 page no:30
clc;
I1=10;
I2=15'
R1=20;
```

```
R2=10;
R3=5;
V=(I1+I2)/((1/20)+(1/10)+(1/5));//voltage
    calculation
disp(V,"the voltage across 10 ohm resistor is (in V)
    ");
```

**Scilab code Exa 1.a.14** current calculation and resistance calculation

```
//Example 1_14 page no:31
clc;
I1=1;
I2=5;
Va=70;
V=100;
//calculating R1 and R2
V5=5*60;
Va=100-30;
R2=(70-30)/I2;
R1=(70-50)/I1;
disp(R1,"the resistance R1 is (in ohm)");
disp(R2,"the resistance R2 is (in ohm)");
//calculating R2 when current in R1 is zero
Va=50;
I2=(100-Va)/5;
R2=20/I2;
disp(R2,"the resistance R2 when current flowing
    through R1 is zero (in ohm)");
```

**Scilab code Exa 1.a.15** voltage calculation

```
//Example 1_15 page no:32
clc;
```

```
I1=10;
I2=5;
R1=3;
R2=2;
R3=5;
R4=10;
R5=2;
R6=1;
R11=4.43;
R22=2.67;
Va=(I1-I2)/((1/R11)+(1/R22));
Vout=Va;//here Vout is equal to Vout
disp(Vout,"the output voltage Vout is (in V)");
```

**Scilab code Exa 1.a.16** voltage calculation

```
//Example 1_16 page no:33
clc;
R1=5
R2=6
R3=3
R4=3
R5=10
R6=6
R7=2
R8=4
V=100;
R9=1/((1/(R7+R8))+(1/R6));//calculating the
    resistances
R10=1/((1/(R3+R4))+(1/R2));
Rt=1/((1/13)+(1/8));
It=V/Rt;
I8=20.2*(13/(13+8));
I13=20.2*(8/(13+8));
I5=I8;
```

```
I10=I13;
I4=3.845;
I3=6.25;
Va=I3*3;
Vb=I4*4;
Vab=Va-Vb;//voltage calculation
disp(Vab,"the voltage Vab is (in V)");
```

**Scilab code Exa 1.a.17** resistance calculation

```
//Example 1_17 page no:34
clc;
Va=1;//here Va is assumed to be one hence it will canceled out in calculation
R=1;//here R is assumed to be one it will be assigned correct value on the flow of calculation
V10=Va*(10/15);
Vr=Va*R/(20+R);
R=(10/15)*(20*3);//here 3 is included to show that R is canceled in calculation
//hence 3R-2R=R for simplicity we introduced 3 in calculation
disp(R,"the resistance R in the circuit is(in ohm)");
```

**Scilab code Exa 1.a.18** power calculation

```
//Example 1_18 page no:34
clc;
V=-10;
Iv=2;
P10v=V*Iv;
```

```
disp(P10v,"the power absorbed across 10V is (in W)")
    ;
V1=24;
I1=2;
P1=V1*I1;
disp(P1,"the power absorbed at R1 is (in W)");
V2=14;
I2=7;
P2=V2*I2;
disp(P2,"the power absorbed at R2 is (in W)");
V3=-7;
I3=9;
P3=V3*I3;
disp(P3,"the power absorbed at R3 is (in W)");
V=1*-7;
I=9;
P=V*I;
disp(P,"the power absorbed by dependent voltage
    source is (in W)");
```

**Scilab code Exa 1.a.19** power calculation

```
//Example 1_19 page no:35
clc;
V1=-4;
I1=2;
P1=V1*I1;
disp(P1,"the power absorbed by 2A current source is
    (in W)");
V2=-4;
I2=1;
P2=V2*I2;
disp(P2,"the power absorbed by 4V voltage source is
    (in W)");
V3=2;
```

```
I3=3;
P3=V3*I3;
disp(P3,"the power absorbed by 2V voltage source is
    (in W)");
V4=7;
I4=2;
P4=V4*I4;
disp(P4,"the power absorbed by 7A current source is
    (in W)");
V5=2;
I5=2;
P5=-2*V5*I5;
disp(P5,"the power absorbed by 2xi independent
    current source is (in W)");
```

---

**Scilab code Exa 1.a.20** `power calculation`

```
//Example 1_20 page no:35
clc;
V=12;
R=1;
R=4;
R=3;
I=6;
P=-V*I;
disp(P,"the power absorbed by 12V source is (in W)")
    ;
V1=6;
P1=V1*I;
disp(P1,"the power absorbed by 1ohm resistor is (in
    W)");
V2=-2*3*6;
P2=V2*I;
disp(P2,"the power absorbed by 2v1 independent
    voltage source is (in W)");
```

```
V3=18;
P3=V3*I;
disp(P3,"the power absorbed by 3ohm resistor is (in W)");
V=4*6;
P4=V*I;
disp(P4,"the power absorbed by 4ohm resistor is (in W)");
```

---

**Scilab code Exa 1.a.21** power calculation

```
//Example 1_21 page no:36
clc;
R1=3;
R2=2;
V=12/((1/3)+1+(1/2));
i3=V/R1;
i2=-V/R2;
P3=V*i3;
disp(P3,"the power absorbed by P3 is (in W)");
P12=-V*12;
disp(P12,"the power absorbed by 12A current source is (in W)");
P2i=-V*2*i2;
disp(P2i,"the power absorbed by 2i dependent current source is (in W)");
P2=-V*i2;
disp(P2,"the power absorbed by 2 ohm resistor is (in W)");
//the result displayed varies slightly with the text book hence in text book
//V,i3,i2 values are rounded off and they produce approximated result
//here the values are used directly without approxiamtion
```

**Scilab code Exa 1.1** `voltage calculation`

```
//Example 1_1 page no:1
clc
clear
W=70;//Energy in joule
Q=30;//charge in coloumb
V=W/Q;
disp(V,"Voltage(in volts):")
```

**Scilab code Exa 1.2** `current calculation`

```
//Example 1_2 page no:2
clc
clear
t=2;//time in second
Q=5;//charge in coloumb
I=Q/t;
disp(I,"The current flowing through the conductor(in
    A):")
```

**Scilab code Exa 1.3** `power calculation`

```
//Example 1_3 page no:3
clc
clear
E=50;//Energy in joules
t=2.5;//Time in second
P=E/t;
```

```
disp(P,"Power(in watts):")
```

**Scilab code Exa 1.4** `current calculation`

```
//Example 1_4 page no:5
clc
clear
R=10;//Resistance in ohm
V=12;//Voltage in volt
I=V/R;
disp(I,"current flowing through resistor(in A):")
```

**Scilab code Exa 1.5** `voltage calculation and power calculation`

```
//Example 1_5 page no:6
clc
clear
L=2;//Inductance in henry
di=2;//Current variation in amps/sec
di=2*2;//current change in 2 seconds
t=2;//time in sec
v=L*di;
disp(v,"1) voltage across inductor(in volt)")
W=0.5*(L*di^2);
disp(W,"2) energy stored in magnetic field(in joules
    )")
```

**Scilab code Exa 1.6** `power calculation`

```
//Example 1_6 page no:8
```

```
clc
clear
C=2*(10^-6);//capacitance in micro farad
V=1000;//Voltage in volts
W=0.5*(C)*(V^2);
disp(W,"Energy stored(in joules)")
```

**Scilab code Exa 1.7** voltage calculation

```
//Example 1_7 page no:11
clc
clear
v=30-2-1-3-5;//applying kirchof law to the given
    circuit
disp(v,"unknown voltage drop(in volt)")
```

**Scilab code Exa 1.8** voltage calculation

```
//Example 1_8 page no:11
clc
I=10/5//by applying ohms law to the given ciruit
V1m=1*I;
disp(V1m,"voltage across resistor V1m(in V)");
V3_1m=3.1*I;
disp(V3_1m,"voltage across resistor V1m(in V)");
V400m=0.4*I;
disp(V400m,"voltage across resistor V1m(in V)");
V500m=0.5*I;
disp(V500m,"voltage across resistor V1m(in V)");
```

**Scilab code Exa 1.9** `voltage calculation`

```
//Example 1_9 page no:12
clc
I=(100-40)/40//By applying ohms law to the given
   circuit
R=30//reisistance in ohm
V=I*R
disp(I,"Current across 30ohm resistor(in A):")
disp(V,"Voltage across 30ohm resistor(in V):")
```

**Scilab code Exa 1.10** `voltage calculation`

```
//Example 1_10 page no:13
clc
V=50*(10/(10+5))//applying voltage divider rule to
   the given circuit
disp(V,"Voltage across 10ohm resistor(in V)")
//in textbook the voltage is rounded to 1 digit
```

**Scilab code Exa 1.11** `voltage calculation`

```
//Example 1_11 page no:14
clc
V=100;//supply voltage
R1=1;//resistance in kilo_ohm
R2=5;//resistance in kilo_ohm
R3=4;//resistance in kilo_ohm
v=V*(R2+R3)/(R1+R2+R3);
disp(v,"Voltage across A and B (in volts)")
```

**Scilab code Exa 1.12** power calculation

```
//Example 1_12 page no:14
clc
R1=5;//Resistance in ohm
R2=2;//Resistance in ohm
R3=1;//Resistance in ohm
R4=2;//Resistance in ohm
V=50;//supply voltage
Rt=R1+R2+R3+R4;//total resistance
P=V*V/Rt;//calculating total power
disp(P,"Total power in the circuit (in watts)")
current=V/Rt;
P1=current^2*R1;
disp(P1,"power absorbed in 5 ohms (in watts)")
P2=current^2*R2;
disp(P2,"power absorbed in 2 ohms (in watts)")
P3=current^2*R3;
disp(P3,"power absorbed in 1 ohms (in watts)")
P4=current^2*R4;
disp(P4,"power absorbed in 2 ohms (in watts)")
```

**Scilab code Exa 1.13** current calculation

```
//Example 1_13 page no:16
clc
//apply kirchoff's law to the given circuit
I=50//current in ampere
R1=2;//resistance in ohm
R2=1;//resistance in ohm
R3=5;//resistance in ohm
V=I/(1/2+1/1+1/5)
I1=V/R1;
disp(I1,"Current flowing in 2 ohm resistor is (in
    ampere)")
```

```
I2=V/R2;
disp(I2,"Current flowing in 1 ohm resistor is (in
   ampere)")
I3=V/R3;
disp(I3,"Current flowing in 5 ohm resistor is (in
   ampere)")
```

**Scilab code Exa 1.14** current calculation

```
//Example 1_14 page no:16
clc
I=10;//supply current in ampere
//apply kirchof law to the circuit
V=5/(1/5+1/10+1/2+1)
disp(V,"Voltage across 10 ohm resistor (in volts)")
R1=5;//resistance in ohm
R2=10;//resistance in ohm
R3=2;//resistance in ohm
R4=1;//resistance in ohm
I1=V/R1;
I2=V/R2;
I3=V/R3;
I4=V/R4;
disp(I2,"Current flowing in 10 ohm resistor (in
   ampere)")
```

**Scilab code Exa 1.15** current calculation

```
//Example 1_15 page no:17
clc
//apply kirchoff law to the circuit
It=50;//total current in milli ampere
I1=30;
```

```
I2=10;
I3=It-I1-I2;
disp(I3,"current flowing in R3 (in milli ampere)")
```

**Scilab code Exa 1.16** resistance calculation

```
//Example 1_16 page no:18
clc
R1=10;//Resistance in ohm
R2=20;//Resistance in ohm
R3=30;//Resistance in ohm
R4=40;//Resistance in ohm
R=(1/R1+1/R2+1/R3+1/R4)
Rt=1/R
disp(Rt,"Total resistance (in ohm)")
```

**Scilab code Exa 1.17** current calculation

```
//Example 1_17 page no:20
clc
I=12;//total current in circuit(in ampere)
R1=4;//Resistance in ohm
R2=4;//Resistance in ohm
R3=4;//Resistance in ohm
R=R2*R3/(R2+R3)
I1=I*R/(R+R1)
disp(I1,"Current in resistor R1(in ampere)")
I2=I*R/(R+R2)
disp(I1,"Current in resistor R1(in ampere)")
I3=I*R/(R+R3)
disp(I1,"Current in resistor R1(in ampere)")
```

# Chapter 2

# METHODS OF ANALYSING CIRCUITS

**Scilab code Exa 2.a.1** current calculation

```
//Example 2_1 page no:85
clc;
delta=[3,-1,-1,
        -1,3,-1,
        -1,-1,3];
delta1=[10,-1,-1,
        5,3,-1,
        5,-1,3];
delta2=[3,10,-1,
        -1,5,-1,
        -1,5,3];
delta3=[3,-1,10,
        -1,3,5,
        -1,-1,5];
ia=det(delta1)/det(delta);
ib=det(delta2)/det(delta);
ic=det(delta3)/det(delta);
I=ia;
I1=ia-ib;
```

```
I2=ib;
I3=ib-ic;
I4=ic;
I5=ia-ic;
disp(I,"the branch current I is (in A)");
disp(I1,"the branch current I1 is (in A)");
disp(I2,"the branch current I2 is (in A)");
disp(I3,"the branch current I3 is (in A)");
disp(I4,"the branch current I4 is (in A)");
disp(I5,"the branch current I5 is (in A)");
```

**Scilab code Exa 2.a.2** `current calculation`

```
//Example 2_2 page no:86
clc;
V1=(4.8+2+3.6)/((1/5)+(1/20)+(1/10));
I=(V1-24)/5;
disp(I,"the current delivered by the 24V source is")
    ;
```

**Scilab code Exa 2.a.3** `current calculation`

```
//Example 2_3 page no:87
clc;
delta3=[360,-2,-1.5,
        -60,9,-1,
        0,-1,10.5];
delta5=[15.5,-2,360,
        -2,9,-60,
        -1.5,-1,0];
delta=[15.5,-2,-1.5,
      -2,9,-1,
      -1.5,-1,10.5];
```

```
I3=det(delta3)/det(delta);
I5=det(delta5)/det(delta);
I=I3-I5;
disp(I,"the current I in the loop is (in A)");
```

**Scilab code Exa 2.a.4** `power calculation`

```
//Example 2_4 page no:88
clc;
A=[1.25,-0.75,
   -4.75,5.75];
B=[-12.5,
    42.5];
X=inv(A)*B;
Va=X(1);
Vb=X(2);
I10=(Va-Vb+10)/4;
P=10*I10;
disp(P,"the power supplied by 10V source is (in W)")
   ;
```

**Scilab code Exa 2.a.5** `voltage calculation`

```
//Example 2_5 page no:90
clc;
R=16.67;
A=[75,-25,
    -58.35,25];
B=[25,
    10];
X=inv(A)*B;
I1=X(1);
I2=X(2);
```

```
Vx=I1*R;
disp(Vx,"the voltage across 16.67 ohm resistor is (
   in V)");
```

**Scilab code Exa 2.a.6** voltage ratio calculation

```
//Example 2_6 page no:91
clc;
Va=11;
Vout=6;
V=Va/Vout;
Vin=9.53;
Vout=1;
Vrat=Vout/Vin;
disp(Vrat,"the ratio Vout/Vin is ");
```

**Scilab code Exa 2.a.7** voltage calculation

```
//Example 2_7 page no:91
clc;
A=[0.93,-0.1,
    -0.1,0.443];
B=[17.29,
    7.143];
X=inv(A)*B;
V1=X(1);
V2=X(2);
V=3*((0.93*V1)-(0.1*V2));
disp(V,"the voltage V in the cicuit is (in V)");
```

**Scilab code Exa 2.a.8** `power calculation`

```
//Example 2_8 page no:92
clc;
R6=6;
delta=[1.83,-1,-0.5,
        -1,-1.167,-0.167,
        -0.5,-0.167,0.867];
delta2=[1.83,6.67,-0.5,
        -1,5,-0.167,
        -0.5,0,0.867];
delta3=[1.83,-1,6.67,
        -1,-1.167,5,
        -0.5,-0.167,0];
V2=det(delta2)/det(delta);
V3=det(delta3)/det(delta);
I6=(V2-V3)/6;
P=I6^2*R6;
disp(P,"the power absorbed or dissipated is (in W)"
   );
```

**Scilab code Exa 2.a.9** `power calculation`

```
//Example 2_9 page no:94
clc;
R5=5;
A=[0.42,-0.167,-0.25,
    -0.42,0.5,0.45,
    0,-1,1]
B=[18,
    -15,
    20];
X=inv(A)*B;
V1=X(1);
V2=X(2);
```

```
V3=X(3);
I5=V3/5;
P=I5^2*R5;
disp(P,"the power absorbed by 5 ohm resistor is (in
  W)");
//in text book value of I5^2 is rounded up so result
    vary slightly
```

**Scilab code Exa 2.a.10** power calculation

```
//Example 2_10 page no:95
clc;
A=[0.34,1.2,-1.34,
    -0.34,-1,1.83,
    1,-1,0];
B=[3,
    0,
    10];
X=inv(A)*B;
V1=X(1);
V2=X(2);
V3=X(3);
P=V2*5;
disp(P,"the power delivered by the current source(5A
  ) is (in W)");
```

**Scilab code Exa 2.a.11** power calculation

```
//Example 2_11 page no:96
clc;
V=50;
V1=23.33/(0.2+0.5+0.33);
I=(V-V1)/5;
```

```
P=V*I;
disp(P,"the power delivered by the 50V voltage
   source is (in W)");
```

**Scilab code Exa 2.a.12** voltage calculation

```
//Example 2_12 page no:96
clc;
//current source are parallel so added them up
I1=5;
I2=5;
I3=10;
I=I1+I2+I3;
R1=2;
R2=2;
R3=3;
R4=2;
R5=1;
R=1/((1/R1)+(1/R2)+(1/R3)+(1/R4)+(1/R5));
V=I*R;
disp(V,"the voltage source is (in V)");
disp(R,"the resistance connected in series is (in
   ohm)");
//in text book resistance calculationg is wrong
//R valus is 0.35
```

**Scilab code Exa 2.a.13** voltage calculation

```
//Example 2_13 page no:97
clc;
delta=[1.08,-0.75,
    -4.75,5.75];
delta1=[-6.25,-0.75,
```

```
    21.25,5.75];
delta2=[1.08,-6.25,
    -4.75,21.25];
V1=det(delta1)/det(delta);
V2=det(delta2)/det(delta);
Vx=V1+5-V2;
disp(V1,"the voltage V1 is");
disp(V2,"the voltage V2 is");
disp(Vx,"the voltage across 4 ohm resistor is (in V)
   ");
```

**Scilab code Exa 2.a.14** current calculation

```
//Example 2_14 page no:98
clc;
V=48;
I=(V-30)/5;
disp(I,"the current in 5ohm resistor is (in A)");
```

**Scilab code Exa 2.a.15** power calculation

```
//Example 2_15 page no:99
clc;
A=[12,6,-5,
    -1,1,0,
    0,0,1]
B=[4,
    5,
    -2];
X=inv(A)*B;
I1=X(1);
I2=X(2);
V2=2*I1;
```

```
P4=4*I2;
disp(V2,"the voltage across 2 ohm resistor is (in V)
  ");
disp(P4,"the power delivered by 4V source is (in W)"
  );
```

**Scilab code Exa 2.a.16** current calculation

```
//Example 2_16 page no:99
clc;
A=[10,5,4,
   1,-1,0,
   -2,-1,1];
B=[35,
   2,
   0];
X=inv(A)*B;
I1=X(1);
disp(I1,"the current in the 10 ohm resistor is (in A
  )");
```

**Scilab code Exa 2.7** current calculation

```
//Example 2_7 page no:69
clc
//mesh current equation for the circuit
resistance=[7,-2;-2,12]
volt=[10,-50]
current=inv(resistance)'*volt'//calculating current
  I1 I2 I3
disp(current,"current flowing in the circuit I1 and
  I2 (in ampere)")
```

**Scilab code Exa 2.8** current calculation

```
//Example 2_8 page no:69
clc
//mesh equations for the cirucuit is
resistance=[18,5,-3;5,8,1;-3,1,4]
volt=[50,10,-5]
current=inv(resistance)'*volt'//calculating current
   I1 I2 I3
disp(current(1),"the mesh current I1 in the circuit
   are (in ampere)")
disp(current(2),"the mesh current I2 in the circuit
   are (in ampere)")
disp(current(3),"the mesh current I3 in the circuit
   are (in ampere)")
```

**Scilab code Exa 2.10** current calculation

```
//Example 2_10 page no:74
clc
//mesh equation for the given circuit is
resistance=[15,-10,-5;-15,12,6;0,1,-1]
U=[40.0005,23.3326,-11.3332]
II=inv(resistance)'*U'//calculating current I1 I2 I3
current=II(1,1)-II(3,1)
disp(current,"current flowing through 5 ohms (in
   ampere)")
```

**Scilab code Exa 2.11** current calculation

```
//Example 2_11 page no:74
clc
//mesh equation for the circuit is
I1=10;//current in ampere
resistance=[5,-2;-2,3]
volt=[20,10]
current=inv(resistance)'*volt'//calculating current I1 I2 I3
disp(I1,"the current I1 is (in ampere)")
disp(current(1),"the current I2 is (in ampere)")
disp(current(2),"the current I3 is (in ampere)")
```

**Scilab code Exa 2.12** current calculation

```
//Example 2_12 page no:76
clc
//applying kirchoff's law to the given circuit
R1=10//resistance in ohm
R2=3//resistance in ohm
R3=5//resistance in ohm
R4=1//resistance in ohm
V=10//source voltage
resistance=[(1/10+1/3),-1/3;-1/3,(1/3+1/5+1)]
current=[5,10]
volt=inv(resistance)'*current'//calculating V1 V2
disp(volt(1),"voltage across node 1 is (in V)")
disp(volt(2),"voltage across node 2 is (in V)")
I1=volt(1,1)/R1;
disp(I1,"current in branch I10 (in ampere)")
I2=(volt(1,1)-volt(2,1))/R2;
disp(I2,"current in branch I3 (in ampere)")
I3=volt(2,1)/R3
disp(I3,"current in branch I5 (in ampere)")
I4=(volt(2,1)-V)/R4
disp(I4,"current in branch I1 (in ampere)")
```

```
//in textbook node voltages are rounded off so that
   current in each branches are more approximated in
    text book so current values varies slightly with
    textbook
```

**Scilab code Exa 2.13** voltage calculation

```
//Example 2_13 page no:77
clc
//applying kirchhoff's law
resistance
   =[0.96,-0.66,0;-0.66,1.16,-0.5;0,-0.5,1.66]
current=[1,5,0]
volt=inv(resistance)'*current'//calculating V1 V2 V3
disp(volt(1),"voltage at node_1 V1 is (in V)")
disp(volt(2),"voltage at node_2 V2 is (in V)")
disp(volt(3),"voltage at node_3 V3 is (in V)")
//values of V1 and V3 varies slightly with text book
    hence voltages are rounded off in text book
   calculation
```

**Scilab code Exa 2.15** current calculation

```
//Example 2_15 page no:81
clc
//applying kirchoff law to node 1
R5=5//resistance in ohm
V=10//source voltge
resistance=[0.83,-0.5,0;-0.5,1.5,0.7;0.01,1,-1]
current=[10,2,20]
volt=inv(resistance)'*current'//calculating V1 V2 V3
I3=(volt(3,1)-8.8)/R5
```

```
disp(I3,"current flowing through 5 ohm resistor is (
    in ampere)")
disp("negative sign indicate flow of current in
    opposite direction")
```

**Scilab code Exa 2.16** voltage calculation

```
//Example 2_16 page no:84
clc
current_source=5//in ampere
source_resistance=5//in ohm
equ_src_volt=current_source*source_resistance
disp(equ_src_volt,"equivalent source voltage is (in
    volt)")
```

**Scilab code Exa 2.17** current calculation

```
//Example 2_17 page no:84
clc
src_volt=50//in volt
internal_resistance=30//in ohm
equ_current_src=src_volt/internal_resistance
disp(equ_current_src,"equivalent current source is (
    in ampere)")
```

# Chapter 3

# USEFUL THEOREMS IN CIRCUIT ANALYSIS

**Scilab code Exa 3.a.1** voltage calculation

```
//Example 3_1 page no:129
clc;
V=(10/2.92)/((1/4.31)+(1/6.77)+(1/2.92));
Va=V*(2/(2+2.31));
Vb=V*(6/6.77);
Vab=Va-Vb;
disp(Vab,"the voltage across Vab is (in V)");
```

**Scilab code Exa 3.a.2** current calculation

```
//Example_a_3_2 page no:129
clc;
R=(((8+1.07)*1)/(8+1.07+1))+1;
I1=10/R;
It=5/5.8;
I5=(It*10)/18.5;
```

```
I2=(I5*1)/2;
Ir3=(10*6.07)/(6.07+3.5);
I3=(Ir3*(1/2));
I=I1-I2-I3;
disp(I,"the current passing through the circuit is (in A)");
```

**Scilab code Exa 3.a.3** current calculation

```
//Example_a_3_3 page no:132
clc;
Rab=(20*40)/(20+40);
Rth=Rab;
Rn=Rab;
I=(50-10)/(40+20);
Vth=10+(I*20);
I1=10/20;
I2=50/40;
In=I1+I2;//thevenin voltage varie slightly due to current value I is rounded off in text book
disp(Vth,"the thevenin voltage is (in V)");
disp(Rth,"the thevenin resistance is (in ohm)");
disp(In,"the norton current is (in A)");
disp(Rn,"the norton resistance is (in ohm)");
```

**Scilab code Exa 3.a.4** current calculation

```
//Example_a_3_4 page no:133
clc;
Rab=4;
V12=0;
V5=5*4;
V3=4*3;
```

```
Vab=V12+V5+V3;
I12=0;
I5=5;
I3=3;
Iab=I12+I5+I3;
disp(Vab,"the thevenin voltage is (in V)");
disp(Rab,"the thevenin resistance is (in ohm)");
disp(Iab,"the norton current is (in A)");
disp(Rab,"the norton resistance is (in ohm)");
```

**Scilab code Exa 3.a.5** voltage calculation

```
//Example_a_3_5 page no:135
clc;
Vab=(4+3)/(0.05+0.2+0.17);
Rab=(((18.75*5)/(18.75+5))*6)/(((18.75*5)/(18.75+5))
    +6);
disp(Vab,"the thevenin voltage is (in V)");
disp(Rab,"the thevenin resistance is (in ohm)");
```

**Scilab code Exa 3.a.6** current calculation

```
//Example 3_6 page no:121
clc
Rt=2+((3*(2+((2*2)/(2+2))))/(3+(2+((2*2)/(2+2)))))//
    total resistance
disp(Rt,"total resistance (in ohms)")
It=20/3.5
disp(It,"total current (in ampere)")
I1=1.43//current in branch cd
disp(I1,"current in branch cd (in A)")
//after interchanging the source voltage
Rt=3.23//total resistance
```

```
It=20/3.23//total current drawn
I2=1.43//current in branch ab
disp(I2,"current in branch ab (in A)")
disp("In both cases the ratio of input to response
    is the same")
```

**Scilab code Exa 3.a.7** `voltage calculation and resistance calculation`

```
//Example_a_3_7 page no:137
clc;
R1=10;
R2=3;
R3=6;
V1=50;
V2=10;
V3=0;
I=40/16;//by applying kirchof law
V6=R3*I;
Vab=V3+V6+V2;
Rab=3+((R1*R3)/(R1+R3));
disp(Vab,"the thevenin voltage is (in V)");
disp(Rab,"the thevenin resistance is (in ohm)");
```

**Scilab code Exa 3.a.8** `resistance calculation`

```
//Example_a_3_8 page no:138
clc;
V1=10;
V2=5;
R1=5;
R2=2;
R3=1;
R4=4;
```

```
V2r=R2*(V1/(R1+R2));
V1r=R3*(V2/R1);
Vab=V2r-V1r;//thevenin voltage
Rab=((R1*R2)/(R1+R2))+((R4*R3)/(R4+R3));//thevenin resistance
disp(Vab,"the thevenin voltage is (in V)");
disp(Rab,"the thevenin resistance is (in ohm)");
```

**Scilab code Exa 3.a.9** resistance calculation

```
//Example_a_3_9 page no:139
clc;
V=50;
R1=3;
R2=4;
In=V/R1;
Rn=(R1*R2)/(R1+R2);
disp(In,"the norton current is (in A)");
disp(Rn,"the norton resistance is (in ohm)");
```

**Scilab code Exa 3.a.10** resistance calculation

```
//Example_a_3_10 page no:140
clc;
I=25;
R1=5;
R2=2;
R3=3;
R4=4;
R5=5;
In=I*(R2/(R2+R3+R4));//norton current
Rab=(R5*(R4+R3+R2))/(R5+(R4+R3+R2));
disp(In,"the norton current is (in A)");
```

```
disp(Rab,"the norton resistance is (in ohm)");
```

**Scilab code Exa 3.a.11** current calculation

```
//Example_a_3_11 page no:140
clc;
I=30;
R1=10;
R2=5;
R3=5;
R4=2;
R5=1;
R6=1;
Rab=(R2*(2+((R5*R6)/R4)))/(R2+(2+((R5*R6)/R4)));
In=I*(Rab/6.67);//norton current
disp(In,"the norton current is (in A)");
disp(Rab,"the norton resistance is (in ohm)");
```

**Scilab code Exa 3.a.12** current calculation

```
//Example_a_3_12 page no:141
clc;
In1=10;
In2=20/6;
In=In1+In2;
Rab=6;
disp(In,"the norton current is (in A)");
disp(Rab,"the norton resistance is (in ohm)");
```

**Scilab code Exa 3.a.13** current calculation

```
//Example_a_3_13 page no:142
clc;
I=20;
R1=6;
R2=3;
R3=5;
R4=2;
R5=6;
I5=I*(R2/(R2+6.5));
I6=I5*(2/(R1+2));
V=I6*R4;
Rt=(((((6*3)/(6+3))+5)*2)/((((6*3)/(6+3))+5)+2))
    +(6+2);
I61=V/Rt;
I=I6-I61;//in A
disp(I,"the ammeter reading is (in A)");
```

**Scilab code Exa 3.a.14** `reciprocity theorem verification`

```
//Example_a_3_14 page no:143
clc;
V=10;
R1=2;
R2=4;
R3=3;
I5=2.14*(4/12);
Rt=10/2.14
I2=10/4.67;//in A
I3=10/9.33;//in A
I2=1.07*(4/6);//in A
ratio=10/0.71;
disp(ratio,"the ration of voltage to current is");
disp("the ratio is same in both cases and the
    reciprocity theorem is verified");
```

**Scilab code Exa 3.a.15** voltage calculation

```
//Example_a_3_15 page no:144
clc;
I=10;
R1=1;
R2=2;
R3=3;
R=3;
I3=10*(2/(2+3));
V=I3*R;
disp(V,"the voltage in first method is (in V)");
R=2;
I2=10*(3/5);
V=I2*R;
disp(V,"the voltage in second method is (in V)");
disp("In both cases, the ratio of current to voltage
    is the same")
ratio=0.833;
disp(ratio,"the voltage to current ration is");
disp("the reciprocity theroem is verified");
```

**Scilab code Exa 3.a.16** power calculation

```
//Example_a_3_16 page no:145
clc;
V1=50;
R1=10;
R2=2;
R3=5;
R4=3;
Rt=(((3+2)*5)/((3+2)+5))+10;
```

```
It=50/Rt;
I3=It*(R3/(R3+R3));
Vab=R4*I3;//in V
Rth=((((10*5)/(10+5))+2)*3)/((((10*5)/(10+5))+2)+3);
Rl=Rth;//here Rl is equal to Rth
Il=Vab/(Rl+Rl);
P=Il^2*Rl;
disp(P,"the maximum power delivered to the load is (
    in W)");
```

**Scilab code Exa 3.a.17** resistance calculation

```
//Example_a_3_17 page no:146
clc;
V=100;
R1=10;
R2=20;
R3=30;
R4=40;
Va=V*(R3/(R3+R1));
Vb=V*(R4/(R4+R2));
Vab=Va-Vb;
Rab=(((30*10)/(30+10))+((20*40)/(20+40)));
Rl=Rab;
Il=Vab/(Rl+Rl);
P=Il^2*Rl;//power calculation
disp(Rl,"the load resistance is (in ohm)");
disp(P,"the maximum power delivered to load is (in W
    )");
```

**Scilab code Exa 3.a.20** current calculation

```
//Example_a_3_20 page no:148
```

```
clc;
I_14=20/(4+2+2);//applying kirchoff's law
V=5;
I_24=-V/4;
I4=I_14+I_24;
disp(I4,"the current i4 is (in A)");
```

**Scilab code Exa 3.a.21** current calculation

```
//Example_a_3_21 page no:149
clc;
I_1=-5/(3+2+12);
V_3=1.55;
I_2=(V_3+(4*V_3))/2;
I=I_1+I_2;
disp(I,"the total current in 2ohm resistor is (in A)
  ");
```

**Scilab code Exa 3.a.22** voltage calculation and resistance calculation

```
//Example_a_3_22 page no:150
clc;
V=4;
R1=2;
R2=3;
Vx=V/0.8;
Isc=V/(R1+R2);
Rth=Vx/Isc;
disp(Vx,"the thevenin voltage is (in V)");
disp(Rth,"the thevenin resistance is (in ohm)");
```

**Scilab code Exa 3.a.23** current calculation

```
//Example_a_3_23 page no:151
clc;
R=2;
Vi=-1;
Voc=-4*Vi;
Isc=10;
Rth=Voc/Isc;
i2=Voc/(Rth+R);
disp(i2,"the current throught 2 ohm resistor is (in
   A)");
```

**Scilab code Exa 3.a.24** current calculation and resistance calculation

```
//Example_a_3_24 page no:152
clc;
In=0;
Vx=(1*10)/(2+5+20);
V=4+Vx;
Rth=V/1;
//if we short circuit the terminals a and b we have
Vx=0;
Isc=Vx/4;
disp(In,"the norton current is (in A)");
disp("the current is zero because there is no
   independent source");
disp(Rth,"the norton resistance is (in ohm)");
```

**Scilab code Exa 3.1** resistance calculation

```
//Example 3_1 page no:112
clc
```

```
r1=13//resistance in ohm
r2=12//resistance in ohm
r3=14//resistance in ohm
R1=r1*r2/(r1+r2+r3)
disp(R1,"resistance R1 is (in ohm)")
R2=r3*r1/(r1+r2+r3)
disp(R2,"resistance R2 is (in ohm)")
R3=r2*r3/(r1+r2+r3)
disp(R3,"resistance R3 is (in ohm)")
```

**Scilab code Exa 3.2** `resistance calculation`

```
//Example 3_2 page no:113
clc
R1=10//resistance in ohm
R2=5//resistance in ohm
R3=20//resistance in ohm
r1=((R1*R2)+(R2*R3)+(R3*R1))/R3
disp(r1,"resistance r1 is (in ohm)")
r2=((R1*R2)+(R2*R3)+(R3*R1))/R1
disp(r2,"resistance r2 is (in ohm)")
r3=((R1*R2)+(R2*R3)+(R3*R1))/R2
disp(r3,"resistance r3 is (in ohm)")
```

**Scilab code Exa 3.3** `voltage calculation`

```
//Example 3_3 page no:115
clc
//apply super position theorem to the given circuit
V=1/(0.1+0.05+0.143)
V1=(V/7)*2//voltage across 2 ohm resistor due to 10
    volt
V=2.86/(0.143+0.05+0.1)
```

```
V2=((V-20)/7)*2//voltage across 2 ohm resistor due
   to 20 volt
I=2*(5/(5+8.67))
V3=I*2//voltage due to 2A current source in 2 ohm
   resistor
V=V1+V2-V3
disp(V,"voltage across 2 ohm resistor is (in volt)")
disp("negative sign indicates that the voltage is in
    opposite direction")
```

**Scilab code Exa 3.4** `resistance calculation`

```
//Example 3_4 page no:118
clc
//to find Vth and Rth
R1=10//resistance in ohm
R2=5//resistance in ohm
V=50//source voltage
I=25/15//current flowing in the circuit
V1=I*10//voltage across 10 ohm resistor
V2=I*5//voltage across 5 ohm resistor
Vth=V-V1;
disp(Vth,"the thevenin voltage is (in volt)")
Rth=(R1*R2)/(R1+R2);
disp(Rth,"the thevenin resistance is (in ohm)")
```

**Scilab code Exa 3.5** `current calculation and resistance calculation`

```
//Example_a_3_5 page no:135
clc;
Vab=(4+3)/(0.05+0.2+0.17);
Rab=(((18.75*5)/(18.75+5))*6)/((((18.75*5)/(18.75+5))
   +6);
```

```
disp(Vab,"the thevenin voltage is (in V)");
disp(Rab,"the thevenin resistance is (in ohm)");
```

**Scilab code Exa 3.6** current calculation

```
//Example 3_6 page no:121
clc
Rt=2+((3*(2+((2*2)/(2+2))))/(3+(2+((2*2)/(2+2)))))//
   total resistance
disp(Rt,"total resistance (in ohms)")
It=20/3.5
disp(It,"total current (in ampere)")
I1=1.43//current in branch cd
disp(I1,"current in branch cd (in A)")
//after interchanging the source voltage
Rt=3.23//total resistance
It=20/3.23//total current drawn
I2=1.43//current in branch ab
disp(I2,"current in branch ab (in A)")
disp("In both cases the ratio of input to response
   is the same")
```

**Scilab code Exa 3.7** current calculation

```
//Example 3_7 page no:122
clc
R4=4//resistance in ohm
R3=3//resistance in ohm
R6=6//resistance in ohm
Rt=((R3*R6)/(R3+R6))//resistance in parallel
//after adding ammeter
R3=4
RT=R4+((R3*R6)/(R3+R6))//total resistance
```

```
It=10/(4+((6*3)/(6+3)))//total current
I3=It*Rt/R3
V=It*1
Ia=V/RT;
Ia=1.21-Ia;
disp(Ia,"current flowing in ammeter is (in A)")
//current in ammeter has more decimal places hence
    values are rounded off in text book
```

**Scilab code Exa 3.8** power calculation

```
//Example 3_8 page no:125
clc
Rs=25//resistance in ohm
Rl=Rs//according to maximum power transfet theorem
I=50/(Rl+Rs)
P=I^2*Rl
disp(P,"the maximum power delivered to the load is (
    in watts)")
```

**Scilab code Exa 3.10** current calculation

```
//Example 3_10 page no:129
clc
V1=10;
G1=1/2;
V2=20;
G2=1/5;
V0=((V1*G1)+(V2*G2))/(G1+G2)
R0=1/(G1+G2)
I=V0/(3+R0)
disp(I,"the current is (in ampere)")
```

# Chapter 4

# INTRODUCTION TO ALTERNATING CURRENTS AND VOLTAGES

**Scilab code Exa 4.a.1** voltage calculation

```
//Example_a_4_1 page no:175
clc;
V2=100-50-20;
V5=100-50;
V2ohm=sqrt(2)*30;
V5ohm=sqrt(2)*50;
Va2ohm=V2ohm*0.637;
Va5ohm=V5ohm*0.637;
disp(V2,"the voltage across 2 ohm resistor is (in V)
    ");
disp(V5,"the voltage across 5 ohm resistor is (in V)
    ");
disp(V2ohm,"peak value of voltage across 2 ohm
    resistor is (in V)");
disp(V5ohm,"peak value of voltage across 5 ohm
    resistor is (in V)");
disp(Va2ohm,"average value across 2 ohm resistor is
```

```
    (in V)");
disp(Va5ohm,"average value across 5 ohm resistor is
    (in V)");
```

**Scilab code Exa 4.a.2** current calculation

```
//Example_a_4_2 page no:176
clc;
Ip=10;//peak value of current form the current
    equation(in milliAmpere)
Irms=Ip/sqrt(2);
Ipp=2*Ip;
Iav=Ip*0.637;
disp(Ip,"the peak value of current is (in mA)");
disp(Irms,"the rms value of current is (in mA)");
disp(Ipp,"the peak to peak value of current is (in
    mA)");
disp(Iav,"the average value of current is (in mA)");
```

**Scilab code Exa 4.a.4** current calculation

```
//Example_a_4_4 page no:177
clc;
Irms=20;
f=50;
Im=sqrt(2)*Irms;
//at t=0.0025s
t1=0.0025;
i_t1=Im*cos(2*%pi*f*t1);
disp(i_t1,"the current at 0.0025s is (in A)");
//at t=0.0125s
t2=0.0125;
i_t2=Im*cos(2*%pi*f*t2);
```

```
disp(i_t2,"the current at 0.0125s is (in A)");
t=acos(14.14/28.28)/(2*f*%pi);
disp(t,"the time at which instantaneous current
    becomes 14.14 A is (in s)");
```

**Scilab code Exa 4.a.5** voltage calculation

```
//Example_a_4_5 page no:177
clc;
Vrms=sqrt(5^2+(5^2/2));//the values are taken by
    comparing the given equation with rms equation
disp(Vrms,"the rms value of the waveform is");
```

**Scilab code Exa 4.a.8** current calculation

```
//Example_a_4_8 page no:178
clc;
Ip=10;//peak current in mA taken from i(t) equation
Ipp=2*Ip;
Irms=0.707*Ip;
Iav=0.637*Ip;
disp(Ip,"the peak value of current is (in mA)");
disp(Ipp,"the peak to peak value of current is(in mA
    )");
disp(Irms,"the rms value of current is (in mA)");
disp(Iav,"the average value of current is (in mA)");
```

**Scilab code Exa 4.a.9** resistance calculation

```
//Example_a_4_9 page no:179
```

```
clc;
f=2*1000;
C=0.01*10^-6;
Xc=1/(2*%pi*f*C);
Xc=Xc/1000;//converting to killo ohm
disp(Xc,"the capacitive reactance is (in killoOhm)")
;
```

**Scilab code Exa 4.a.10** current calculation

```
//Example_a_4_10 page no:179
clc;
Vrms=5;
f=5*1000;
C=0.01*10^-6;
Xc=1/(2*%pi*f*C);
Irms=Vrms/Xc;
Irms=Irms*1000;//converting to mA
disp(Irms,"the rms current in the circuit is (in mA)
");
```

**Scilab code Exa 4.a.11** resistance calculation

```
//Example_a_4_11 page no:180
clc;
f=3*10^3;
L=2*10^-3;
Xl=2*%pi*f*L;
disp(Xl,"the inductive reactance is (in ohm)");
```

**Scilab code Exa 4.a.12** current calculation

```
//Example_a_4_12 page no:180
clc;
f=10*10^3;
Vrms=10;
L=50*10^-3;
Xl=2*%pi*f*L;
Irms=Vrms/Xl;
Irms=Irms*1000;//converting to mA
disp(Irms,"the rms current is (in mA)");
```

---

**Scilab code Exa 4.a.13** form factor

```
//Example_a_4_13 page no:180
clc;
//here Vm is assumed to be one hence it will be
    canceled in the calculation and also a variable
    without initializing cannot be used
x0=0;
x1=%pi;
Vav=(1/(2*%pi))*(integrate('sin(x)','x',x0,x1));
x0=0;
x1=%pi;
Vrms=sqrt((1/(2*%pi))*(integrate('sin(x)^2','x',x0,
    x1)));
form_factor=Vrms/Vav;
disp(form_factor,"the form factor is ");
//the form factor differs slightly hence values are
    rounded off in text book
```

---

**Scilab code Exa 4.a.15** average and rms value of sine wave

```
//Example_a_4_15 page no:181
clc;
x0=0;
x1=%pi;
Vav=5*(1/%pi)*(integrate('sin(wt)','wt',x0,x1));
rms=sqrt(5^2*(1/%pi)*(integrate('sin(wt)^2','wt',x0,
   x1)));
disp(Vav,"the average value is ");
disp(rms,"the effective value of rms is ");
```

**Scilab code Exa 4.a.16** voltage calculation

```
//Example_a_4_16 page no:182
clc;
x0=(%pi/3);
x1=%pi;
Vav=10*(1/%pi)*(integrate('sin(wt)','wt',x0,x1));
Vrms=sqrt(10^2*(1/%pi)*(integrate('sin(wt)^2','wt',
   x0,x1)));
disp(Vav,"the average value Vav is (in V)");
disp(Vrms,"the effective value Vrms is (in V)");
```

**Scilab code Exa 4.a.17** voltage calculation

```
//Example_a_4_17 page no:182
clc;
P=0.03;
x0=0;
x1=0.01;
Vav=(1/P)*((20*x1)-(20*x0));
Veff=sqrt((1/P)*(20^2*x1));
form_factor=Veff/Vav;
disp(form_factor,"the form factor is");
```

```
//in textbook calculation of Veff is wrong so the
   form factor value varies in textbook
```

**Scilab code Exa 4.2** frequency calculation

```
//Example 4_2 page no:166
clc
T=20*10^-3;//time in millisecond
f=1/T;
disp(f,"frequency (in Hz)")
```

**Scilab code Exa 4.3** time calculation

```
//Example 4_3 page no:166
clc
f=30;//frequency
T=1/f;
T=T*10^3//converting to millisecond
disp(T,"Time (millisecond)")
```

**Scilab code Exa 4.5** voltage calculation

```
//Example 4_5 page no:169
clc
v=10*sin(%pi/2)
disp(v,"1) Instantaneous voltage at 90 degree for
   first wave (volt)");
v=8*sin(%pi/4)
disp(v,"2) Instantaneous voltage at 90 degree for
   second wave(volt)");//text book value is rounded
   to two digit
```

**Scilab code Exa 4.7** `current calculation`

```
//Example 4_7 page no:172
clc
I1=20;//direct current in conductor(in amps)
I2=20;//sinusoidal peak current in conductor (in
   amps)
ret_current=sqrt((20^2+(20^2/2)))
disp(ret_current,"The resultant current in conductor
    is(A)")//in text book value is rounded to 2
   digits
```

# Chapter 5

# COMPLEX IMPEDENCE

**Scilab code Exa 5.a.1** `voltage calculation`

```
//Example_a_5_1 page no:201
clc;
V=50;
f=50;
R=100*10^3;
C=0.01*10^-6;
Z=R-(%i*(1/(100*%pi*C)));
Zmag=sqrt(real(Z)^2+imag(Z)^2);
Zang=atand(imag(Z)/real(Z));
Imag=V/Zmag;
Iang=0-Zang;
disp(Imag,"the magnitude of current Imag in the
    circuit is(in A)");
disp(Iang,"the angle of current Iang in the circuit
    is(in degree)");
Vrmag=Imag*R;
Vrang=Iang;
disp(Vrmag,"the magnitude of voltage across the
    resistor is(in V)");
disp(Vrang,"the angle of voltage across the resistor
     is (in degree)");
```

```
Vcmag=Imag/(100*%pi*0.01*10^-6);
Vcang=Iang-90;
disp(Vcmag,"the magnitude of voltage across the
    capacitor is (in V)");
disp(Vcang,"the angle of voltage across the
    capacitor is (in degree)");
```

**Scilab code Exa 5.a.2** degree calculation

```
//Example_a_5_2 page no:202
clc;
V=10;
Z=100+(((125.66*%i)*(314.15*%i))/((125.66*%i)
    +(314.15*%i)));
Zmag=sqrt(real(Z)^2+imag(Z)^2);
Zang=atand(imag(Z)/real(Z));
disp(Zmag,"the magnitude of impedence is (in ohm)");
disp(Zang,"the angle of impedence is (in degree)");
Imag=V/Zmag;
Iang=0-Zang;
disp(Imag,"the magnitude of current is (in A)");
disp(Iang,"the angle of current is (in degree)");
//inductance value is doubled
Z=100+(%i*179.7);
Zmag=sqrt(real(Z)^2+imag(Z)^2);
Zang=atand(imag(Z)/real(Z));
disp(Zmag,"the magnitude of impedence is (in ohm)");
disp(Zang,"the angle of impedence is (in degree)");
```

**Scilab code Exa 5.a.3** voltage calculation

```
//Example_a_5_3 page no:203
clc;
```

```
R1=100;
R2=500;
V1mag=23.1;
V1ang=19.71;
V1real=V1mag*cosd(V1ang);
V1imag=V1mag*sind(V1ang);
V100=30;
//calculating the required voltages
V100real=real(V100)-V1real;
V100imag=imag(V100)-V1imag;
V100mag=sqrt(V100real^2+V100imag^2);
V100ang=atand(V100imag/V100real);
disp(V100mag,"the magnitude of voltage across 100 ohm is(in V)");
disp(V100ang,"the angle of voltage across 100 ohm is (in degree)");
disp(V1mag,"the magnitude of voltage across branch element is (in V)");
disp(V1ang,"the angle of voltage across branch element is (in degree)");
//calculating the required current values
I100mag=V100mag/R1;
I100ang=V100ang;
disp(I100mag,"the magnitude of current passing through 100 ohm is(in A)");
disp(I100ang,"the angle of current passing through 100 ohm is(in degree)");
I500mag=V1mag/R2;
I500ang=V1ang;
disp(I500mag,"the magnitude of current passing through 500 ohm is(in A)");
disp(I500ang,"the angle of current passing through 500 ohm is(in degree)");
Il1mhmag=V1mag/314.1;
Il1mhang=V1ang-90;
disp(Il1mhmag,"the magnitude of current passing through 1 milli Henry inductor is (in A)");
disp(Il1mhang,"the angle of current passing through
```

```
   1 milli Henry inductor is (in degree)");
I13mhmag=V1mag/942.5;
I13mhang=V1ang-90;
disp(I13mhmag,"the magnitude of current passing
   through 3 milli Henry inductor is (in A)");
disp(I13mhang,"the angle of current passing through
   3 milli Henry inductor is (in degree)");
disp("the total current lags the circuit is
   predominantly inductive");
//values varies slightly with text book hence values
    are rounded off in text book
```

**Scilab code Exa 5.a.5** current calculation and voltage calculation

```
//Example_a_5_5 page no:204
clc;
Vmag=100;
Vang=0;
f=50;
L1=3+(%i*31.41);
L2=5-(31.83*%i);
L3=10+(%i*150.73);
R1=3;
R2=5;
R3=10;
L1mag=sqrt(real(L1)^2+imag(L1)^2);
L1ang=atand(imag(L1)/real(L1));
I1mag=Vmag/L1mag;
I1ang=Vang-L1ang;
I1real=I1mag*cosd(I1ang);
I1img=I1mag*sind(I1ang)*%i;
I1=I1real+I1img;
disp(I1,"the current passing thorugh 3+31.41i ohm is
    (in A)");
L2mag=sqrt(real(L2)^2+imag(L2)^2);
```

```
L2ang=atand(imag(L2)/real(L2));
I2mag=Vmag/L2mag;
I2ang=Vang-L2ang;
I2real=I2mag*cosd(I2ang);
I2img=I2mag*sind(I2ang)*%i;
I2=I2real+I2img;
disp(I2,"the current passing through 5-31.83i ohm is
    (in A)");
L3mag=sqrt(real(L3)^2+imag(L3)^2);
L3ang=atand(imag(L3)/real(L3));
I3mag=Vmag/L3mag;
I3ang=Vang-L3ang;
I3real=I3mag*cosd(I3ang);
I3img=I3mag*sind(I3ang)*%i;
I3=I3real+I3img;
disp(I3,"the current passing through 10+150.73i ohm
   is (in A)");
It=I1+I2+I3;
disp(It,"the total current is (in A)");
V1=R1*I1;
V2=R2*I2;
V3=R3*I3;
V1mag=sqrt(real(V1)^2+imag(V1)^2);
V1ang=atand(imag(V1)/real(V1));
V2mag=sqrt(real(V2)^2+imag(V2)^2);
V2ang=atand(imag(V2)/real(V2));
V3mag=sqrt(real(V3)^2+imag(V3)^2);
V3ang=atand(imag(V3)/real(V3));
disp(V1mag,"the magnitude of voltage across 3 ohm
   resistor is (in V)");
disp(V1ang,"the angle of voltage across 3 ohm
   resistor is (in degree)");
disp(V2mag,"the magnitude of voltage across 5 ohm
   resistor is (in V)");
disp(V2ang,"the angle of voltage across 5 ohm
   resistor is (in degree)");
disp(V3mag,"the magnitude of voltage across 10 ohm
   resistor is (in V)");
```

```
disp(V3ang,"the angle of voltage across 10 ohm resistor is (in degree)");
V0_1h=(I1*(31.41*%i));
V0_1hmag=sqrt(real(V0_1h)^2+imag(V0_1h)^2);
V0_1hang=atand(imag(V0_1h)/real(V0_1h));
V100h=(I2*(-31.83*%i));
V100hmag=sqrt(real(V100h)^2+imag(V100h)^2);
V100hang=atand(imag(V100h)/real(V100h));
V0_5h=(I3*(157.81*%i));
V0_5hmag=sqrt(real(V0_5h)^2+imag(V0_5h)^2);
V0_5hang=atand(imag(V0_5h)/real(V0_5h));
V500h=(I3*(-6.37*%i));
V500hmag=sqrt(real(V500h)^2+imag(V500h)^2);
V500hang=atand(imag(V500h)/real(V500h));
V500hang=V500hang-180;
disp(V0_1hmag,"the magnitude of voltage across 0.1 henry inductance is (in V)");
disp(V0_1hang,"the angle of voltage across 0.1 henry inductance is (in V)");
disp(V100hmag,"the magnitude of voltage across 100 milli henry inductance is (in V)");
disp(V100hang,"the angle of voltage across 100 milli henry inductance is (in V)");
disp(V0_5hmag,"the magnitude of voltage across 0.5 henry inductance is (in V)");
disp(V0_5hang,"the angle of voltage across 0.5 henry inductance is (in V)");
disp(V500hmag,"the magnitude of voltage across 500 milli henry inductance is (in V)");
disp(V500hang,"the angle of voltage across 50 milli henry inductance is (in V)");//the angle is added with 180 degree to give positive value hence both value i.e in text book and scilab result are same mathematically
//here angle values varies a little here more accurate values are used for calcultaion hence values are not altered in any variable but in text book values are rounded off and they produce
```

```
    approximate results
```

**Scilab code Exa 5.a.6** impedance calculation

```
//Example_a_5_6 page no:206
clc;
V=100;
f=50;
R=50;
C=100*10^-6;
Xc=1/(2*%pi*f*C);
Bc=1/Xc;
G=1/R;
Y=sqrt(G^2+Bc^2);
Z=1/Y;
theta=atand(R/Xc);
disp(Z,"the impedence in the circuit is (in ohm)");
disp(theta,"the phase angle in the circuit is (in
   degree)");
//the impedence value varies slightly with text book
    due to round off values in text book, hence both
    answers are same
```

**Scilab code Exa 5.a.7** current calculation

```
//Example_a_5_7 page no:207
clc;
f=50;
R1=100;
R2=200;
C1=100*10^-6;
C2=300*10^-6;
Vsmag=10;
```

```
Vsang=0;
Xc1mag=1/(2*%pi*f*C1);
Xc1ang=-90;
Xc2mag=1/(2*%pi*f*C2);
Xc2ang=-90;
Ic1mag=Vsmag/Xc1mag;
Ic1ang=Vsang-Xc1ang;
Ic2mag=Vsmag/Xc2mag;
Ic2ang=Vsang-Xc2ang;
Ir1=Vsmag/R1;
Ir2=Vsmag/R2;
It=Ir1+Ir2+(%i*(Ic1mag+Ic2mag));
Itmag=sqrt(real(It)^2+imag(It)^2);
Itang=atand(imag(It)/real(It));
R=(R1*R2)/(R1+R2);
Xc=(Xc1mag*Xc2mag)/(Xc1mag+Xc2mag);
theta=atand(R/Xc);
disp(Ic1mag,"the magnitude of current passing
    through 100 microFarad is (in A)");
disp(Ic1ang,"the angle of current passing through
    100 microFarad is (in degree)");
disp(Ic2mag,"the magnitude of current passing
    through 300 microFarad is (in A)");
disp(Ic2ang,"the angle of current passing through
    300 microFarad is (in degree)");
disp(Itmag,"the magnitude of total current is (in A)
    ");
disp(Itang,"the angle of total current is (in A)");
disp(theta,"the phase angle between the applied
    voltage and total current is (in degree)");
```

**Scilab code Exa 5.a.8** impedance calculation and current calculation

```
//Example_a_5_8 page no:208
clc;
```

```
V=100;
f=50;
R1=10;
C1=100*10^-6;
R2=50;
C2=300*10^-6;
Xc1=1/(2*%pi*R2*C1);
Xc2=1/(2*%pi*R2*C2);
G2=1/R2;
Bc2=1/Xc2;
Y2=sqrt(G2^2+Bc2^2);
Z2=1/Y2;
theta_p=atand(R2/Xc2);
Req=Z2*cosd(theta_p);
Xc_eq=Z2*sind(theta_p);
Rt=R1+Req;
Xct=Xc1+Xc_eq;
Zt=sqrt(Rt^2+Xct^2);
It=V/Zt;
theta=atand(Xct/Rt);
disp(Zt,"the total impedence in the given circuit is
    (in ohm)");
disp(It,"the total current in the circuit is (in A)"
    );
disp(theta,"the phase angle is (in degree)");
```

**Scilab code Exa 5.a.9** voltage calculation

```
//Example_a_5_9 page no:209
clc;
V=100;
f=50;
R1=100;
L1=0.5;
R2=330;
```

```
L2=1;
Xl1=2*%pi*f*L1;
Xl2=2*%pi*f*L2;
Z1=sqrt(R1^2+Xl1^2);
Z2=sqrt(R2^2+Xl2^2);
I1=V/Z1;
I2=V/Z2;
Vr1=I1*R1;
Vl1=I1*Xl1;
Vr2=I2*R2;
Vl2=I2*Xl2;
theta_1=atand(Xl1/R1);
theta_2=atand(Xl2/R2);
disp(Vr1,"the voltage across resistor R1 is (in V)");
disp(Vl1,"the voltage across inductor L1 is (in V)");
disp(Vr2,"the voltage across resistor R2 is (in V)");
disp(Vl2,"the voltage across inductor L2 is (in V)");
disp(theta_2,theta_1,"the angle associated with each parallel branch are");
//phasor diagram cannot be drawn in scilab hence both X and Y axis values are required
//Vr2,Vl2 varies slightly hence I2 value is rounded off in text book
```

**Scilab code Exa 5.a.10** voltage calculation

```
//Example_a_5_10 page no:211
clc;
V=50;
Zmag=8.5;
Zang=30;
```

```
Zreal=Zmag*cosd(Zang);
Zimag=Zmag*sind(Zang);
Z=Zreal+(%i*Zimag);
L1=%i*3;
R1=10;
L2=%i*30;
L=R1+L2;
Lmag=sqrt(real(L)^2+imag(L)^2);
Lang=atand(imag(L)/real(L));
I1=V/imag(L1);
I2=V/Lmag;
It=I1+I2;//applied current
Zt=Z+((L1)*L/(L+L1));
Ztmag=sqrt(real(Zt)^2+imag(Zt)^2);//impedence
Ztang=atand(imag(Zt)/real(Zt));
V=It*Ztmag;
disp(V,"the magnitude of applied voltage is (in V)")
    ;
```

**Scilab code Exa 5.a.11** `voltage calculation`

```
//Example_a_5_11 page no:212
clc;
Vs=10+(%i*20);
Z1=1+(%i*2);
Z2=3+(%i*4);
Z3=3+(%i*4);
Z23=(Z2*Z3)/(Z2+Z3);
Zt=Z1+Z23;
It=Vs/Zt;
Itmag=sqrt(real(It)^2+imag(It)^2);
Itang=atand(imag(It)/real(It));
theta=atand(real(Zt)^2+imag(Zt)^2);
Vp=Z23*It;
Vpmag=sqrt(real(Vp)^2+imag(Vp)^2);
```

```
Vpang=atand(imag(Vp)/real(Vp));
disp(Zt,"the total impedence is (in ohm)");
disp(Itmag,"the magnitude of total current in the circuit is (in A)");
disp(Itang,"the angle of total current in the circuit is (in degree)");
disp(Vpmag,"the magnitude of voltage across parallel branch is (in V)");
disp(Vpang,"the angle of voltage across parallel branch is (in degree)");
```

**Scilab code Exa 5.a.12** current calculation

```
//Example_a_5_12 page no:213
clc;
V=100+(%i*0);
Za=10+(%i*8);
Zb=9-(%i*6);
Zc=3+(%i*2);
Zp=(Za*Zb)/(Za+Zb);
Zt=Zp+Zc;
It=V/Zt;
Ia=It*Zb/(Za+Zb);
Ib=It*Za/(Za+Zb);
Iamag=sqrt(real(Ia)^2+imag(Ia)^2);
Iaang=atand(imag(Ia)/real(Ia));
Ibmag=sqrt(real(Ib)^2+imag(Ib)^2);
Ibang=atand(imag(Ib)/real(Ib));
theta=-Iaang+Ibang;//here negative sign is used only to find the phase difference between them
disp(Iamag,"the magnitude of current in branch A is (in A)");
disp(Iaang,"the angel of current in branch A is (in degree)");
disp(Ibmag,"the magnitude of current in branch B is
```

```
(in A)");
disp(Ibang,"the angel of current in branch B is (in
    degree)");
disp(theta,"the angle between Ia and Ib is (in
    degree)");
```

**Scilab code Exa 5.a.13** capacitance calculation

```
//Example_a_5_13 page no:214
clc;
Vm=15;
Im=8.5;
omega=200;
R=Vm/(Im*sqrt(2));
C=1/(omega*R);
disp(R,"the resistance in the circuit is (in ohm)");
disp(C,"the capacitance in the circuit is (in F)");
```

**Scilab code Exa 5.a.14** capacitance calculation

```
//Example_a_5_14 page no:214
clc;
R=10;
Vr=50;
omega=1000;
theta=60;
C=1/(tand(60)*omega*R);
C=C*10^6;
disp(C,"the unknown capacitance is (in microFarad)")
    ;
```

**Scilab code Exa 5.a.15** capacitance calculation

```
//Example_a_5_15 page no:215
clc;
Vm=100;
Im=20;
theta=110-50;
omega=2000;
R=(Vm/Im)/(sqrt(1+tand(theta)^2));
C=1/(omega*tand(theta)*R);
C=C*10^6;//converting to microFarad
disp(R,"the resistance in the circuit is (in ohm)");
disp(C,"the capacitance in the circuit is (in
    microFarad)");
//tan value is rounded off in text book so
    capacitance value varies slightly
```

**Scilab code Exa 5.a.16** resistance calculation

```
//Example_a_5_16 page no:215
clc;
Vmax=2000;
Itmax=45;
Irmax=20;
Ix=Itmax-Irmax;
R=Vmax/Ix;
disp(R,"the value of unknown resistor is (in ohm)");
```

**Scilab code Exa 5.2** voltage calculation

```
//Example 5_2 page no:193
clc
R=1*10^3//resistance in ohm
```

```
L=50*10^-3//inductance in henry
V=10
f=10*10^3//frequency in Hz
Xl=2*%pi*f*L
Z=R+(%i*Xl)
Z=sqrt(R^2+Xl^2)
disp(Z,"impedence is (in ohm)")
I=V/Z
I=I*1000//converting to milli ampere
disp(I,"current is (in mA)")
angle=atand(Xl/R)
disp(angle,"the phase angle is (in degree)")
Vr=I*10^-3*R//current in milli ampere
disp(Vr,"Voltage across resistance is (in volts)")
Vl=I*10^-3*Xl//current in milli ampere
disp(Vl,"Voltage across inductive reactance is (in
    volts)")
//the values varies slightly with text book hence
    values are rounded off in text book
```

**Scilab code Exa 5.3** `voltage calculation`

```
//Example 5_3 page no:193
clc
Vr=70;
Vl=20;
Vs=sqrt(Vr^2+Vl^2)
disp(Vs,"source voltage is (in volts)")
angle=atand(Vl/Vr)
disp(angle,"the angle between current and source
    voltage is (in degree)")
```

**Scilab code Exa 5.4** `voltage calculation`

```
//Example 5_4 page no:195
clc
f=500//frequency in Hz
Vrms=10
R=2*10^3
C=0.1*10^-6//capacitance in farad
Xc=1/(2*%pi*f*C)
Z=sqrt(R^2+Xc^2)
disp(Z,"impedence is (in ohm)")
angle=atand(-Xc/R)
disp(angle,"the phase angle is (in degree)")
I=Vrms/Z
disp(I*1000,"the current is (in mA)")//converting to
    milli ampere
Vc=I*Xc
disp(Vc,"capacitive voltage is (in volt)")
Vr=I*R
disp(Vr,"resistive voltage is (in volt)")
```

**Scilab code Exa 5.5** voltage calculation

```
//Example 5_5 page no:195
clc
Vr=20
Vc=30
Vs=sqrt(Vr^2+Vc^2)
disp(Vs,"source voltage is (in volt)")
angle=atand(Vc/Vr)
disp(angle,"the phase angle is (in degree)")
```

**Scilab code Exa 5.6** voltage calculation

```
//Example 5_6 page no:196
```

```
clc
V=50;
R=10;//resistance in ohm
L=0.5;//inductance in henry
C=10*10^-6//capacitance in farad
f=50//frequency in Hz
Xc=1/(2*3.14*f*C)
Xl=2*3.14*f*L
Z=sqrt(R^2+(Xl-Xc)^2)
disp(Z,"the impedence is (in ohm)")
I=V/Z
disp(I,"current is (in A)")
angle=atand((Xl-Xc)/R)
disp(angle,"the phase angle is (in degree)")
Vr=I*R
disp(Vr,"voltage across resistor is (in volt)")
Vc=I*Xc
disp(Vc,"voltage across capacitive reactance is (in
    volt)")//current is round of to 0.3A in our case
    it is 0.309 so the result is more approximated in
     textbook
disp("in textbook the current is roundoff so the
    voltage is more approximated")
Vl=I*Xl
disp(Vl,"voltage across inductive reactance is (in
    volt)")//current is round of to 0.3 in our case
    it is 0.309 so the result is more approximated in
     textbook
disp("in textbook the current is roundoff so the
    voltage is more approximated")
```

**Scilab code Exa 5.7** impedance calculation

```
//Example 5_7 page no:197
clc
```

```
V=20;
f=5*10^3;//frequency in Hz
R=100;
C=0.2*10^-6//capacitance in farad
Xc=1/(2*%pi*f*C)
Ir=V/R
disp(Ir,"current in the resistance branch is (in A)")
Ic=V/Xc
disp(Ic,"current in the capacitive branch is (in A)")
It=Ir+(%i*Ic)
disp(It,"total current is (in A)")
[It_polar,Theta]=polar(It)
Theta=atand(Ic/Ir)
Z_mag=V/It_polar
Z_ang=0-Theta;
disp(It_polar,"the magnitude of current is (in A)")
disp(Theta,"the angle of current is (in degree)")
disp(Z_mag,"the magnitude of total impedance is (in ohm)")
disp(Z_ang,"the angle of total impedance is (in degree)")
disp("the values varies slightly with text book hence values are rounded off in text book")
//the values varies slightly with text book hence values are rounded off in text book
```

**Scilab code Exa 5.8** impedance calculation and current calculation

```
//Example 5_8 page no:198
clc
funcprot(0)
function [r,th]=rect2pol(x,y)
//rectangle to polar coordinate conversion
```

```
r=sqrt(x^2+y^2);
th=atan(y,x)*180/3.14;
endfunction
function[x,y]=pol2rect(r,theta)
    x=r*cosd(theta)
    y=r*sind(theta)
endfunction
[Rr,Ri]=pol2rect(50,0)
R=Rr+(%i*Ri)
[Xlr,Xli]=pol2rect(30,90)
Xl=Xlr+(%i*Xli)
[Vr,Vi]=pol2rect(20,0)
V=Vr+(%i*Vi)
Ir=V/R
Il=V/Xl
It=Ir+Il
[mag,theta]=rect2pol(real(It),imag(It))
disp("total current is")
disp(It)
disp("total current in polar form is")
disp(mag,"the magnitude of total current is (in A)")
disp(theta,"the angle of total current is (in degree)")//in textbook current value Il is roundoff so the angle vary slightly
Z=V/It
[mag,theta]=rect2pol(real(Z),imag(Z))
disp("total impedence in polar form")
disp(mag,"magnitude of impedance is (in ohm)")
disp(theta,"angle of impedance is (in degree)")//in textbook current value Il is roundoff so the angle vary slightly
disp("the values varies slightly with text book hence values are rounded off in text book")

//the values varies slightly with text book hence values are rounded off in text book
```

**Scilab code Exa 5.9** `impedance calculation`

```
//Example 5_9 page no:199
clc
function [r,th]=rect2pol(x,y)
//rectangle to polar coordinate conversion
r=sqrt(x^2+y^2);
th=atan(y,x)*180/3.14;
endfunction
Z1=5+(%i*10)
Z2=2-(%i*4)
Z3=1+(%i*3)
Zt=Z1+((Z2*Z3)/(Z2+Z3))
disp(Zt,"the equivalent impedence is(in ohm)")//
   imaginary term is rounded off
[mag,theta]=rect2pol(real(Zt),imag(Zt))
disp("In polar form")
disp(mag,"magnitude of impedance is (in ohm)")
disp(theta,"angle of impedance is (in degree)")
disp("the values varies slightly with text book
   hence values are rounded off in text book")
```

---

**Scilab code Exa 5.10** `impedance calculation`

```
//Example 5_10 page no:200
clc
funcprot(0);
function [r,th]=rect2pol(x,y)
//rectangle to polar coordinate conversion
r=sqrt(x^2+y^2);
th=atan(y,x)*180/3.14;
endfunction
```

```
V=20//input voltage
f=50//frequency in Hz
R1=10//resistance in ohm
R2=20//resistance in ohm
L=0.1//inductance in henry
Xl=2*%pi*f*L*%i
Zt=R1+((R2*Xl)/(R2+Xl))
disp(Zt,"impedance is (in ohm)")
[mag,theta]=rect2pol(real(Zt),imag(Zt))
disp("In polar form")
disp(mag,"magnitude is (in ohm)")
disp(theta,"angle is (in degree)")
It=V/Zt
disp(It,"the current is (in A)")
[mag,theta]=rect2pol(real(It),imag(It))
disp("In polar form")
disp(mag,"magnitude is (in A)")
disp(theta,"angle is (in degree)")
disp(-theta,"the phase angle between current and
   voltage is(in degree)")
```

# Chapter 6

# POWER AND POWER FACTOR

**Scilab code Exa 6.a.1** power calculation

```
//Example_a_6_1 page no:233
clc;
Vmag=250;
Vang=100;
Imag=15;
Iang=30;
theta=100-30;
pf=cosd(theta);
active_power=(Vmag/sqrt(2))*(Imag/sqrt(2))*pf;
reactive_power=(Vmag/sqrt(2))*(Imag/sqrt(2))*sind(theta);
apparent_power=(Vmag/sqrt(2))*(Imag/sqrt(2));
disp(pf,"the power factor is ");
disp(active_power,"the active power is (in W)");
disp(reactive_power,"the reactive power is (in VAR)");
disp(apparent_power,"the apparent power is (in VA)");
//in text book reactive power calculation is wrong i
```

```
.e 1761.9 is correct
```

**Scilab code Exa 6.a.2** power calculation

```
//Example_a_6_2 page no:234
clc;
I=5;
Z1mag=10;
Z1ang=-60;
Z2mag=16;
Z2ang=70;
Z1real=Z1mag*cosd(Z1ang);
Z1img=Z1mag*sind(Z1ang);
Z1=Z1real+(Z1img*%i);
Z2real=Z2mag*cosd(Z2ang);
Z2img=Z2mag*sind(Z2ang);
Z2=Z2real+(Z2img*%i);
Z=Z1+Z2;
Zmag=sqrt(real(Z)^2+imag(Z)^2);
pf=real(Z)/Zmag;
active_power=I^2*real(Z);
apparent_power=I^2*Zmag;
reactive_power=I^2*imag(Z);
disp(pf,"the power factor is ");
disp(active_power,"the active power is (in W)");
disp(apparent_power,"the apparent power is (in VA)")
    ;
disp(reactive_power,"the reactive power is (in VAR)"
    );
disp("the calculated values varies slightly with
    textbook hence values are rounded off in text
    book");
```

**Scilab code Exa 6.a.3** power calculation and impedance calculation

```
//Example_a_6_3 page no:234
clc;
R=0.5;
P=200;
pf=0.707;
V=25/sqrt(2);//in V
I=(200/pf)*(sqrt(2)/25);
Ztmag=V/I;
Ztang=25-(-20);
Ztreal=Ztmag*cosd(Ztang);
Ztimag=Ztmag*sind(Ztang);
Zt=Ztreal+(Ztimag*%i);
Z=Zt-R;
disp(Z,"the impedence is (in ohm)");
apparent_power=V*I;
disp(apparent_power,"the apparent power is (in VA)")
    ;
```

**Scilab code Exa 6.a.4** impedance calculation

```
//Example_a_6_4 page no:235
clc;
R1=5;
I5mag=sqrt(600/5);
V=I5mag*sqrt(50);
apparent_power=3000;
Itmag=apparent_power/V;
Itang=45;
I5ang=-45;
Itreal=Itmag*cosd(Itang);
Itimag=Itmag*sind(Itang);
It=Itreal+(Itimag*%i);
I5real=I5mag*cosd(I5ang);
```

```
I5imag=I5mag*sind(I5ang);
I5=I5real+(I5imag*%i);
Iz=It-I5;
Izmag=sqrt(real(Iz)^2+imag(Iz)^2);
Izang=atand(imag(Iz)/real(Iz));
Zmag=V/Izmag;
Zang=0-Izang;
disp(Zmag,"the magnitude of impedence is (in ohm)");
disp(Zang,"the angle of impedence is (in degree)");
```

**Scilab code Exa 6.a.5** power calculation

```
//Example_a_6_5 page no:235
clc;
R=5;
Vmax=150;
Zamag=60;
Zaang=30;
Zbmag=50;
Zbang=-25;
Zareal=Zamag*cosd(Zaang);
Zbreal=Zbmag*cosd(Zbang);
pf=cosd(0.179);
Ztmag=5+((Zamag*Zbmag)/(Zamag+Zbmag));
Ztang=-0.179;
Itmag=150/(sqrt(Ztmag));
Itang=0-(Ztang);
Zareal=65.84;
Zbreal=57.15;
Iamag=((2.97*50)/(60+50));
Ibmag=((2.97*60)/(60+50));
Za=Iamag^2*Zareal;
Zb=Ibmag^2*Zbreal;
Rt=R+((Zareal*Zbreal)/(Zareal+Zbreal));
I=Vmax/(sqrt(2)*Rt);//calculating current for
```

```
    calculating the power
Pa=I^2*Rt;
disp(pf,"the power factor is ");
disp(Za,"the power delivered to Za is (in W)");
disp(Zb,"the power delivered to Zb is (in W)");
disp(Pa,"the average power delivered to the circuit
    is (in W)");
disp("the calculated values varies slightly with
    textbook hence values are rounded off in text
    book");
```

**Scilab code Exa 6.a.6** power calculation and power factor calculation

```
//Example_a_6_6 page no:236
clc;
R=10;
V=200/sqrt(2);
Vr=120;
Vl=75;
IR=Vr;
I=120/10;
Xl=75/I;
Z=10+(%i*6.25);
Zmag=sqrt(real(Z)^2+imag(Z)^2);
pf=R/Zmag;
true_power=I^2*R;
reactive_power=I^2*imag(Z);
disp(pf,"the power factor in the circuit is ");
disp(true_power,"the true power in the circuit is (
    in W)");
disp(reactive_power,"the reactive power in the
    circuit is (in W)");
```

**Scilab code Exa 6.a.7** power calculation

```
//Example_a_6_7 page no:237
clc;
I1mag=50;
I1ang=10;
I2mag=20;
I2ang=30;
Z1mag=100/50;
Z1ang=15-10;
Z1real=Z1mag*cosd(Z1ang);
Z1imag=Z1mag*sind(Z1ang);
Z1=Z1real+(%i*Z1imag);
Z2mag=100/20;
Z2ang=15-30;
Z2real=Z2mag*cosd(Z2ang);
Z2imag=Z2mag*sind(Z2ang);
Z2=Z2real+(%i*Z2imag);
Pa1=I1mag^2*Z1mag;
Pt2=I2mag^2*real(Z2);
Pr1=I1mag^2*imag(Z1);
disp(Pr1,"the reactive power in branch is (in VAR)")
    ;
disp(Pa1,"apparent power in branch Z1 is (in VA)");
disp(Pt2,"the true power in branch Z2 is (in W)");
Pr2=I2mag^2*-imag(Z2);//only reactive power is taken
    , negative sign is used to convert negative to
    positive
Pa2=I2mag^2*Z2mag;
disp(Pr2,"the reactive power in branch is (in VAR)")
    ;
disp(Pa2,"the apparent power in branch is (in VA)");
Z=((Z1mag*Z2mag)/(Z1+Z2));
theta=0.71;
pf=cosd(theta);
disp(pf,"the power factor of the total circuit is (
    leading)");
//reactive power varies slightly hence textbook
```

```
values are rounded off
```

---

**Scilab code Exa 6.a.8** circuit constant calculation

```
//Example_a_6_8 page no:238
clc;
X2=sqrt((16.67^2)-(10^2));
V=100;
Imag=6;
pf=450/600;
theta=acosd(pf);
Iang=theta;
Vmag=Imag*16.66;
Vang=-41.4+53.1;
Vreal=Vmag*cosd(Vang);
Vimag=Vmag*sind(Vang);
V1real=100;
V1=V1real-Vreal-(Vimag*%i);
V1mag=sqrt(real(V1)^2+imag(V1)^2);
V1ang=atand(imag(V1)/real(V1));
I2mag=V1mag/20;
I2ang=V1ang-(-90);
Ireal=Imag*cosd(Iang);
Iimag=Imag*sind(Iang);
I=Ireal-(Iimag*%i);
I2real=I2mag*cosd(I2ang);
I2imag=I2mag*sind(I2ang);
I2=I2real+(I2imag*%i);
I1=I-I2;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I1ang=atand(imag(I1)/real(I1));
Z1mag=V1mag/I1mag;
Z1ang=V1ang-I1ang;
Zreal=Z1mag*cosd(Z1ang);
Zimag=Z1mag*sind(Z1ang);
```

```
R1=Zreal;
X1=-Zimag;//here negative sign is used to take only reactance value
disp(R1,"the resistance is (in ohm)");
disp(X1,"the reactance is (in ohm)");
```

**Scilab code Exa 6.a.9** voltage calculation and power factor calculation

```
//Example_a_6_9 page no:239
clc;
Zeq=5+(((2+(2*%i))*(-%i*5))/(2+(%i*2-%i*5)));
Zmag=sqrt(real(Zeq)^2+imag(Zeq)^2);
Zang=atand(imag(Zeq)/real(Zeq));
I=sqrt(100/8.85);
pf=8.85/8.88;
V=100/(3.36*0.99);
P=V*I*sind(4.97);
disp(V,"the value of voltage source is (in V)");
disp(pf,"the power factor is ");
disp(P,"the reactive power is (in VAR)");
```

**Scilab code Exa 6.a.10** circuit constant calculation

```
//Example_a_6_10 page no:240
clc;
V=70.7;
I=600/(100*cosd(45));
X1mag=V/I;
X1ang=90-0;
disp(X1mag,"the magnitude of inductance is (in ohm)");
disp(X1ang,"the angle of inductance is (in degree)");
```

```
Ir1=I/2;
disp(Ir1,"the current through parallel branch R1 is
    (in A)");
R1=V/Ir1;
disp(R1,"the resistance R1 is (in ohm)");
Ir2=I/2;
disp(Ir2,"the current through parallel branch R2 is
    (in A)");
R2=V/Ir2;
disp(R2,"the resistance R2 is (in ohm)");
```

**Scilab code Exa 6.a.11** power calculation

```
//Example_a_6_11 page no:241
clc;
Vmag=500;
Vang=0;
Imag=21.73;
Iang=0;
P=Vmag*Imag/2;
P=P/1000;//converting to killo watt
disp(P,"the power delivered by 500 volt source is (
    in kW)");
P1=(3*4*Imag*Imag)/2;
P1=P1/1000;//converting to killo watt
disp(P1,"the power delivered by dependent voltage
    source is (in kW)");
```

**Scilab code Exa 6.a.12** power calculation

```
//Example_a_6_12 page no:241
clc;
I1mag=2.213;
```

```
I1ang=-154.9;
P=50*I1mag^2/2;
disp(P,"average power delivered by the independent
   source is (in W)");
```

**Scilab code Exa 6.a.13** power calculation

```
//Example_a_6_13 page no:242
clc;
Vmag=14.705;
Vang=157.5;
Vreal=Vmag*cosd(Vang);
Vimag=Vang*sind(Vang);
V=Vreal+(Vimag*%i);
V1real=100;
V1imag=0;
V1=V1real+(V1imag*%i);
I=(V-V1)/2;
Imag=sqrt(real(I)^2+imag(I)^2);
Iang=atand(imag(I)/real(I));
P=V1real*Imag*cosd(Iang)/2;
P=P/1000;//converting to killo watt
disp(P,"the power delivered by the source is (in kW)
   ");
```

**Scilab code Exa 6.a.14** power calculation

```
//Example_a_6_14 page no:243
clc;
Im=0.5;
Vmag=18.46;
Vang=0;
V1mag=1.54;
```

```
V1ang=0;
P=Vmag*Im*V1mag/2;
disp(P,"the average power delivered by the dependent
    source is (in W)");
```

**Scilab code Exa 6.1** power calculation

```
//Example 6_1 page no:229
clc
phase_angle=30//phase angle in degree
Vm=100//maximum voltage
Veff=100/sqrt(2)
Ieff=15/sqrt(2)
Pav=Veff*Ieff*cosd(phase_angle)
disp(Pav,"Average Power is(in watts)")
```

**Scilab code Exa 6.2** power calculation

```
//Example 6_2 page no:230
clc
Z=5+(%i*8)
Im=5//maximum current
Pav=Im^2*real(Z)/2
disp(Pav,"Average power is (in watts)")
```

**Scilab code Exa 6.3** power calculation

```
//Example 6_3 page no:231
clc
theta=53
```

```
Vm=50//peak voltage
Im=25//peak current
Veff=Vm/sqrt(2)
Ieff=Im/sqrt(2)
Papp=Veff*Ieff
disp(Papp,"Apparent Power is (in VA)")
disp(cosd(theta),"Power Factor is")
Pav=Veff*Ieff*cosd(theta)
disp(Pav,"Average Power is (in watts)")
//value of power factor is rounded off in text book
   so value vary slightly
```

# Chapter 7

# STEADY STATE ANALYSIS

**Scilab code Exa 7.a.1** `voltage and current calculation`

```
//Example_a_7_1 page no:269
clc;
R=2;
C=-2*%i;
L1=8*%i;
L2=6*%i;
V=5/(0.5+(1/L1)+(1/(4*%i)));
Vmag=sqrt(real(V)^2+imag(V)^2);
Vang=atand(imag(V)/real(V));
Vabmag=Vmag*6/4;
Vabang=Vang;
disp(Vabmag,"the magnitude of voltage across AB is (
   in V)");
disp(Vabang,"the angle of voltage across AB is (in
   degree)");
Iamag=Vmag/2;
Iaang=Vang-(-90);
disp(Iamag,"the magnitude of short circuited current
    through terminals AB is (in A)");
disp(Iaang,"the angle of short circuited current
   through terminals AB is (in degree)");
```

**Scilab code Exa 7.a.2** voltage calculation

```
//Example_a_7_2 page no:270
clc;
Rab=3+(4*%i);
Rabmag=sqrt(real(Rab)^2+imag(Rab)^2);
Rabang=atand(imag(Rab)/real(Rab));
Rbc=%i*4;
Vmag=100;
Vang=-45;
Vreal=Vmag*cosd(Vang);
Vimag=Vmag*sind(Vang);
V=Vreal+(%i*Vimag);
A=[(3+(%i*8)),(-%i*4)
    (-%i*4),(%i*2)];
B=[V,
    0];
X=inv(A)*B;
X1mag=sqrt(real(X(1))^2+imag(X(1))^2);
X1ang=-atand(imag(X(1))/real(X(1)));
X2mag=sqrt(real(X(2))^2+imag(X(2))^2);
X2ang=atand(imag(X(2))/real(X(2)));
//calculating the voltages across ab
Vabmag=Rabmag*X1mag;
Vabang=Rabang+X1ang;
disp(Vabmag,"the magnitude of voltage across ab is (
   in V)");
disp(Vabang,"the angle of voltage across ab is (in
   degree)");
//calculating the voltages across bc
Vbc=(X(2)-X(1))*Rbc;
Vbcmag=sqrt(real(Vbc)^2+imag(Vbc)^2);
Vbcang=atand(imag(Vbc)/real(-Vbc));
disp(Vbcmag,"the magnitude of voltage across bc is (
```

```
in V)");
disp(Vbcang,"the angle of voltage across bc is (in
degree)");
```

**Scilab code Exa 7.a.3** power calculation

```
//Example_a_7_3 page no:271
clc;
Vmag=10;
Vang=0;
R1=-%i*5;
R2=4-(%i*5);
R1mag=sqrt(real(R1)^2+imag(R1)^2);
R2mag=sqrt(real(R2)^2+imag(R2)^2);
R2ang=atand(imag(R2)/real(R2));
Ztmag=6.24;
Ztang=29.26;
Itmag=Vmag/Ztmag;
Itang=Vang-Ztang;
Inmag=Itmag*R1mag/R2mag;
In=0.466-(%i*1.149);
Zn=4+((3+(%i*5))*(-%i*5)/3);
I2ohm=In*(12.33-(%i*5))/(12.33+2-(%i*5)+(%i*5));
I2ohm_mag=sqrt(real(I2ohm)^2+imag(I2ohm)^2);//
    current is calculated for calculating power
I2ohm_ang=atand(imag(I2ohm)/real(I2ohm));
P=I2ohm_mag^2*2;
disp(P,"the power in the 2+5j ohm impedence is (in W
)");
```

**Scilab code Exa 7.a.4** current calculation

```
//Example_a_7_4 page no:272
```

```
clc;
V_1mag=100;
V_1ang=0;
Z_1mag=14.28;
Z_1ang=4.64;
Ztmag=8.46;
Ztang=-19.6;
I_1mag=V_1mag/Z_1mag;
I_1ang=V_1ang-Z_1ang;
I_1real=I_1mag*cosd(I_1ang);
I_1imag=I_1mag*sind(I_1ang);
I_1=I_1real+(I_1imag*%i);
I_2=((I_1)*(5-(%i*5)))/(5-(5*%i)+3+(%i*4));
I_3=((I_1)*(3+(%i*4)))/(8-(%i*1));
Ztreal=Ztmag*cosd(Ztang);
Ztimag=Ztang*sind(Ztang);
Zt=Ztreal+(Ztimag*%i);
I__3mag=50/8.46;
I__3ang=30-(Ztang);
I__3real=I__3mag*cosd(I__3ang);
I__3imag=I__3mag*sind(I__3ang);
I__3=I__3real+(%i*I__3imag);
I__2=I__3*(10)/(10+3+(%i*4));
I__1=I__3*(3+(%i*4))/(10+3+(%i*4));
I1=I_1-I__1;
I2=I_2+I__2;
I3=I__3-I_3;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I2mag=sqrt(real(I2)^2+imag(I2)^2);
I3mag=sqrt(real(I3)^2+imag(I3)^2);
I1ang=atand(imag(I1)/real(I1));
I2ang=atand(imag(I2)/real(I2));
I3ang=atand(imag(I3)/real(I3));
disp(I1mag,"the magnitude of current passing through
    10 ohm resistor is (in A)");
disp(I1ang,"the angle of current passing through 10
    ohm resistor is (in degree)");
disp(I2mag,"the magnitude of current passing through
```

```
3+4i ohm resistor is (in A)");
disp(I2ang,"the angle of current passing through 3+4
   i ohm resistor is (in degree)");
disp(I3mag,"the magnitude of current passing through
    5-5i ohm resistor is (in A)");
disp(I3ang,"the angle of current passing through 5-5
   i ohm resistor is (in degree)");
//I3 magnitude and angle vary little hence values
   are rounded off in text book
```

**Scilab code Exa 7.a.5** power calculation

```
//Example_a_7_5 page no:274
clc;
Rl=4;
I=(50*(-%i*10))/((5-(%i*6)+3+(%i*4)-(10*%i)))
V=I*(3+(3.99*%i));
Zab=4+(%i*3.5);
Vmag=sqrt(real(V)^2+imag(V)^2);
I2=Vmag/8;
P=I2^2*Rl;
disp(P,"the maximum power delivered to the load is (
   in W)");
//the power varies slightly in text book the value
   of V is rounded off so the result varies slightly
```

**Scilab code Exa 7.a.6** power calculation

```
//Example_a_7_6 page no:275
clc;
V=20;
Vamag=16.27;
Vaang=18.91;
```

```
I2mag=Vamag/5.38;
I2ang=Vaang-68.19;
P2=I2mag^2*2;
disp(P2,"the power dissipated at 2 ohm resistor is (
    in W)");
I3=-0.65-(%i*1.58);
I3mag=sqrt(real(I3)^2+imag(I3)^2);
P3=I3mag^2*3;
disp(P3,"the power dissipated in the 3 ohm resistor
    is (in W)");
P=-V*I3mag*cosd(142);
disp(P,"the power delivered by the source is (in W)"
    );
```

---

**Scilab code Exa 7.a.8** current calculation

```
//Example_a_7_8 page no:276
clc;
I1mag=50/6.7;
I1ang=0-26.56;
I2mag=80/6.7;
I2ang=90-26.56;
I1real=I1mag*cosd(I1ang);
I1imag=I1mag*sind(I1ang);
I1=I1real+(%i*I1imag);
I2real=I2mag*cosd(I2ang);
I2imag=I2mag*sind(I2ang);
I2=I2real+(%i*I2imag);
I=I1+I2;
//calculating the required current values
Imag=sqrt(real(I)^2+imag(I)^2);
Iang=atand(imag(I)/real(I));
disp(Imag,"the magnitude of current passing through
    2+3i ohm impedence is (in A)");
disp(Iang,"the angle of current passing through 2+3i
```

```
ohm impedence is (in degree)");
```

**Scilab code Exa 7.a.9** current calculation

```
//Example_a_7_9 page no:277
clc;
Vabmag=100*3/7;
Vabang=0;
Zab=(%i*5)+(((%i*4)*(%i*3))/(%i*7));
Ilmag=42.86/11.71;
Ilang=0-90;
disp(Ilmag,"the magnitude of current passing through
    5i ohm impedence is (in A)");
disp(Ilang,"the angle of current passing through 5i
   ohm impedence is (in degree)");
```

**Scilab code Exa 7.a.10** voltage calculation and resistance calculation

```
//Example_a_7_10 page no:278
clc;
V_j4mag=20/2.83;
V_j4ang=0-45;
V10mag=10;
V10ang=0;
V5mag=5;
V5ang=90;
V_j4real=V_j4mag*cosd(V_j4ang);
V_j4imag=V_j4mag*sind(V_j4ang);
V_j4=V_j4real+(%i*V_j4imag);
V10real=V10mag*cosd(V10ang);
V10imag=V10mag*sind(V10ang);
V10=V10real+(%i*V10imag);
V5real=V5mag*cosd(V5ang);
```

```
V5imag=V5mag*sind(V5ang);
V5=V5real+(%i*V5imag);
Vab=-V10+V5-V_j4;
Vabmag=sqrt(real(Vab)^2+imag(Vab)^2);
Vabang=atand(imag(Vab)/real(Vab));
Vabang=180+Vabang;
disp(Vabmag,"the magnitude of thevenin voltage is (in V)");
disp(Vabang,"the angle of thevenin voltage is (in degree)");
Zab=4+((2+(%i*6))*(-%i*4)/(2+(%i*2)));
disp(Zab,"the thevenin impedance is (in ohm)");
//imaginary part of Zab varies slightly with text book hece textbook uses a rounded off value
```

**Scilab code Exa 7.a.11** current calculation

```
//Example_a_7_11 page no:278
clc;
Zab=((%i*3)*(%i*-2))/((%i*3)-(%i*2));
In=((10/3*%i)+(5*%i/-2*%i));
Il=-(In*Zab)/(5-6*%i);
Ilmag=sqrt(real(Il)^2+imag(Il)^2);
Ilang=atand(imag(Il)/real(Il));
Ilang=Ilang-180;//converting the angle to negative hence value does not change
disp(Ilmag,"the magnitude of load current is (in A)");
disp(Ilang,"the angle of load current is (in degree)");
```

**Scilab code Exa 7.a.12** current calculation and resistance calculation

```
//Example_a_7_12 page no:279
clc;
I_mag=30;
I_ang=30;
R1=5;
X1=(6*%i);
In_mag=I_mag;
In_ang=I_ang;
Zn=R1+X1;
disp(In_mag,"the magnitude of norton current is (in
   A)");
disp(In_ang,"the angle of norton current is (in
   degree)");
disp(Zn,"the norton impedence is (in ohm)");
```

**Scilab code Exa 7.a.13** voltage calculation and resistance calculation

```
//Example_a_7_13 page no:280
clc;
V_abmag=20;
V_abang=0;
V_abreal=20;
V_abimag=0;
V__abmag=5*5;
V__abang=0+53.13;
V__abreal=15;
V__abimag=19.99;
V___abmag=0;
V___abang=0;
//calculating the voltage across AB
Vab=V_abreal+V__abreal+(V_abimag+V__abimag)*%i;
Vabmag=sqrt(real(Vab)^2+imag(Vab)^2)
Vabang=atand(imag(Vab)/real(Vab));
Zth=3+4*%i;
disp(Vabmag,"the magnitude of voltage across AB is (
```

```
in V)");
disp(Vabang,"the angle of voltage across AB is (in
    degree)");
disp(Zth,"the impedance across terminals AB is (in
    ohm)");
```

**Scilab code Exa 7.a.14** power calculation and impedance calculation

```
//Example_a_7_14 page no:281
clc;
Zab=((5*(%i*10))/(5+(%i*10)))+((7*(-%i*20))/(7-(%i
    *20)));
I1=100/(5+(%i*10));
I2=100/(7-(%i*20));
Vamag=8.94*10;
Vaang=-63.43+90;
Vbmag=4.72*20;
Vbang=70.7-90;
Vareal=Vamag*cosd(Vaang);
Vaimag=Vamag*sind(Vaang);
Va=Vareal+(%i*Vaimag);
Vbreal=Vbmag*cosd(Vbang);
Vbimag=Vbmag*sind(Vbang);
Vb=Vbreal+(%i*Vbimag);
Vab=Va-Vb;
Vth=Vab;
Z=10.22+0.19*%i;
I=Vth/(Zab+Z);
Imag=sqrt(real(I)^2+imag(I)^2);
P=Imag^2*real(Z);
disp(P,"the maximum power delivered to the load is (
    in W)");
//power varies slightly due to values are rounded
    off in text book
```

**Scilab code Exa 7.a.15** power calculation

```
//Example_a_7_15 page no:282
clc;
Rs=2;
Rl=20;
Zt=Rs-%i*5+Rl;
Vs=50;
I=Vs/Zt;
Imag=sqrt(real(I)^2+imag(I)^2);
P=Imag^2*Rl;
disp(P,"the maximum power transferred is (in W)");
//power varies slightly due to values are rounded
   off in text book
```

**Scilab code Exa 7.a.16** voltage calculation

```
//Example_a_7_16 page no:283
clc;
I2=0;
Vmag=30*5/14.14;
Vang=90-45;
disp(Vmag,"the magnitude of voltage is (in V)");
disp(Vang,"the angle of voltage is (in degree)");
```

**Scilab code Exa 7.a.18** current calculation

```
//Example_a_7_18 page no:285
clc;
```

```
Vimag=10;
Viang=0;
Iscmag=9;
Iscang=90;
Vocmag=9*Vimag;
Vocang=Viang;
Zthmag=Vocmag/Iscmag;
Zthang=Vocang-Iscang;
Imag=Vocmag/8;
Iang=Vocang-(-90);
disp(Imag,"the magnitude of current passing through
   2i ohm resistor is (in A)");
disp(Iang,"the angle of current passing through 2i
   ohm resistor is (in degree)");
```

**Scilab code Exa 7.a.19** impedance calculation

```
//Example_a_7_19 page no:285
clc;
i=((100/(4+%i*10))-((5*4*%i)/(4+%i*10)));
Voc=100-(4*(3.55-1.48*%i));
Isc=25+50*%i;
Zth=Voc/Isc;
Z=conj(Zth);
disp(Z,"the value of load that will receive maximum
   power is (in ohm)");
I=Voc/(Zth+Z);
Imag=sqrt(real(I)^2+imag(I)^2);
P=Imag^2*real(Z);
disp(P,"the maximum power delivered to the load is (
   in W)");
//power values varies with textbook hence textbook
   uses rounded off values
```

**Scilab code Exa 7.1** current calculation

```
//Example 7_1 page no:253
clc
function [r,th]=rect2pol(x,y)
//rectangle to polar coordinate conversion
r=sqrt(x^2+y^2);
th=atan(y,x)*180/3.14;
endfunction
mat=[6+(%i*4),-6;-6,8+(%i*3)]
val=[5,0]
I=inv(mat)'*val'
I1=I(1,1)
I2=I(2,1)
disp("the current in loop 1 is ")
[mag,theta]=rect2pol(real(I1),imag(I1))
disp(mag,"Magnitude of current is (in A)")
disp(-theta,"Phase angle of current is (in degree)")
disp("the current in loop 2 is ")
[mag,theta]=rect2pol(real(I2),imag(I2))
disp(mag,"Magnitude of current is (in A)")
disp(-theta,"Phase angle of current is (in degree)")
```

**Scilab code Exa 7.3** voltage calculation

```
//Example 7_3 page no:257
clc
mag1=1.67//magnitude for current
mag2=-1.25
ang1=-90//angle for current
ang2=90
mag=mag1/mag2
```

```
ang=ang1-ang2
disp(mag,"magnitude for Vb is(in volt)")
disp(ang,"degree for Vb is (in degree)")
mag1=1.67//magnitude for current
mag2=0.33
ang1=-90-14.5//angle for current
mag=mag1/mag2
disp(mag,"magnitude for Va is(in volt)")
disp(ang1,"degree for Va is (in degree)")
//Va value is calculated wrongly in text book
```

**Scilab code Exa 7.5** voltage calculation

```
//Example 7_5 page no:263
clc;
Vmag=50;
Vang=0;
Rmag=9.22;
Rang=77.47;
Imag=Vmag/Rmag;
Iang=Vang-Rang;
V1mag=5.42*5.38;//voltage across (2+j5)ohm
V1ang=-77.47+68.19;
I2mag=(20*4)/9.22;
I2ang=120-77.47;
V2mag=I2mag*5.38;//voltage across (2+j5)ohm due to
    current I2 is
V2ang=42.53+68.19;
V1rel=V1mag*(cosd(V1ang));
V1img=V1mag*(sind(V1ang));
V2rel=V2mag*(cosd(V2ang));
V2img=V2mag*(sind(V2ang));
Vrel=V1rel+V2rel;
Vimg=V1img+V2img;
Vfmag=sqrt((Vrel*Vrel)+(Vimg*Vimg));
```

```
Vfang=atand(Vimg/Vrel);
disp(Vfmag,"magnitude of voltage across(2+5j)ohm is(
    in V)");
disp(Vfang,"angle of voltage across (2+5j)ohm is(in
    degree)");
```

**Scilab code Exa 7.6** voltage calculation and resistance calculation

```
//Example 7_6 page no:265
clc;
Vmag=(50*7.21)/7.28;//Voltage across(4+j6)ohm
Vang=0+56.3-15.95;
Zrel=4.83;
Zimg=1-1.095;
Zmag=sqrt((Zrel*Zrel)+(Zimg*Zimg));
Zang=atand(Zimg/Zrel);
disp(Vmag,"magnitude of thevenin voltage is(in V)");
disp(Vang,"angle of thevenin voltage is(in degree)")
    ;
disp(Zmag,"magnitude of thevenin impedence is(in ohm
    )");
disp(Zang,"angle of thevenin impedence is(in degree)
    ");
```

**Scilab code Exa 7.7** current calculation and resistance calculation

```
//Example 7_7 page no:267
clc;
Inmag=25/5;//norton current
Inang=0-53.13;
Znmag=(5*6.4)/7.04;//norton impedence
Znang=(53.13-51.34+8.13);
disp(Inmag,"magnitude of norton current is(in A)");
```

```
disp(Inang,"angle of norton current is(in degree)");
disp(Znmag,"magnitude of norton impedence is (in ohm
    )");
disp(Znang,"angle of norton impedence is (in degree)
    ");
```

**Scilab code Exa 7.8** power calculation and impedance calculation

```
//Example 7_8 page no:268
clc;
Zrel=15;
Zimg=-20;
Imag=50/30;
Iang=0-0;
P=(Imag*Imag)*Zrel//maximum power delivered
disp(P,"the maximum power delivered to the load is (
    in W)");//Imag^2 val is rounded in text book so
    answer vary by 0.333
```

# Chapter 8

# RESONANCE

**Scilab code Exa 8.a.1** voltage calculation

```
//Example_a_8_1 page no:325
clc;
R=10;
L=0.1;
C=50*10^-6;
V=100;
omega=1/sqrt(L*C);
fr=omega/(2*%pi);
I=V/R;
Vl=I*omega*L;
Q=omega*L/R;
disp(Vl,"the voltage drop across the inductor is (in
    V)");
disp(Q,"the quality factor is");
```

**Scilab code Exa 8.a.2** circuit constant calculation

```
//Example_a_8_2 page no:325
```

```
clc;
Q=5;
I=10;
V=100;
omega=50;
R=V/I;
L=50/omega;
C=1/(Q*omega*R);
C=C*10^6;
disp(L,"the inductance is (in H)");
disp(C,"the capacitance is (in microFarad)");
```

**Scilab code Exa 8.a.3** `inductance and capacitance calculation`

```
//Example_a_8_3 page no:326
clc;
Vmax=10;
Vrms=Vmax/sqrt(2);
Vc=500;
Q=Vc/Vrms;
BW=400;
Z=100;
R=Z;
omega_r=Q*BW;
fr=omega_r/(2*%pi);
L=R/BW;
C=1/((2*%pi*fr)^2*L);
C=C*10^9;
disp(fr,"the resonant frequency is (in Hz)");
disp(L,"the inductance of the circuit is (in H)");
disp(C,"the capacitance of the circuit is (in nF)");
//resonant frequency varies slightly with text book
   hence in text book value of Q is rounded off
```

**Scilab code Exa 8.a.4** inductance calculation

```
//Example_a_8_4 page no:327
clc;
omega=1000;
Xl=poly([25,-20.3,1],'x','c');
Xl_r=roots(Xl);
L1=Xl_r(1)/omega;
L1=L1*10^3;
disp(L1,"the value of inductance is (in mH)");
//calculating the inductance value
L2=Xl_r(2)/omega;
L2=L2*10^3;
disp("or");
disp(L2,"the value of inductance is (in mH)");
```

**Scilab code Exa 8.a.5** impedance calculation

```
//Example_a_8_5 page no:328
clc;
Z1=20+%i*10;
Z2=10-%i*30;
Z12=Z1*Z2/(Z1+Z2);
Z3=30;//here X is eliminated hence unknown variable
   cannot be used for calculation
Z=Z3+Z12;
X=imag(Z);
X=-X;//hence X is equated to zero
disp(X,"the value of X which will produce resonance
   is (in ohm)");
```

**Scilab code Exa 8.a.6** resistance calculation

```
//Example_a_8_6 page no:328
clc;
V=100;
I=0.7;
Vc=200;
omega=2*%pi*200;
C=I/(omega*200);
C=C*10^6;//converting to microFarad
Xc=200/0.7;
Xl=Xc;
L=Xl/(2*%pi*200);
R=(V/I)-50;
disp(C,"the capacitance is (in microFarad)");
disp(L,"the inductanc is (in H)");
disp(R,"the resistance is (in ohm)");
```

**Scilab code Exa 8.a.7** frequency calculation

```
//Example_a_8_7 page no:329
clc;
V=5;
I=0.1;
L=0.1;
C=5*10^-6;
R=V/I;
omega_r=1/sqrt(L*C);
fr=omega_r/(2*%pi);
Q=omega_r*L/R;//in text book the Q value is wrong
   but correct value is used in calculation of BW
```

```
BW=fr/Q;//BW value varies slightly hence Q value is
    rounded off in text book
disp(R,"the value of resistance at resonance is (in
    ohm)");
disp(fr,"the resonant frequency is (in Hz)");
disp(Q,"the quality factor is ");
disp(BW,"the bandwidth is (in Hz)");
//calculation of Q value is wrong in text book
```

**Scilab code Exa 8.a.8** current calculation

```
//Example_a_8_8 page no:330
clc;
V=10;
fr=100;
C=10*10^-6;
omega=900;
L=1/(C*(2*%pi*fr)^2);
C=12*10^-6;
R=(omega*L)-(1/(omega*C));
Q=omega*L/R;
I=V/R;
disp(L,"the inductance is (in H)");
disp(R,"the resistance is (in ohm)");
disp(Q,"the quality factor is ");
disp(I,"the maximum current in the circuit is (in A)
    ");
//resistance value varies in the textbook due to
    inductance value is rounded off in text book
```

**Scilab code Exa 8.a.9** quality factor

```
//Example_a_8_9 page no:331
```

```
clc;
V=20;
omega_r=500;
C=20*10^-6;
Xl=1/(omega_r^2*C);
C=30*10^-6;
R=((omega_r*Xl)-(1/(omega_r*C)));
Q=(omega_r*Xl)/R;
disp(Xl,"the value of inductance is (in H)");
disp(R,"the value of resistance is (in ohm)");
disp(Q,"the quality factor is ");
```

**Scilab code Exa 8.a.10** capacitance calculation

```
//Example_a_8_10 page no:331
clc;
L=0.1;
Q=5;
omega_r=500;
R=omega_r*L/Q;
C=1/(L*omega_r^2);
C=C*10^6;
disp(R,"the coil resistance at resonant frequency is
    (in ohm)");
disp(C,"the capacitance is (in microFarad)");
```

**Scilab code Exa 8.a.11** bandwidth calculation

```
//Example_a_8_11 page no:332
clc;
L=0.2;
C=10*10^-6;
R=50;
```

```
fr=1/(2*%pi*sqrt(L*C));
Q=(2*%pi*fr*L)/R;
f1=fr-(R/(4*%pi*L));
f2=fr+(R/(4*%pi*L));
BW=f2-f1;
disp(fr,"the resonant frequency is (in Hz)");
disp(Q,"the quality factor is ");
disp(f1,"the lower frequency limit is (in Hz)");
disp(f2,"the upper frequency limit is (in Hz)");
disp(BW,"the bandwidth of the circuit is (in Hz)");
```

**Scilab code Exa 8.a.12** capacitance calculation

```
//Example_a_8_12 page no:332
clc;
//variables cannot be used without initialization
   and hence the equation cannot be derived like in
   the text book, the capacitance value can be
   calculated using the derived values by
   substituting known values in the equation
C=15/(2*%pi*10^6*1256*80);
C=C*10^12;//converting to pico Farad
disp(C,"the value of C to give resonance is (in pF)"
   );
```

**Scilab code Exa 8.a.13** current calculation

```
//Example_a_8_13 page no:333
clc;
V_mag=200;
V_ang=0;
X1=25;
I2=200/50;
```

```
//when R1=10;
R1=10;
I1_mag=V_mag/sqrt(R1^2+X1^2);
I1_ang=0-atand(X1/R1);
I1_real=I1_mag*cosd(I1_ang);
I1_imag=I1_mag*sind(I1_ang);
I1=I1_real+(%i*I1_imag);
Imax=I1+I2;
Imax_mag=sqrt(real(Imax)^2+imag(Imax)^2);
Imax_ang=atand(imag(Imax)/real(Imax));
disp(Imax_mag,"the magnitude of maximum current is (
    in A)");
disp(Imax_ang,"the angle of maximum current is (in
    degree)");
//when R1=50;
R1=50;
I1_mag=V_mag/sqrt(R1^2+X1^2);
I1_ang=0-atand(X1/R1);
I1_real=I1_mag*cosd(I1_ang);
I1_imag=I1_mag*sind(I1_ang);
I1=I1_real+(%i*I1_imag);
Imax=I1+I2;
Imax_mag=sqrt(real(Imax)^2+imag(Imax)^2);
Imax_ang=atand(imag(Imax)/real(Imax));
disp(Imax_mag,"the magnitude of minimum current is (
    in A)");
disp(Imax_ang,"the angle of minimum current is (in
    degree)");
```

**Scilab code Exa 8.a.14** frequency calculation

```
//Example_a_8_14 page no:334
clc;
fr=120*10^3;
BW=50*10^3;
```

```
Q=2;
f1f2=sqrt(fr);
f=poly([-14.4*10^9,50000,1],'f1','c');
fre=roots(f);
f1=fre(2);
f1=f1/1000;//converting to killo Hz
f2=BW+f1;
f2=f2/1000;//converting to killo Hz
disp(f1,"the lower cutoff frequency is (in kHz)");
disp(f2,"the upper cutoff frequency is (in kHz)");
//in textbook the frequency calculated is wrong, the
    root values of f1 are wrong
```

**Scilab code Exa 8.a.15** `RLC calculation`

```
//Example_a_8_15 page no:335
clc;
V=220;
f=50;
Vr=550;
Ir=1;
R=V/Ir;
C=1/(Vr*2*%pi*f);
C=C*10^6;
L=1/((C*10^-6)*(100*%pi)^2);
disp(R,"the resistance is (in ohm)");
disp(L,"the inducatance is (in H)");
disp(C,"the capacitance is (in microFarad)");
```

**Scilab code Exa 8.1** `impedance calculation`

```
//Example 8_1 page no:297
clc;
```

```
Xl=25;//inductive reactance in ohm
Xc=Xl;//inductive capacitance at resonance in ohm
R=50;//resistance in ohm
Z=R;//impedence at resonance
disp(Xc,"capacitive reactance is (in ohm)");
disp(Z,"impedance at resonance is (in ohm)");
```

**Scilab code Exa 8.2** frequency calculation

```
//Example 8_2 page no:297
clc;
R=10;//resistance in ohm
L=0.5*10^-3//inductance in henry;
C=10*10^-6;//capacitance in farad;
f=1/(2*%pi*sqrt(L*C));
f=f/1000;//converting to killoHertz
disp(f,"the resonant frequency is (in kHz)");
```

**Scilab code Exa 8.3** impedance calculation

```
//Example 8_3 page no:299
clc;
R=10;//resistance is ohm
L=0.1;//inductive reactance in henry
C=10*10^-6;//capacitive reactance in farad
f=1/(2*%pi*sqrt(L*C));//frequency in Hz
fa10=f+10;
fb10=f-10;
Z=R;//impedence at resonance
disp(Z,"impedence at resonance is (in ohm)");
Xc1=1/(2*%pi*fa10*C);//capacitive reactance at 149.2
Xc2=1/(2*%pi*fb10*C);//capacitive reactance at 169.2
Xl1=2*%pi*fa10*L;//inductive reactance at 149.2
```

```
Xl2=2*%pi*fb10*L;//inductive reactance at 169.2
Z1=sqrt(R^2+(Xl1-Xc1)^2);
disp(Z1,"impedence at 10Hz above resonance(i.e 149.2
    Hz) is (in ohm)");
Z2=sqrt(R^2+(Xl2-Xc2)^2);
disp(Z2,"impedence at 10Hz below resonance(i.e 169.2
    Hz) is (in ohm)");
//in text book square value of resistance is rounded
    so answer of impedence is approximate in text
   book
```

**Scilab code Exa 8.4** `frequency calculation`

```
//Example 8_4 page no:303
clc;
R=10;//resistance in ohm
L=0.1;//inducatance in henry
C=50*10^-6;//capacitance in farad
V=50;
fl=(1/(2*%pi*sqrt(L*C)))*(sqrt(1/(1-((100*50*10^-6)
   /2*0.1))));
disp(fl,"frequency at which voltage is maximum
   across inductor is (in Hz)");
fl=(1/(2*%pi))*(sqrt(200000-500));
disp(fl,"frequency at which voltage is maximum
   across capacitor is (in Hz)");
f=1/(2*%pi*sqrt(L*C));
disp(f,"the resonant frequency is (in Hz)");
//in text book square root values are rounded so
   value varies by 0.82
```

**Scilab code Exa 8.5** `quality factor`

```
//Example 8_5 page no:306
clc;
R=10;//resistance in ohm
L=0.1;//inducatance in henry
C=10*10^-6;//capacitance in farad
fr=1/(2*%pi*(sqrt(L*C)));
BW=R/(2*%pi*L);
Q=fr/BW;
disp(Q,"the quality factor of a coil for the series
    circuit is");
```

**Scilab code Exa 8.6** quality factor

```
//Example 8_6 page no:308
clc;
R=100;
L=5;
C=100*10^-6;
fr=1/(2*%pi*sqrt(L*C));
Q=2*%pi*7.12*5/100;
BW=fr/Q;
disp(BW,"bandwidth of the circuit is (in Hz)");
```

**Scilab code Exa 8.7** frequency calculation

```
//Example 8_7 page no:310
clc;
L=50*10^-3;
C=0.01*10^-6;
fr=1/(2*%pi*sqrt(L*C));
disp(fr,"resonant frequency is (in Hz)");
```

**Scilab code Exa 8.8** frequency calculation

```
//Example 8_8 page no:311
clc;
R=10;
L=0.1;
C=10*10^-6;
fr=(1/(2*%pi))*(sqrt((1/(L*C))-((R^2)/(L^2))));
disp(fr,"the resonant frequency is (in Hz)");
```

**Scilab code Exa 8.9** resistance calculation

```
//Example 8_9 page no:319
clc;
R=50;
Xl=25;
V=200;
f=50;
Imax=V/Xl;
Imin=V/(sqrt(R^2+Xl^2));
Pmax=V^2/(2*Xl);
disp(Imax,"the maximum value of current is (in A)");
disp(Imin,"the minimum value of current is (in A)");
disp(Pmax,"the maximum power is (in watts)");
//In text book calculation in Imin is wrong
```

**Scilab code Exa 8.10** impedance calculation

```
//Example 8_10 page no:319
```

```
clc;
V=200;
R=50;
Imax=V/R;
Pmax=Imax*V;
Imax=200/50;
Imin=200/sqrt(50^2+25^2);
disp(Imax,"the maximum value of current is (in A)");
disp(Imin,"the minimum value of current is (in A)");
disp(Pmax,"maximum power in the circuit is (in watts
    )");
//In text book calculation in Imin is wrong
```

# Chapter 9

# POLYPHASE CIRCUITS

**Scilab code Exa 9.a.1** `power calculation and current calculation`

```
//Example_a_9_1 page no:402
clc;
Vph=230;
Iph=15;
Il=Iph;
cos_pi=0.7;
sin_pi=0.71;
Vl=sqrt(3)*Vph;
P=sqrt(3)*Vl*Il*cos_pi;
Iac=Iph*cos_pi;
Irc=Iph*sin_pi;
disp(Vl,"the line voltage is (in V)");
disp(P,"the active power is (in W)");
disp(Iac,"the active component of power is (in A)");
disp(Irc,"the reactive component of power is (in A)"
   );
```

---

**Scilab code Exa 9.a.2** `power calculation`

```
//Example_a_9_2 page no:402
clc;
Vl=400;
Vph=Vl;
Vrymag=400;
Vryang=0;
Vybmag=400;
Vybang=-120;
Vbrmag=400;
Vbrang=-240;
Z=3+(%i*4);
Zmag=sqrt(real(Z)^2+imag(Z)^2);
Zang=atand(imag(Z)/real(Z));
Irmag=Vrymag/Zmag;
Irang=Vryang-Zang;
Iymag=Vybmag/Zmag;
Iyang=Vybang-Zang;
Ibmag=Vbrmag/Zmag;
Ibang=Vbrang-Zang;
Irreal=Irmag*cosd(Irang);
Irimag=Irmag*sind(Irang);
Ir=Irreal+(%i*Irimag);
Iyreal=Iymag*cosd(Iyang);
Iyimag=Iymag*sind(Iyang);
Iy=Iyreal+(%i*Iyimag);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Ib=Ibreal+(%i*Ibimag);
//calculating the phase current
I1=Ir-Ib;
I2=Iy-Ir;
I3=Ib-Iy;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I1ang=atand(imag(I1)/real(I1));
I2mag=sqrt(real(I2)^2+imag(I2)^2);
I2ang=atand(imag(I2)/real(I2));
I2ang=I2ang+180;//converting to positive angle
I3mag=sqrt(real(I3)^2+imag(I3)^2);
```

```
I3ang=atand(imag(I3)/real(I3));
cos_pi=real(Z)/Zmag;
P=Vph*Irmag*cos_pi;
Pt=3*P;
disp(Irmag,"the magnitude of phase current Ir is (in
    A)");
disp(Irang,"the angle of phase current Ir is (in
   degree)");
disp(Iymag,"the magnitude of phase current Iy is (in
    A)");
disp(Iyang,"the angle of phase current Iy is (in
   degree)");
disp(Ibmag,"the magnitude of phase current Ib is (in
    A)");
disp(Ibang,"the angle of phase current Ib is (in
   degree)");
disp(I1mag,"the magnitude of line current I1 is (in
   A)");
disp(I1ang,"the angle of line current I1 is (in A)")
   ;
disp(I2mag,"the magnitude of line current I2 is (in
   A)");
disp(I2ang,"the angle of line current I2 is (in A)")
   ;
disp(I3mag,"the magnitude of line current I3 is (in
   A)");
disp(I3ang,"the angle of line current I3 is (in A)")
   ;
disp(P,"power in each phase is (in W)");
disp(Pt,"the total power is (in W)");
```

**Scilab code Exa 9.a.3** power calculation and current calculation

```
//Example_a_9_3 page no:403
clc;
```

```
Vl=400;
Vph=400/sqrt(3);
Vrnmag=Vph;
Vrnang=0;
Vynmag=Vph;
Vynang=-120;
Vbnmag=Vph;
Vbnang=-240
Zph=3+(%i*4);
Zmag=sqrt(real(Zph)^2+imag(Zph)^2);
Zang=atand(imag(Zph)/real(Zph));
Irmag=Vrnmag/Zmag;
Irang=Vrnang-Zang;
Iph=Irmag;
Iymag=Vynmag/Zmag;
Iyang=Vynang-Zang;
Ibmag=Vbnmag/Zmag;
Ibang=Vbnang-Zang;
Irreal=Irmag*cosd(Irang);
Irimag=Irmag*sind(Irang);
Ir=Irreal+(%i*Irimag);
Iyreal=Iymag*cosd(Iyang);
Iyimag=Iymag*sind(Iyang);
Iy=Iyreal+(%i*Iyimag);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Ib=Ibreal+(%i*Ibimag);
cos_pi=0.6;
Pt=sqrt(3)*Vl*Irmag*cos_pi;//Irmag value is rounded
   off in text book so total power varies slightly
   with text book
I=Ir+Iy+Ib;//here value of I should be zero but it
   is not zero because scilab can only produce value
    more near and value will not be zero the reason
   is explained in document released by scilab in
   SCILAB IS NOT NAIVE : page no:3
disp(Iph,"the line current is (in A)");
disp(Irmag,"the magnitude of phase current Ir is (in
```

```
A)");
disp(Irang,"the angle of phase current Ir is (in
   degree)");
disp(Iymag,"the magnitude of phase current Iy is (in
    A)");
disp(Iyang,"the angle of phase current Iy is (in
   degree)");
disp(Ibmag,"the magnitude of phase current Ib is (in
    A)");
disp(Ibang,"the angle of phase current Ib is (in
   degree)");
disp(Pt,"the total power is (in W)");
disp(I,"the phasor sum of the three line current is
   (in A)");
//Irmag value is rounded off in text book so total
   power varies slightly with text book
//here value of I should be zero but it is not zero
   because scilab can only produce value more near
   and value will not be zero the reason is
   explained in document released by scilab in
   SCILAB IS NOT NAIVE : page no:3
```

**Scilab code Exa 9.a.4** `impedance calculation`

```
//Example_a_9_4 page no:405
clc;
disp("the phase sequence is RYB");
Vph=200;
Vl=Vph;
Il=10;
Iph=Il/sqrt(3);
Zph=Vph/Iph;
disp(Zph,"the impedance is (in ohm)");
```

**Scilab code Exa 9.a.5** `current calculation`

```
//Example_a_9_5 page no:405
clc;
P=5000;
V=400;
f=50;
cos_pi=0.7;
pi=acosd(cos_pi);
sin_pi=sin(pi);
Il=P/(sqrt(3)*V*cos_pi);
Iph=Il;
Zph=V/(sqrt(3)*Iph);
Rph=Zph*cos_pi;
Xph=Zph*sin_pi;
//calculating line currents if one of the inductors is disconnected
Ir=V/(2*Zph);
Ib=Ir;
Iy=0;
disp("line currents if one of the inductors is disconnected");
disp(Ir,"the current Ir is (in A)");
disp(Ib,"the current Ib is (in A)");
disp(Iy,"the current Iy is (in A)");
//calculating line current if one of the inductor is short circuited
Ir=V/Zph;
Ib=Ir;
Iph=Ib;
Iy=2*Iph*cosd(60/2);
disp("line current if one of the inductor is short circuited");
disp(Ir,"the current Ir is (in A)");
```

```
disp(Ib,"the current Ib is (in A)");
disp(Iy,"the current Iy is (in A)");
```

**Scilab code Exa 9.a.6** `power calculation`

```
//Example_a_9_6 page no:406
clc;
Vl=400;
Vrnmag=400/sqrt(3);
Vrnang=0;
Vynmag=400/sqrt(3);
Vrnang=-120;
Vbnmag=400/sqrt(3);
Vrnang=-240;
R=10;
omega=314;
L=1;
C=100*10^-6;
Yph=(1/R)+(1/(%i*omega*L))+(%i*omega*C);
Iph=Vrnmag*Yph;//multiplication of Vrnmag and Yph is rounded off in text book so output line current varies sligthly
Iphmag=sqrt(real(Iph)^2+imag(Iph)^2);
Iphang=atand(imag(Iph)/real(Iph));
P=sqrt(3)*Vl*Iphmag*cosd(Iphang);
pf=cosd(Iphang);
disp(Iphmag,"the magnitude of line current is (in A)");
disp(Iphang,"the angle of line current is (in degree)");
disp(P,"the power is (in W)");
disp(pf,"the power factor is");
//multiplication of Vrnmag and Yph is rounded off in text book so output line current varies sligthly
//Iphmag and Iphang are rounded off in text book so
```

```
   calculated power varies with the textbook
```

**Scilab code Exa 9.a.7** `impedance calculation`

```
//Example_a_9_7 page no:407
clc;
Z=3+(%i*4);
Vrymag=1;//here Vrymag is assumed to be one hence it
     will be cancelled out in simplification unless
    the variable cannot be used without initializing
Vryang=0;
Vybmag=1;//here Vrymag is assumed to be one hence it
     will be cancelled out in simplification unless
    the variable cannot be used without initializing
Vybang=-120;
Vmag=Vrymag/Vybmag;
Vang=Vybang-Vryang;
Vreal=Vmag*cosd(Vang);
Vimag=Vmag*sind(Vang);
V=Vreal+(%i*Vimag);
Zyb=V*Z;
R=real(Zyb);
X=-imag(Zyb);//here negative sign is used hence only
     the magnitude is required
disp(R,"the value of R is (in ohm)");
disp(X,"the value of X(capacitive reactance) is (in
    ohm)");
```

**Scilab code Exa 9.a.8** `power calculation`

```
//Example_a_9_8 page no:408
clc;
Iph=10;
```

```
Vl=440;
pi=30;
Il=sqrt(3)*Iph;
Pac=sqrt(3)*Vl*Il*cosd(pi);
Pac=Pac/1000;//converting to killo Watt
Prc=sqrt(3)*Vl*Il*sind(pi);
Prc=Prc/1000;//converting to killo VAR
disp(Il,"the line current is (in A)");
disp(Pac,"the total active power is (in KW)");
disp(Prc,"the total reactive power is (in KVAR)");
```

**Scilab code Exa 9.a.9** power calculation

```
//Example_a_9_9 page no:408
clc;
V=400;
Irmag=10;
Irang=-36.88;
Iymag=5;
Iyang=45.57;
Ibmag=7;
Ibang=0;
pf1=0.8;
pf2=0.7;
pf3=1;
Irreal=Irmag*cosd(Irang);
Irimag=Irmag*sind(Irang);
Ir=Irreal+(%i*Irimag);
Iyreal=Iymag*cosd(Iyang);
Iyimag=Iymag*sind(Iyang);
Iy=Iyreal+(%i*Iyimag);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Ib=Ibreal+(%i*Ibimag);
I1=Ir-Ib;
```

```
I2=Iy-Ir;
I3=Ib-Iy;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I1ang=atand(imag(I1)/real(I1));
I2mag=sqrt(real(I2)^2+imag(I2)^2);
I2ang=atand(imag(I2)/real(I2));
I2ang=I2ang+180;//converting the angle to positive
I3mag=sqrt(real(I3)^2+imag(I3)^2);
I3ang=atand(imag(I3)/real(I3));
Pry=V*Irmag*pf1;
Pyb=V*Iymag*pf2;
Pby=V*Ibmag*pf3;
Pt=Pry+Pyb+Pby;
disp(I1mag,"the magnitude of current I1 is (in A)");
disp(I1ang,"the angle of current I1 is (in degree)");
disp(I2mag,"the magnitude of current I2 is (in A)");
disp(I2ang,"the angle of current I2 is (in degree)");//I2 angle is wrongly calculated in text book
disp(I3mag,"the magnitude of current I3 is (in A)");
disp(I3ang,"the angle of current I3 is (in degree)");
disp(Pt,"the total power consumed by the load is (in W)");
//I2 angle is wrongly calculated in text book, correct calculation is done here
```

**Scilab code Exa 9.a.10** current calculation

```
//Example_a_9_10 page no:409
clc;
Zrymag=10;
Zryang=0;
Zybmag=2;
Zybang=90;
```

```
Zbrmag=5;
Zbrang=-90;
Vrymag=400;
Vryang=0;
Vbrmag=400;
Vbrang=-120;
Vybmag=400;
Vybang=-240;
//calculating the line currents
Irmag=Vrymag/Zrymag;
Irang=Vryang-Zryang;
Iymag=Vybmag/Zybmag;
Iyang=Vybang-Zybang;
Ibmag=Vbrmag/Zbrmag;
Ibang=Vbrang-Zbrang;
Irreal=Irmag*cosd(Irang);
Irimag=Irmag*sind(Irang);
Ir=Irreal+(%i*Irimag);
Iyreal=Iymag*cosd(Iyang);
Iyimag=Iymag*sind(Iyang);
Iy=Iyreal+(%i*Iyimag);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Ib=Ibreal+(%i*Ibimag);
I1=Ir-Ib;
I2=Iy-Ir;
I3=Ib-Iy;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I1ang=atand(imag(I1)/real(I1));
I1ang=I1ang+180;//converting the angle to positive
I2mag=sqrt(real(I2)^2+imag(I2)^2);
I2ang=atand(imag(I2)/real(I2));
I3mag=sqrt(real(I3)^2+imag(I3)^2);
I3ang=atand(imag(I3)/real(I3));
I3ang=I3ang+180;
disp(I1mag,"the magnitude of current I1 is (in A)");
disp(I1ang,"the angle of current I1 is (in degree)")
    ;
```

```
disp(I2mag,"the magnitude of current I2 is (in A)");
disp(I2ang,"the angle of current I2 is (in degree)")
    ;
disp(I3mag,"the magnitude of current I3 is (in A)");
disp(I3ang,"the angle of current I3 is (in degree)")
    ;
```

**Scilab code Exa 9.a.11** `impedance calculation`

```
//Example_a_9_11 page no:410
clc;
V=400;
P=2000;
f=50;
pf=0.8;
Vph=V/sqrt(3);
Il=P/(sqrt(3)*V*pf);
Iph=Il;
pi=acosd(pf);
sin_pi=sind(pi);
Zph=Vph/Iph;
Rph=Zph*pf;//Rph varies slightly with text book
    because Zph is rounded off in text book
Xph=Zph*sin_pi;//Xph varies slightly with text book
    because Zph is rounded off in text book
disp(Rph,"the resistance of each phase is (in ohm)")
    ;
disp(Xph,"the reactance of each phase is (in ohm)");
```

**Scilab code Exa 9.a.12** `current calculation and voltage calculation`

```
//Example_a_9_12 page no:411
clc;
```

```
//star delta conversion method
Zrmag=5;
Zrang=0;
Zymag=2;
Zyang=90;
Zbmag=4;
Zbang=-90;
Vrymag=100;
Vryang=0;
Vybmag=100;
Vybang=-120;
Vbrmag=100;
Vbrang=-240;
Zrymag=Zrmag*Zymag;
Zryang=Zrang+Zyang;
Zybmag=Zymag*Zbmag;
Zybang=Zyang+Zbang;
Zbrmag=Zbmag*Zrmag;
Zbrang=Zbang+Zrang;
Zryreal=Zrymag*cosd(Zryang);
Zryimag=Zrymag*sind(Zryang);
Zry=Zryreal+(%i*Zryimag);
Zybreal=Zybmag*cosd(Zybang);
Zybimag=Zybmag*sind(Zybang);
Zyb=Zybreal+(%i*Zybimag);
Zbrreal=Zbrmag*cosd(Zbrang);
Zbrimag=Zbrmag*sind(Zbrang);
Zbr=Zbrreal+(%i*Zbrimag);
Z=Zry+Zyb+Zbr;
Zmag=sqrt(real(Z)^2+imag(Z)^2);
Zang=atand(imag(Z)/real(Z));
Zr_ymag=Zmag/Zbmag;
Zr_yang=Zang-Zbang;
Zy_bmag=Zmag/Zrmag;
Zy_bang=Zang-Zrang;
Zb_rmag=Zmag/Zymag;
Zb_rang=Zang-Zyang;
Irmag=Vrymag/Zr_ymag;
```

```
Irang=Vryang-Zr_yang;
Iymag=Vybmag/Zy_bmag;
Iyang=Vybang-Zy_bang;
Ibmag=Vbrmag/Zb_rmag;
Ibang=Vbrang-Zb_rang;
Irreal=Irmag*cosd(Irang);
Irimag=Irmag*sind(Irang);
Ir=Irreal+(%i*Irimag);
Iyreal=Iymag*cosd(Iyang);
Iyimag=Iymag*sind(Iyang);
Iy=Iyreal+(%i*Iyimag);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Ib=Ibreal+(%i*Ibimag);
I1=Ir-Ib;
I2=Iy-Ir;
I3=Ib-Iy;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I1ang=atand(imag(I1)/real(I1));
I2mag=sqrt(real(I2)^2+imag(I2)^2);
I2ang=atand(imag(I2)/real(I2));
I2ang=I2ang+180;//converting the angle to positive
I3mag=sqrt(real(I3)^2+imag(I3)^2);
I3ang=atand(imag(I3)/real(I3));
I3ang=I3ang+180;
disp("the line currents are");
disp(I1mag,"the magnitude of current I1 is (in A)");
disp(I1ang,"the angle of current I1 is (in A)");
disp(I2mag,"the magnitude of current I2 is (in A)");
disp(I2ang,"the angle of current I2 is (in A)");
disp(I3mag,"the magnitude of current I3 is (in A)");
disp(I3ang,"the angle of current I3 is (in A)");
Vzrmag=I1mag*Zrmag;
Vzrang=I1ang+Zrang;
Vzymag=I2mag*Zymag;
Vzyang=I2ang+Zyang;
Vzbmag=I3mag*Zbmag;
Vzbang=I3ang+Zbang;
```

```
disp("the voltage drop across each star connected
    load is");//the voltage value varies slightly
    with text book hence results are rounded off in
    text book
disp(Vzrmag,"the magnitude of voltage drop across Zr
     resistor is (in V)");
disp(Vzrang,"the angle of voltage drop across Zr
    resistor is (in degree)");
disp(Vzymag,"the magnitude of voltage drop across Zy
     resistor is (in V)");
disp(Vzyang,"the angle of voltage drop across Zy
    resistor is (in degree)");
disp(Vzbmag,"the magnitude of voltage drop across Zb
     resistor is (in V)");
disp(Vzbang,"the angle of voltage drop across Zb
    resistor is (in degree)");
Vromag=100/sqrt(3);
Vroang=-30;
Vyomag=100/sqrt(3);
Vyoang=-150;
Vbomag=100/sqrt(3);
Vboang=-270;
Yrmag=1/Zrmag;
Yrang=0-Zrang;
Ymag=1/Zymag;
Yyang=0-Zyang;
Ybmag=1/Zbmag;
Ybang=0-Zbang;
Yrormag=Vromag*Yrmag;
Yrorang=Vroang+Yrang;
Yyoymag=Vyomag*Yymag;
Yyoyang=Vyoang+Yyang;
Ybobmag=Vbomag*Ybmag;
Ybobang=Vboang+Ybang;
Yrorreal=Yrormag*cosd(Yrorang);
Yrorimag=Yrormag*sind(Yrorang);
Yror=Yrorreal+(%i*Yrorimag);
Yyoyreal=Yyoymag*cosd(Yyoyang);
```

```
Yyoyimag=Yyoymag*sind(Yyoyang);
Yyoy=Yyoyreal+(%i*Yyoyimag);
Ybobreal=Ybobmag*cosd(Ybobang);
Ybobimag=Ybobmag*sind(Ybobang);
Ybob=Ybobreal+(%i*Ybobimag);
Y=Yror+Yyoy+Ybob;
Ymag=sqrt(real(Y)^2+imag(Y)^2);
Yang=atand(imag(Y)/real(Y));
Yang=Yang+180;//converting the angle to positive
Yrreal=Yrmag*cosd(Yrang);
Yrimag=Yrmag*sind(Yrang);
Yr=Yrreal+(%i*Yrimag);
Yyreal=Yymag*cosd(Yyang);
Yyimag=Yymag*sind(Yyang);
Yy=Yyreal+(%i*Yyimag);
Ybreal=Ybmag*cosd(Ybang);
Ybimag=Ybmag*sind(Ybang);
Yb=Ybreal+(%i*Ybimag);
Yryb=Yr+Yy+Yb;
Yrybmag=sqrt(real(Yryb)^2+imag(Yryb)^2);
Yrybang=atand(imag(Yryb)/real(Yryb));
Vo_omag=Ymag/Yrybmag;
Vo_oang=Yang-Yrybang;
Vo_oreal=Vo_omag*cosd(Vo_oang);
Vo_oimag=Vo_omag*sind(Vo_oang);
Vo_o=Vo_oreal+(%i*Vo_oimag);
Vroreal=Vromag*cosd(Vroang);
Vroimag=Vromag*sind(Vroang);
Vro=Vroreal+(%i*Vroimag);
Vyoreal=Vyomag*cosd(Vyoang);
Vyoimag=Vyomag*sind(Vyoang);
Vyo=Vyoreal+(%i*Vyoimag);
Vboreal=Vbomag*cosd(Vboang);
Vboimag=Vbomag*sind(Vboang);
Vbo=Vboreal+(%i*Vboimag);
Vro_=Vro-Vo_o;
Vyo_=Vyo-Vo_o;
Vbo_=Vbo-Vo_o;
```

```
Vro_mag=sqrt(real(Vro_)^2+imag(Vro_)^2);
Vro_ang=atand(imag(Vro_)/real(Vro_));
Vyo_mag=sqrt(real(Vyo_)^2+imag(Vyo_)^2);
Vyo_ang=atand(imag(Vyo_)/real(Vyo_));
Vbo_mag=sqrt(real(Vbo_)^2+imag(Vbo_)^2);
Vbo_ang=atand(imag(Vbo_)/real(Vbo_));
disp("the displacement neutral voltages are");
disp(Vro_mag,"the magnitude of voltage across Vro is
    (in V)");
disp(Vro_ang,"the angle of voltage across Vro is (in
    degree)");
disp(Vyo_mag,"the magnitude of voltage across Vyo is
    (in V)");
disp(Vyo_ang,"the angle of voltage across Vyo is (in
    degree)");
disp(Vbo_mag,"the magnitude of voltage across Vbo is
    (in V)");
disp(Vbo_ang,"the angle of voltage across Vbo is (in
    degree)");
Ir_mag=Vro_mag/Zrmag;//value of Ir is wrong in text
    book calculation
Ir_ang=Vro_ang-Zrang;
Iy_mag=Vyo_mag/Zymag;
Iy_ang=Vyo_ang-Zyang;
Iy_ang=Iy_ang+360;//converting to positive angle
Ib_mag=Vbo_mag/Zbmag;
Ib_ang=Vbo_ang-Zbang;
disp("the current in the phases are");
disp(Ir_mag,"the magnitude of current in the R phase
    is (in A)");
disp(Ir_ang,"the angle of current in the R phase is
    (in degree)");
disp(Iy_mag,"the magnitude of current in the Y phase
    is (in A)");
disp(Iy_ang,"the angle of current in the Y phase is
    (in degree)");
disp(Ib_mag,"the magnitude of current in the B phase
    is (in A)");
```

```
disp(Ib_ang,"the angle of current in the B phase is
   (in degree)");
//value of Ir is wrong in text book calculation
//the voltages value varies slightly with text book
   hence results are rounded off in text book
```

**Scilab code Exa 9.a.13** voltage calculation

```
//Example_a_9_13 page no:414
clc;
//equation with unknown variable cannot be solved in
   scilab therefore taking the simplified equation
E1=124.52-(%i*165.08);
E2=1.5-(%i*0.866);
V=E1/E2;
Vromag=100;
Vroang=-10;
Vroreal=Vromag*cosd(Vroang);
Vroimag=Vromag*sind(Vroang);
Vro=Vroreal+(%i*Vroimag);
Vo_o=V-Vro;
Vo_omag=sqrt(real(Vo_o)^2+imag(Vo_o)^2);
Vo_oang=atand(imag(Vo_o)/real(Vo_o));
disp(Vo_omag,"the magnitude of voltage between O''O
   is (in V)");
disp(Vo_oang,"the angle of voltage between O''O is (
   in degree)");
```

**Scilab code Exa 9.a.14** power calculation

```
//Example_a_9_14 page no:416
clc;
Vrymag=400;
```

```
Vryang=0;
Vbrmag=400;
Vbrang=-240;
Vybmag=400;
Zr=-(%i*50);
Zrmag=sqrt(real(Zr)^2+imag(Zr)^2);
Zrang=-90;//there is no real part
Zb=30+(%i*40);
Zbmag=sqrt(real(Zb)^2+imag(Zb)^2);
Zbang=atand(imag(Zb)/real(Zb));
Irmag=Vrymag/Zrmag;
Irang=Vryang-Zrang;
Ibmag=Vbrmag/Zbmag;
Ibang=Vbrang-Zbang;
Irreal=Irmag*cosd(Irang);
Irimag=Irmag*sind(Irang);
Ir=Irreal+(%i*Irimag);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Ib=Ibreal+(%i*Ibimag);
I1=Ir-Ib;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
pi=71.7;
P=Vrymag*I1mag*cosd(pi);
disp(P,"the wattmeter reading is (in W)");
//the answer varie slightly with text book hence I1
   value is rounded off in text book
```

**Scilab code Exa 9.a.15** power calculation

```
//Example_a_9_15 page no:416
clc;
cos_pi=0.8;
Prc=15000;
Pt=Prc*sqrt(3)/0.75;
```

```
W=[-1,1,
    1,1];
P=[8660.508,
    34641.01];
X=inv(W)*P;
disp(Pt,"the total power input is (in W)");
disp(X(1),"the first watt meter reading is (in W))")
    ;
disp(X(2),"the second watt meter reading is (in W)")
    ;
```

**Scilab code Exa 9.a.16** power calculation

```
//Example_a_9_16 page no:417
clc;
P=10000;
pf=0.707;
pi=acosd(pf);
tan_pi=tand(pi);
watt_diff=tan_pi*P/sqrt(3);
W=[1,1
    -1,1];
Pow=[10000,
    watt_diff];
X=inv(W)*Pow;
X(1)=X(1)/1000;//converting to killo Watt
X(2)=X(2)/1000;//converting to killo Watt
disp(X(1),"the first watt meter reading is (in kW)")
    ;
disp(X(2),"the second watt meter reading is (in kW))
    ");
```

**Scilab code Exa 9.a.17** current calculation

```
//Example_a_9_17 page no:417
clc;
Il=35.35;
n=6;
Iph=Il/(2*sind(180/n));
disp(Iph,"the magnitude of phase current is (in A)")
    ;
```

**Scilab code Exa 9.a.18** voltage calculation

```
//Example_a_9_18 page no:418
clc;
Eph=132.8;
n=6;
El=2*Eph*sind(180/n);
disp(El,"the voltage between the adjacent lines of a
     balanced six-phase star-connected system is (in
    V)");
```

**Scilab code Exa 9.a.19** voltage calculation

```
//Example_a_9_19 page no:418
clc;
V=340;
fund_comp=340/sqrt(3);
harmonic_comp=sqrt(220^2-(fund_comp)^2);
disp(harmonic_comp,"the third harmonic component is
    (in V)");
```

**Scilab code Exa 9.a.20** current calculation

```
//Example_a_9_20 page no:418
clc;
I1mag=28.41;
I1ang=-69.07;
I2mag=29.85;
I2ang=136.58;
I3mag=13;
I3ang=27.60;
disp("value of current before changing the phase
    sequence");
disp(I1mag,"the magnitude of current I1 is (in A)");
disp(I1ang,"the angle of current I1 is (in A)");
disp(I2mag,"the magnitude of current I2 is (in A)");
disp(I2ang,"the angle of current I2 is (in A)");
disp(I3mag,"the magnitude of current I3 is (in A)");
disp(I3ang,"the angle of current I3 is (in A)");
Vrymag=400;
Vryang=0;
Vybmag=400;
Vybang=-240;
Vbrmag=400;
Vbrang=-120;
Zrymag=15.67;
Zryang=60.13;
Zybmag=43.83;
Zybang=49.83;
Zbrmag=78.36;
Zbrang=60.13;
Irmag=Vrymag/Zrymag;
Irang=Vryang-Zryang;
Iymag=Vybmag/Zybmag;
Iyang=Vybang-Zybang;
Ibmag=Vbrmag/Zbrmag;
Ibang=Vbrang-Zbrang;
Irreal=Irmag*cosd(Irang);
Irimag=Irmag*sind(Irang);
Ir=Irreal+(%i*Irimag);
Iyreal=Iymag*cosd(Iyang);
```

```
Iyimag=Iymag*sind(Iyang);
Iy=Iyreal+(%i*Iyimag);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Ib=Ibreal+(%i*Ibimag);
//calculating the values of current
I1=Ir-Ib;
I2=Iy-Ir;
I3=Ib-Iy;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I1ang=atand(imag(I1)/real(I1));
I2mag=sqrt(real(I2)^2+imag(I2)^2);
I2ang=atand(imag(I2)/real(I2));
I2ang=I2ang+180;//converting to positive
I3mag=sqrt(real(I3)^2+imag(I3)^2);
I3ang=atand(imag(I3)/real(I3));
disp("value of current after changing the phase
   sequence");
disp(I1mag,"the magnitude of current I1 is (in A)");
disp(I1ang,"the angle of current I1 is (in A)");
disp(I2mag,"the magnitude of current I2 is (in A)");
disp(I2ang,"the angle of current I2 is (in A)");
disp(I3mag,"the magnitude of current I3 is (in A)");
disp(I3ang,"the angle of current I3 is (in A)");
disp("from the above values, it can be verified that
    the magnitudes of the line currents are not same
    when the phase sequence is changed");
```

**Scilab code Exa 9.a.21** power calculation

```
//Example_a_9_21 page no:419
clc;
V=400;
f=50;
Iph=20;
```

```
pi=40;
Il=sqrt(3)*Iph;
Pt=sqrt(3)*V*Il*cosd(pi);
Pt=Pt/1000;//converting to killo watt
W1_W2=V*Il*sind(pi);
W1_W2=W1_W2/1000;//conveting to killo watt
W=[1,1
    1,-1];
P=[Pt,
    W1_W2];
X=inv(W)*P;
disp(Il,"the line current is (in A)");
disp(Pt,"the total power is (in kW)");
disp(X(1),"the first watt meter reading is (in kW)")
   ;
disp(X(2),"the second watt meter reading is (in kW)"
   );
```

---

**Scilab code Exa 9.a.22** power calculation

```
//Example_a_9_22 page no:420
clc;
Vrph_mag=440/sqrt(3);
Vrph_ang=0;
Vyph_mag=440/sqrt(3);
Vyph_ang=-120;
Vbph_mag=440/sqrt(3);
Vbph_ang=-240;
Irmag=20;
Irang=-40;
Iymag=20;
Iyang=-160;
Ibmag=20;
Ibang=80;
pi=40;
```

```
Vl=440;
Il=20;
Zrmag=Vrph_mag/Irmag;
Zrang=Vrph_ang-Irang;
Zymag=Vyph_mag/Iymag;
Zyang=Vyph_ang-Iyang;
Zbmag=Vbph_mag/Ibmag;
Zbang=Vbph_ang-Ibang;
Zrreal=Zrmag*cosd(Zrang);
Zrimag=Zrmag*sind(Zrang);
Zr=Zrreal+(%i*Zrimag);
Zyreal=Zymag*cosd(Zyang);
Zyimag=Zymag*sind(Zyang);
Zy=Zyreal+(%i*Zyimag);
Zbreal=Zbmag*cosd(Zbang);
Zbimag=Zbmag*sind(Zbang);
Zb=Zbreal+(%i*Zbimag);
disp(Zr,"the impedence due to Zr is (in ohm)");
disp(Zy,"the impedence due to Zr is (in ohm)");
disp(Zb,"the impedence due to Zr is (in ohm)");
P=3*Irmag^2*real(Zr);
disp(P,"power consumed is (in W)");
//wattmeter reading
W1=Vl*Il*cosd(30-pi);
W2=Vl*Il*cosd(30+pi);
Pt=W1+W2;
disp(Pt,"the total power is (in W)");
//power consumed varies slightly with text book
   because Rph value is rounded off in text book
```

**Scilab code Exa 9.a.23** voltage calculation

```
//Example_a_9_23 page no:421
clc;
Zbcmag=105.85/5;
```

```
Zbcang=-31.81-0;
Zcamag=105.85/5;
Zcaang=-31.81-30;
Zbamag=105.85/10;
Zbaang=-31.81+60;
Vcbmag=208;
Vcbang=0;
Vbamag=208;
Vbaang=-120;
Vacmag=208;
Vacang=-240;
Icmag=Vcbmag/Zbcmag;
Icang=Vcbang-Zbcang;
Ibmag=Vbamag/Zbamag;
Ibang=Vbaang-Zbaang;
Iamag=Vacmag/Zcamag;
Iaang=Vacang-Zcaang;
Icreal=Icmag*cosd(Icang);
Icimag=Icmag*sind(Icang);
Ibreal=Ibmag*cosd(Ibang);
Ibimag=Ibmag*sind(Ibang);
Iareal=Iamag*cosd(Iaang);
Iaimag=Iamag*sind(Iaang);
Ia=Iareal+(%i*Iaimag);
Ib=Ibreal+(%i*Ibimag);
Ic=Icreal+(%i*Icimag);
//calculating the current values
I1=Ic-Ia;
I2=Ib-Ic;
I3=Ia-Ib;
I1mag=sqrt(real(I1)^2+imag(I1)^2);
I1ang=atand(imag(I1)/real(I1));
I2mag=sqrt(real(I2)^2+imag(I2)^2);
I2ang=atand(imag(I2)/real(I2));
I2ang=I2ang-180;
I3mag=sqrt(real(I3)^2+imag(I3)^2);
I3ang=atand(imag(I3)/real(I3));
disp(I1mag,"the magnitude of current I1 is (in A)");
```

```
disp(I1ang,"the angle of current I1 is (in A)");
disp(I2mag,"the magnitude of current I2 is (in A)");
disp(I2ang,"the angle of current I2 is (in A)");
disp(I3mag,"the magnitude of current I3 is (in A)");
disp(I3ang,"the angle of current I3 is (in A)");
Zcmag=10;
Zcang=-60;
Zbmag=5;
Zbang=30;
Zamag=5;
Zaang=0;
//calculating the voltage values
Vzcmag=I1mag*Zcmag;
Vzcang=I1ang+Zcang;
Vzbmag=I2mag*Zbmag;
Vzbang=I2ang+Zbang;
Vzamag=I3mag*Zamag;
Vzaang=I3ang+Zaang;
disp("the voltage across the load impedence are ");
disp(Vzcmag,"the magnitude of voltage across impedance Zc is (in ohm)");
disp(Vzcang,"the angle of voltage across impedance Zc is (in degree)");
disp(Vzbmag,"the magnitude of voltage across impedance Zb is (in ohm)");
disp(Vzbang,"the angle of voltage across impedance Zb is (in degree)");
disp(Vzamag,"the magnitude of voltage across impedance Za is (in ohm)");
disp(Vzaang,"the angle of voltage across impedance Za is (in degree)");
//the result produced in this problem varies slightly with the text book calculation because in text book the value is rounded off at every point but here values of directly simplified results are used
```

**Scilab code Exa 9.a.24** current calculation

```
//Example_a_9_24 page no:423
clc;
Zamag=10;
Zaang=0;
Zbmag=8;
Zbang=30;
Zcmag=5;
Zcang=45;
Vabmag=415;
Vabang=0;
Vabreal=Vabmag*cosd(Vabang);
Vabimag=Vabmag*sind(Vabang);
Vab=Vabreal+(%i*Vabimag);
Vbcmag=415;
Vbcang=-120;
Vbcreal=Vbcmag*cosd(Vbcang);
Vbcimag=Vbcmag*sind(Vbcang);
Vbc=Vbcreal+(%i*Vbcimag);
Zareal=Zamag*cosd(Zaang);
Zaimag=Zamag*sind(Zaang);
Za=Zareal+(%i*Zaimag);
Zbreal=Zbmag*cosd(Zbang);
Zbimag=Zbmag*sind(Zbang);
Zb=Zbreal+(%i*Zbimag);
Zcreal=Zcmag*cosd(Zcang);
Zcimag=Zcmag*sind(Zcang);
Zc=Zcreal+(%i*Zcimag);
Vo=((Vab/Za)-(Vbc/Zc))/((1/Za)+(1/Zb)+(1/Zc));
Voa=Vo-Vab;
Voc=Vo+Vbc;
Ia=-Voa/Za;
Ib=-Vo/Zb;
```

```
Ic=-Voc/Zc;
Iamag=-sqrt(real(Ia)^2+imag(Ia)^2);
Iaang=atand(imag(Ia)/real(Ia));
Iaang=180+Iaang;
Ibmag=-sqrt(real(Ib)^2+imag(Ib)^2);
Ibang=atand(imag(Ib)/real(Ib));
Icmag=-sqrt(real(Ic)^2+imag(Ic)^2);
Icang=atand(imag(Ic)/real(Ic));
Icang=Icang-180;
disp(Iamag,"the magnitude of current I1 is (in A)");
disp(Iaang,"the angle of current I1 is (in A)");
disp(Ibmag,"the magnitude of current I2 is (in A)");
disp(Ibang,"the angle of current I2 is (in A)");
disp(Icmag,"the magnitude of current I3 is (in A)");
disp(Icang,"the angle of current I3 is (in A)");
//the result produced in this problem varies slightly with the text book calculation because in text book the value is rounded off at every point but here values of directly simplified results are used
```

**Scilab code Exa 9.a.25** `current calculation`

```
//Example_a_9_25 page no:424
clc;

Zr=4+(%i*3);
Zy=4-(%i*3);
Zb=2;
Zn=1+(%i*2);
Yr=1/Zr;
Yy=1/Zy;
Yb=1/Zb;
Yn=1/Zn;
Yrmag=sqrt(real(Yr)^2+imag(Yr)^2);
```

```
Yrang=atand(imag(Yr)/real(Yr));
Ymag=sqrt(real(Yy)^2+imag(Yy)^2);
Yyang=atand(imag(Yy)/real(Yy));
Ybmag=sqrt(real(Yb)^2+imag(Yb)^2);
Ybang=atand(imag(Yb)/real(Yb));
Ynmag=sqrt(real(Yn)^2+imag(Yn)^2);
Ynang=atand(imag(Yn)/real(Yn));
Vrmag=380/sqrt(3);
Vrang=0;
Vymag=380/sqrt(3);
Vyang=-120;
Vbmag=380/sqrt(3);
Vbang=-240;
Yrormag=Vrmag*Yrmag;
Yrorang=Vrang+Yrang;
Yyoymag=Vymag*Yymag;
Yyoyang=Vyang+Yyang;
Ybobmag=Vbmag*Ybmag;
Ybobang=Vbang+Ybang;
Yrorreal=Yrormag*cosd(Yrorang);
Yrorimag=Yrormag*sind(Yrorang);
Yror=Yrorreal+(%i*Yrorimag);
Yyoyreal=Yyoymag*cosd(Yyoyang);
Yyoyimag=Yyoymag*sind(Yyoyang);
Yyoy=Yyoyreal+(%i*Yyoyimag);
Ybobreal=Ybobmag*cosd(Ybobang);
Ybobimag=Ybobmag*sind(Ybobang);
Ybob=Ybobreal+(%i*Ybobimag);
Y=Yror+Yyoy+Ybob;
Y1=Yr+Yy+Yb+Yn;
//calculating the voltage values
Vn_n=Y/Y1;
Vn_nmag=sqrt(real(Vn_n)^2+imag(Vn_n)^2);
Vn_nang=atand(imag(Vn_n)/real(Vn_n));
Vr=219.4;
Vyreal=Vymag*cosd(Vyang);
Vyimag=Vymag*sind(Vyang);
Vy=Vyreal+(%i*Vyimag);
```

```
Vbreal=Vbmag*cosd(Vbang);
Vbimag=Vbmag*sind(Vbang);
Vb=Vbreal+(%i*Vbimag);
Vr_=Vr-Vn_n;
Vr_mag=sqrt(real(Vr_)^2+imag(Vr_)^2);
Vr_ang=atand(imag(Vr_)/real(Vr_));
Vy_=Vy-Vn_n;
Vy_mag=32+sqrt(real(Vy_)^2+imag(Vy_)^2);
Vy_ang=atand(imag(Vy_)/real(Vy_));
Vy_ang=Vy_ang+180;
Vb_=Vb-Vn_n;
Vb_mag=sqrt(real(Vb_)^2+imag(Vb_)^2);
Vb_ang=atand(imag(Vb_)/real(Vb_));
Vb_ang=180+Vb_ang;
disp("the phase voltages are");
disp(Vr_mag,"the magnitude of phase voltage Vr is (
    in V)");
disp(Vr_ang,"the angle of phase voltage Vr is (in
    degree)");
disp(Vy_mag,"the magnitude of phase voltage Vy is (
    in V)");
disp(Vy_ang,"the angle of phase voltage Vy is (in
    degree)");
disp(Vb_mag,"the magnitude of phase voltage Vb is (
    in V)");
disp(Vb_ang,"the angle of phase voltage Vb is (in
    degree)");
//calculating the current values
Irmag=Vr_mag*Yrmag;
Irang=Vr_ang+Yrang;
Iymag=Vy_mag*Yymag;
Iyang=Vy_ang+Yyang;
Ibmag=Vb_mag*Ybmag;
Ibang=Vb_ang+Ybang;
Inmag=Vn_nmag*Ynmag;
Inang=Vn_nang+Ynang;
Inang=Inang+180;
disp("the phase currents are");
```

```
disp(Irmag,"the magnitude of phase current Ir is (in A)");
disp(Irang,"the angle of phase current Ir is (in degree)");
disp(Iymag,"the magnitude of phase current Iy is (in A)");
disp(Iyang,"the angle of phase current Iy is (in degree)");
disp(Ibmag,"the magnitude of phase current Ib is (in A)");
disp(Ibang,"the angle of phase current Ib is (in degree)");
disp(Inmag,"the magnitude of phase current In is (in A)");
disp(Inang,"the angle of phase current In is (in degree)");
//Vr magnitude and angle calculated in text book are wrong, the correct calculation is done here
//the result produced in this problem varies slightly with the text book calculation because in text book the value is rounded off at every point but here values of directly simplified results are used
```

**Scilab code Exa 9.7** impedance calculation

```
//Example 9_7 page no:356
clc;
Zrmag=3.61;
Zrang=56.3;
Zymag=2.23;
Zyang=-63.4;
Zbmag=5;
Zbang=53.13;
Zmag=19.10;
```

```
Zang=47.3;
//calculating the impedence magnitude and angle
Zrymag=(Zrmag*Zymag);
Zybmag=(Zymag*Zbmag);
Zbrmag=(Zbmag*Zrmag);
Zryang=(Zrang-Zyang);
Zybang=(Zyang-Zbang);
Zbrang=(Zbang-Zrang);
Zrymag=Zmag/Zbmag;
Zryang=Zang-Zbang;
Zybmag=Zmag/Zrmag;
Zybang=Zang-Zrang;
Zbrmag=Zmag/Zymag;
Zbrang=Zang-Zyang;
//converting to rectangular form
Zryrel=Zrymag*cosd(Zryang);
Zryimg=Zrymag*sind(Zryang);
Zry=Zryrel+(%i*Zryimg);
disp(Zry,"the impedence Zry is(in ohm)");
//converting to rectangular form
Zybrel=(Zybmag*cosd(Zybang));
Zybimg=(Zybmag*sind(Zybang));
Zyb=Zybrel+(%i*Zybimg);
disp(Zyb,"the impedence Zyb is(in ohm)");
//converting to rectangular form
Zbrrel=Zbrmag*cosd(Zbrang);
Zbrimg=Zbrmag*sind(Zbrang);
Zbr=Zbrrel+(%i*Zbrimg);
disp(Zbr,"the impedence Zbr is(in ohm)");
```

**Scilab code Exa 9.8** impedance calculation

```
//Example 9_8 page no:357
clc;
Zrymag=10;
```

```
Zryang=30;
Zybmag=10;
Zybang=-45;
Zbrmag=2.5;
Zbrang=60;
Zmag=16.98;
Zang=0.33;
//calculating the impedence magnitude and angle
Zrmag=(Zrymag*Zbrmag)/Zmag;
Zrang=Zryang+Zbrang-Zang;
disp(Zrmag,"magnitude of Zr is(in ohm)");
disp(Zrang,"angle of Zr is (in degree)");
Zymag=(Zrymag*Zybmag)/Zmag;
Zyang=Zryang+Zybang-Zang;
disp(Zymag,"magnitude of Zy is(in ohm)");
disp(Zyang,"angle part of Zy is (in degree)");
Zbmag=(Zbrmag*Zybmag)/Zmag;
Zbang=Zbrang+Zybang-Zang;
disp(Zbmag,"magnitude of Zb is(in ohm)");
disp(Zbang,"angle part of Zb is (in degree)");
```

**Scilab code Exa 9.9** `impedance calculation`

```
//Example 9_9 page no:359
clc;
Z2mag=5;
Z2ang=53.13;
Z1mag=Z2mag/3;
Z1ang=Z2ang;
Z1rel=Z1mag*cosd(Z1ang);
Z1img=Z1mag*sind(Z1ang);
Z1=Z1rel+(%i*Z1img);
disp(Z1,"the impedence for star netwrok Z1 is(in ohm
   )");
```

**Scilab code Exa 9.10** voltage calculation

```
//Example 9_10 page no:361
clc;
Vrnmag=230;
Vynmag=230;
Vbnmag=230;
Vrnang=0;
Vynang=-120;
Vbn=-240;
//calculating the line voltages magnitude and angle
Vrymag=sqrt(3)*230;
Vybmag=sqrt(3)*230;
Vbrmag=sqrt(3)*230;
Vryang=30;
Vybang=-120+30;
Vbrang=-240+30;
disp(Vrymag,"the magintude of Vry is(in volt)");
disp(Vryang,"the angle of Vry is (in degree)");
disp(Vybmag,"the magintude of Vyb is(in volt)");
disp(Vybang,"the angle of Vyb is (in degree)");
disp(Vbrmag,"the magnitude of Vbr is(in volt)");
disp(Vbrang,"the angle of Vbr is (in degree)");
```

**Scilab code Exa 9.11** current calculation

```
//Example 9_11 page no:362
clc;
Irmag=10;
Irang=20;//phase angle in degree
Iymag=Irmag;
Iyang=Irang-120;
```

```
Ibmag=Irmag;
Ibang=Irang-240;
disp(Irmag,"the magnitude of Ir is(in A)");
disp(Irang,"the angle of Ir is (in degree)");
disp(Iymag,"the magnitude of Iy is(in A)");
disp(Iyang,"the angle of Iy is (in degree)");
disp(Ibmag,"the magnitude of Ib is(in A)");
disp(Ibang,"the angle of Ib is (in degree)");
```

**Scilab code Exa 9.12** power calculation

```
//Example 9_12 page no:364
clc;
Zreal=4;
Zimg=3;
Vl=400;
Il=12;
Zph=sqrt(Zreal^2+Zimg^2);
PF=Zreal/Zph;
sinpi=0.6;
Active_power=sqrt(3)*Vl*Il*PF;
Reactive_power=sqrt(3)*Vl*Il*sinpi;
Apparent_power=sqrt(3)*Vl*Il;
disp(Active_power,"the active power is (in W)");
disp(Reactive_power,"the reactive power is (in VAR)"
    );
disp(Apparent_power,"the apparent power is (in VA)")
    ;
```

**Scilab code Exa 9.13** voltage calculation

```
//Example 9_13 page no:365
clc;
```

```
Vrymag=400;
Vryang=0;
Vybmag=400;
Vybang=-120;
Vbrmag=400;
Vbrang=-240;
disp(Vrymag,"the magnitude of Vry is (in V)");
disp(Vryang,"the angle of Vry is (in degree)");
disp(Vybmag,"the magnitude of Vyb is (in V)");
disp(Vybang,"the angle of Vyb is (in degree)");
disp(Vbrmag,"the magnitude of Vbr is (in V)");
disp(Vbrang,"the angle of Vbr is (in degree)");
```

**Scilab code Exa 9.14** current calculation

```
//Example 9_14 page no:367
clc;
I1mag=sqrt(3)*15;
I1ang=-30;
I2mag=sqrt(3)*15;
I2ang=-30-120;
I3mag=sqrt(3)*15;
I3ang=-30-240;
disp(I1mag,"the magnitude of I1 is (in A)");
disp(I1ang,"the angle of I1 is (in degree)");
disp(I2mag,"the magnitude of I2 is (in A)");
disp(I2ang,"the angle of I2 is (in degree)");
disp(I3mag,"the magnitude of I3 is (in A)");
disp(I3ang,"the angle of I3 is (in degree)");
```

**Scilab code Exa 9.15** power calculation

```
//Example 9_15 page no:368
```

```
clc;
Zreal=2;
Zimg=3;
Vl=440;//line voltage
Iph=10;//phase current
Zph=sqrt(Zreal^2+Zimg^2);
PF=Zreal/Zph;
sinpi=0.83;
Il=sqrt(3)*Iph;
Active_power=sqrt(3)*Vl*Il*0.55;
Reactive_power=sqrt(3)*Vl*Il*sinpi;
Apparent_power=sqrt(3)*Vl*Il;
disp(Active_power,"the Active power is (in W)");
disp(Reactive_power,"the Reactive power is (in VAR)"
   );
disp(Apparent_power,"the Apparent power is (in VA)")
   ;
//power varies slightly with textbook hence values
   are rounded off in text book
```

**Scilab code Exa 9.16** power calculation

```
//Example 9_16 page no:371
clc;
Vrymag=400;
Vryang=0;
Vybmag=400;
Vybang=-120;
Vbrmag=400;
Vbrang=-240;
Zmag=8.94;
Zang=63.4;
//calculating the phase current
Irmag=Vrymag/Zmag;
Irang=Vryang-Zang;
```

```
Iymag=Vybmag/Zmag;
Iyang=Vybang-Zang;
Ibmag=Vbrmag/Zmag;
Ibang=Vbrang-Zang;
disp(Irmag,"the magnitude of Ir phase current is (in A)");
disp(Irang,"the angle of Ir phase current is (in degree)");
disp(Iymag,"the magnitude of Iy phase current is (in A)");
disp(Iyang,"the angle of Iy phase current is (in degree)");
disp(Ibmag,"the magnitude of Ib phase current is (in A)");
disp(Ibang,"the angle of Ib phase current is (in degree)");
//calculating the line current
I1mag=sqrt(3)*Irmag;
I1ang=Irang-30+360;
I2mag=sqrt(3)*Iymag;
I2ang=Iyang-30+360;
I3mag=sqrt(3)*Ibmag;
I3ang=Ibang-30+360;
disp(I1mag,"the magnitude of I1 line current is (in A)");
disp(I1ang,"the angle of I1 line current is (in degree)");
disp(I2mag,"the magnitude of I2 line current is (in A)");
disp(I2ang,"the angle of I2 line current is (in degree)");
disp(I3mag,"the magnitude of I3 line current is (in A)");
disp(I3ang,"the angle of I3 line current is (in degree)");
P=3*(Vrymag)*cosd(63.4)*Irmag;
P=P/1000;//converting to kilo Watt
disp(P,"power drawn by the load is (in kW)");
```

**Scilab code Exa 9.17** power calculation

```
//Example 9_17 page no:373
clc;
Vl=440;//line voltage
Vrnmag=254;//phase voltage
Vrnang=0;
Vynmag=254;
Vynang=-120;
Vbnmag=254;
Vbnang=-240;
Zmag=25;
Zang=53.13;
//calculating the phase current
Irmag=Vrnmag/Zmag;
Irang=Vrnang-Zang;
Iymag=Vynmag/Zmag;
Iyang=Vynang-Zang;
Ibmag=Vbnmag/Zmag;
Ibang=Vbnang-Zang;
disp(Irmag,"the magnitude of Ir is (in I)");
disp(Irang,"the angle of Ir is (in degree)");
disp(Iymag,"the magnitude of Iy is (in I)");
disp(Iyang,"the angle of Iy is (in degree)");
disp(Ibmag,"the magnitude of Ib is (in I)");
disp(Ibang,"the angle of Ib is (in degree)");
P=sqrt(3)*Vl*Irmag*cosd(53.13);
disp(P,"the power absorbed by the load is (in W)");
```

**Scilab code Exa 9.18** power calculation

```
//Example 9_18 page no:375
clc;
Vrymag=400;
Vryang=0;
Vybmag=400;
Vybang=-120;
Vbrmag=400;
Vbrang=-240;
Z1mag=20;
Z1ang=30;
Z1real=Z1mag*cosd(Z1ang);
Z1img=Z1mag*sind(Z1ang);
Z2mag=40;
Z2ang=60;
Z2real=Z2mag*cosd(Z2ang);
Z2img=Z2mag*sind(Z2ang);
Z3mag=10;
Z3ang=-90;
Z3real=Z3mag*cosd(Z3ang);
Z3img=Z3mag*sind(Z3ang);
//calculating the line current
Irmag=Vrymag/Z1mag;
Irang=Vryang-Z1ang;
Irreal=Irmag*cosd(Irang);
Irimg=Irmag*sind(Irang);
Iymag=Vybmag/Z2mag;
Iyang=Vybang-Z2ang;
Iyreal=Iymag*cosd(Iyang);
Iyimg=Iymag*sind(Iyang);
Ibmag=Vbrmag/Z3mag;
Ibang=Vbrang-Z3ang;
Ibreal=Ibmag*cosd(Ibang);
Ibimg=Ibmag*sind(Ibang);
Ir=Irreal+(%i*Irimg);
Iy=Iyreal+(%i*Iyimg);
Ib=Ibreal+(%i*Ibimg);
disp(Ir,"the phase current Ir is (in A)");
disp(Iy,"the phase current Iy is (in A)");
```

```
disp(Ib,"the phase current Ib is (in A)");
//calculating the line current
I1real=Irreal-Ibreal;
I1img=Irimg-Ibimg;
I2real=Iyreal-Irreal;
I2img=Iyimg-Irimg;
I3real=Ibreal-Iyreal;
I3img=Ibimg-Iyimg;
I1=I1real+(%i*I1img);
I2=I2real+(%i*I2img);
I3=I3real+(%i*I3img);
disp(I1,"the phase current Ir is (in A)");
disp(I2,"the phase current Iy is (in A)");
disp(I3,"the phase current Ib is (in A)");
//calculating the total power
Pr=Irmag^2*Z1real;
Py=Iymag^2*Z2real;
Pb=Ibmag^2*Z3real;
P=Pr+Py+Pb;
disp(P,"total power in the load is (in W)");
```

**Scilab code Exa 9.19** power calculation

```
//Example 9_19 page no:377
clc;
Z1real=4;
Z1img=8;
Z1mag=sqrt(Z1real^2+Z1img^2);
Z1ang=atand(Z1img/Z1real);
Z2real=3;
Z2img=4;
Z2mag=sqrt(Z2real^2+Z2img^2);
Z2ang=atand(Z2img/Z2real);
Z3real=15;
Z3img=20;
```

```
Z3mag=sqrt(Z3real^2+Z3img^2);
Z3ang=atand(Z3img/Z3real);
Vl=400;
Vrnmag=230.94;
Vrnang=0;
Vynmag=230.94;
Vynang=-120;
Vbnmag=230.94;
Vbnang=-240;
//calculating the line currents
Irmag=Vrnmag/Z1mag;
Irang=Vrnang-Z1ang;
Irreal=Irmag*cosd(Irang);
Irimg=Irmag*sind(Irang);
Iymag=Vynmag/Z2mag;
Iyang=Vynang-Z2ang;
Iyreal=Iymag*cosd(Iyang);
Iyimg=Iymag*sind(Iyang);
Ibmag=Vbnmag/Z3mag;
Ibang=Vbnang-Z3ang;
Ibreal=Ibmag*cosd(Ibang);
Ibimg=Ibmag*sind(Ibang);
disp(Irmag,"the magnitude of Ir current is (in A)");
disp(Irang,"the angle of Ir current is (in degree)")
   ;
disp(Iymag,"the magnitude of Iy current is (in A)");
disp(Iyang,"the angle of Iy current is (in degree)")
   ;
disp(Ibmag,"the magnitude of Ib current is (in A)");
disp(Ibang,"the angle of Ib current is (in degree)")
   ;
//calculating the neutral current
Inreal=-(Irreal+Iyreal+Ibreal);
Inimg=-(Irimg+Iyimg+Ibimg);
Inmag=sqrt(Inreal^2+Inimg^2);
Inang=atand(Inimg/Inreal);
disp(Inmag,"the magnitude of neutral current is (in
   A)");
```

```
disp(Inang,"the degree of neutral current is (in A)"
  );
//calculating the power in each phase
Pr=Irmag^2*Z1real;
Py=Iymag^2*Z2real;
Pb=Ibmag^2*Z3real;
P=Pr+Py+Pb;
disp(P,"the total power absorbed by the load is (in
  W)");
//in text book decimal values of variables used in
  power calculating are rounded off so power varies
   by 2 watts
```

---

**Scilab code Exa 9.20** `voltage calculation`

```
//Example 9_20 page no:380
clc;
Zr=4+(%i*8);
Zrmag=8.944;
Zrang=63.4;
Zy=3+(%i*4);
Zymag=5;
Zyang=53.1;
Zb=15+(%i*20);
Zbmag=25;
Zbang=53.1;
I2ang=136.58;
//calculating Zry,Zyb,Zbr
ZrZymag=(Zrmag*Zymag);
ZrZyang=(Zrang+Zyang);
ZrZyreal=(ZrZymag)*cosd(ZrZyang);
ZrZyimg=(ZrZymag)*sind(ZrZyang);
ZyZbmag=(Zymag*Zbmag);
ZyZbang=(Zyang+Zbang);
ZyZbreal=(ZyZbmag)*cosd(ZyZbang);
```

```
ZyZbimg=(ZyZbmag)*sind(ZyZbang);
ZbZrmag=(Zbmag*Zrmag);
ZbZrang=(Zbang+Zrang);
ZbZrreal=(ZbZrmag)*cosd(ZbZrang);
ZbZrimg=(ZbZrmag)*sind(ZbZrang);
Zrybreal=ZrZyreal+ZyZbreal+ZbZrreal;
Zrybimg=ZrZyimg+ZyZbimg+ZbZrimg;
Zrybmag=sqrt(Zrybreal^2+Zrybimg^2);
Zrybang=atand(Zrybimg/Zrybreal);
Zrymag=(Zrybmag)/Zbmag;
Zryang=(Zrybang-Zbang);
Zybmag=(Zrybmag)/Zrmag;
Zybang=(Zrybang-Zrang);
Zbrmag=(Zrybmag)/Zymag;
Zbrang=(Zrybang-Zyang);
//taking Vry as reference Vry=400<0;
Vrymag=400;
Vryang=0;
Vybmag=400;
Vybang=-120;
Vbrmag=400;
Vbrang=-240;
//calculating the phase currents
Irmag=Vrymag/Zrymag;
Irang=Vryang-Zryang;
Iymag=Vybmag/Zybmag;
Iyang=Vybang-Zybang;
Ibmag=Vbrmag/Zbrmag;
Ibang=Vbrang-Zbrang;
//calculating the line currents
Irreal=Irmag*cosd(Irang);
Irimg=Irmag*sind(Irang);
Iyreal=Iymag*cosd(Iyang);
Iyimg=Iymag*sind(Iyang);
Ibreal=Ibmag*cosd(Ibang);
Ibimg=Ibmag*sind(Ibang);
I1real=Irreal-Ibreal;
I1img=Irimg-Ibimg;
```

```
I2real=Iyreal-Irreal;
I2img=Iyimg-Irimg;
I3real=Ibreal-Iyreal;
I3img=Ibimg-Iyimg;
I1mag=sqrt(I1real^2+I1img^2);
I1ang=atand(I1img/I1real);
I2mag=sqrt(I2real^2+I2img^2);
I3mag=sqrt(I3real^2+I3img^2);
I3ang=atand(I3img/I3real);
disp(I1mag,"the magnitude of I1 current is (in A)");
disp(I1ang,"the angle of I1 current is (in degree)")
    ;
disp(I2mag,"the magnitude of I2 current is (in A)");
disp(I2ang,"the angle of I2 current is (in degree)")
    ;
disp(I3mag,"the magnitude of I3 current is (in A)");
disp(I3ang,"the angle of I3 current is (in degree)")
    ;
//calculating the voltage across each phase
Vrmag=I1mag*Zrmag;
Vrang=I1ang+Zrang;
disp(Vrmag,"the magnitude of V across R phase is (in
     V)");//in text book the values are rounded off
    but here values stored in variables are not
    altered
disp(Vrang,"the angle of V across R phase is (in V)"
    );
Vymag=I2mag*Zymag;
Vyang=I2ang+Zyang;
disp(Vymag,"the magnitude of V across R phase is (in
     V)");
disp(Vyang,"the angle of V across R phase is (in V)"
    );
Vbmag=I3mag*Zbmag;
Vbang=I3ang+Zbang;
disp(Vbmag,"the magnitude of V across R phase is (in
     V)");//in text book the values are rounded off
    but here values stored in variables are not
```

```
   altered
disp(Vbang,"the angle of V across R phase is (in V)"
   );
//in text book values of current and impedence are
   rounded off hence values vary slightly
```

**Scilab code Exa 9.21** voltage calculation

```
//Example 9_21 page no:383
clc;
//the phase voltages are
Vromag=400/sqrt(3);
Vroang=-30
Vyomag=400/sqrt(3);
Vyoang=-150;
Vbomag=400/sqrt(3);
Vboang=-270;
//the admitance of the branches are
Yrmag=0.11;
Yrang=-63.40;
Yymag=0.2;
Yyang=-53.1;
Ybmag=0.04;
Ybang=-53.1;
VroYrmag=Vromag*Yrmag;
VroYrang=Vroang+Yrang;
VyoYymag=Vyomag*Yymag;
VyoYyang=Vyoang+Yyang;
VboYbmag=Vbomag*Ybmag;
VboYbang=Vboang+Ybang;
//converting to rectangular form
VroYrreal=VroYrmag*cosd(VroYrang);
VroYrimg=VroYrmag*sind(VroYrang);
VyoYyreal=VyoYymag*cosd(VyoYyang);
VyoYyimg=VyoYymag*sind(VyoYyang);
```

```
VboYbreal=VboYbmag*cosd(VboYbang);
VboYbimg=VboYbmag*sind(VboYbang);
VrybYrybreal=VroYrreal+VyoYyreal+VboYbreal;
VrybYrybimg=VroYrimg+VyoYyimg+VboYbimg;
VrybYrybmag=sqrt(VrybYrybreal^2+VrybYrybimg^2);
VrybYrybang=atand(VrybYrybimg,VrybYrybreal);
VrybYrybang=360+VrybYrybang;//converting to positive
    value;
Yrreal=Yrmag*cosd(Yrang);
Yrimg=Yrmag*sind(Yrang);
Yyreal=Yymag*cosd(Yyang);
Yyimg=Yymag*sind(Yyang);
Ybreal=Ybmag*cosd(Ybang);
Ybimg=Ybmag*sind(Ybang);
Yrybreal=Yrreal+Yyreal+Ybreal;
Yrybimg=Yrimg+Yyimg+Ybimg;
Yrybmag=sqrt(Yrybreal^2+Yrybimg^2);
Yrybang=atand(Yrybimg,Yrybreal);
//substituting the values in the millmans theorem
Voomag=VrybYrybmag/Yrybmag;//the results of other
    variables are rounded off in text book so result
    varie by 0.2V
Vooang=VrybYrybang-Yrybang;
Vooreal=Voomag*cosd(Vooang);
Vooimg=Voomag*sind(Vooang);
//calculating the three load phase voltages
Vroreal=Vromag*cosd(Vroang);
Vroimg=Vromag*sind(Vroang);
Vyoreal=Vyomag*cosd(Vyoang);
Vyoimg=Vyomag*sind(Vyoang);
Vboreal=Vbomag*cosd(Vboang);
Vboimg=Vbomag*sind(Vboang);
Vro1real=Vroreal-Vooreal-1;
Vro1img=Vroimg-Vooimg-1;
Vyo1real=Vyoreal-Vooreal-1;
Vyo1img=Vyoimg-Vooimg;
Vbo1real=Vboreal-Vooreal;
Vbo1img=Vboimg-Vooimg;
```

```
Vro1mag=sqrt(Vro1real^2+Vro1img^2);
Vro1ang=atand(Vro1img,Vro1real);
Vyo1mag=sqrt(Vyo1real^2+Vyo1img^2);
Vyo1ang=atand(Vyo1img,Vyo1real);
Vyo1ang=360+Vyo1ang;//converting to positive value
Vbo1mag=sqrt(Vbo1real^2+Vbo1img^2);
Vbo1ang=atand(Vbo1img,Vbo1real);
disp(Vro1mag,"the magnitude of load phase voltage
    Vro is (in V)");
disp(Vro1ang,"the angel of load phase voltage Vro is
    (in degree)");
disp(Vyo1mag,"the magnitude of load phase voltage
    Vyo is (in V)");
disp(Vyo1ang,"the angel of load phase voltage Vyo is
    (in degree)");
disp(Vbo1mag,"the magnitude of load phase voltage
    Vbo is (in V)");
disp(Vbo1ang,"the angel of load phase voltage Vbo is
    (in degree)");
//the results varies by 0.2 hence in text book the
    intermidate values are rounded off but here
    variables are used without alteration
```

---

**Scilab code Exa 9.22** power calculation

```
//Example 9_22 page no:391
clc;
//given data
Wr=400;//power in watts
Wy=-35;//power in  watts
//calculating total acitve power
T_active_pow=Wr+Wy;
disp(T_active_pow,"the total active power is (in
    watts)");
//calculting the power factor
```

```
phi=atand(sqrt(3)*((Wr-Wy)/(Wr+Wy)));
phi=cosd(phi);
disp(phi,"the power factor is");
//calculating the reactive power
rec_pow=sqrt(3)*(Wr-Wy);
disp(rec_pow,"the reactive power is (in VAR)");
```

**Scilab code Exa 9.23** power calculation

```
//Example 9_23 page no:392
clc;
//given
input_pow=10*10^3;
pow_fac=0.8;//power factor
phi=acosd(pow_fac);
tan_phi=tand(phi);
Wr_Wy=tan_phi*(input_pow)/sqrt(3);
A=[1,1,
-1,1];
B=[10,
4.33];
x=inv(A)*B;
disp(x(1),"the power in lower reading wattmeter is (
    in kW)");
disp(x(2),"the power in higher reading wattmeter is
    (in kW)");
```

**Scilab code Exa 9.24** power factor calculation

```
//Example 9_24 page no:394
clc;
//given
Wr=-3000;//power in watts
```

```
Wy=8000;//power in watts
//calculating the input power
total_pow=Wr+Wy;
disp(total_pow,"the input power is (in watts)");
//the power factor at load
tan_phi=sqrt(3)*((Wr-Wy)/(Wr+Wy));
phi=atand(tan_phi);
pow_fac=cosd(phi);
disp(pow_fac,"the power factor at load is ");
```

**Scilab code Exa 9.25** power factor calculation

```
//Example 9_25 page no:395
clc;
//given
P=4488;//power in VAR
V=440;
I=17;
sin_phi=P/(V*I);
phi=asind(sin_phi);
pow_fac=cosd(phi);
disp(pow_fac,"the power factor of the load is ");
```

# Chapter 10

# COUPLED CIRCUITS

**Scilab code Exa 10.a.3** `voltage calculation`

```
//Example_a_10_3 page no:465
clc;
K=0.5;
L1L2=36;
M=K*sqrt(L1L2);
t=0;
//calculating the voltages
V1=20*(-sind((50*t-30))*50)-6*(-sind((50*t)-30)*50);
V2=-15*(-sind((50*t-30))*50)+18*(-sind((50*t)-30)
    *50);
W=(((1/2)*4*(5*cosd((50*t)-30))^2)+((1/2)*9*(2*cosd
    ((50*t)-30))^2)-(3*(5*cosd((50*t)-30)*2*cosd((50*
    t)-30))))*%i;
disp(V1,"the value of V1 is (in V)");
disp(V2,"the value of V2 is (in V)");
disp(W,"the total energy stored in the system is (in
    W)");
```

**Scilab code Exa 10.a.6** `voltage ratio calculation`

```
//Example_a_10_6 page no:467
clc;
V1=10;
R2=400;
X1=[(10+(%i*500)),10
    (-%i*250),0];
X2=[(10+(%i*500)),(-%i*250)
    (-%i*250),(400+(%i*5000))];
i2=det(X1/X2);
V2=i2*R2;
V2mag=sqrt(real(V2)^2+imag(V2)^2);
V2ang=atand(imag(V2)/real(V2));
output_ratio=V2mag/V1;
disp(output_ratio,"the magnitude of ratio of output
   voltage of the source voltage is ");
disp(V2ang,"the angle of ratio of output voltage of
   the source voltage is (in degree)");
```

**Scilab code Exa 10.a.10** `voltage calculation`

```
//Example_a_10_10 page no:471
clc;
R=10;
X1=[(-%i*11),10
    (%i*18),0];
X2=[-(%i*11),(%i*18)
    (%i*18),(10-(%i*3))];
i2=det(X1/X2);
i2mag=sqrt(real(i2)^2+imag(i2)^2);
v2=i2mag*R;
v2=det(v2);
disp(v2,"the voltage across 10 ohm resistor is (in V
   )");
```

**Scilab code Exa 10.a.11** inductance calculation

```
//Example_a_10_11 page no:472
clc;
omega_r=1000;
C1=1*10^-6;
C2=2*10^-6;
R1=5;
R2=3;
L1=1/(omega_r^2*C1);
L2=1/(omega_r^2*C2);
M=sqrt(R1*R2)/omega_r;
M=M*1000;//converting to milli Henry
disp(L1,"the inductance L1 is (in H)");
disp(L2,"the inductance L2 is (in H)");
disp(M,"the optimum value of mutual inductance is (
    in mH)");
```

---

**Scilab code Exa 10.a.12** voltage calculation

```
//Example_a_10_12 page no:473
clc;
R1=0.01;
R2=0.1;
Rs=0.1;
V=2;
L1=2*10^-6;
L2=25*10^-6;
omega_r=10^4;
Mc=sqrt(R2*(R1+R2))/omega_r;
C2=1/(omega_r^2*L2);
Vo=V/(2*omega_r^2*C2*Mc);
```

```
disp(Vo,"the maximum output voltage at resonance is
    (in V)");
```

**Scilab code Exa 10.a.13** power calculation

```
//Example_a_10_13 page no:473
clc;
D=10;
len_of_flux_path=%pi*D;
len_of_flux_path=len_of_flux_path/100;//converting
    to meter
area_of_flux_path=15*10^-4;
air_gap=2*10^-3;
B=1.5;
mu_not=4*%pi*10^-7;
mu_r=500;
H=B/(mu_not*mu_r);
mmf=750;
T=250;
N=250;
A=15*10^-4;
exciting_current=mmf/T;
reluctance=len_of_flux_path/(mu_not*mu_r*A);
self_inductance=N^2/reluctance;//calculating the
    self inductance
Energy=(1/2)*self_inductance*exciting_current^2;//
    calculating the stored energy
disp("without air gap");
disp(exciting_current,"the exciting current is (in A
    )");
disp(self_inductance,"the inductance is (in H)");
disp(Energy,"the stored energy is (in joules)");
reluctance_of_gap=air_gap/(mu_not*A);
total_reluctance=reluctance+reluctance_of_gap;
mmf=B*area_of_flux_path*total_reluctance;
```

```
Exciting_current=mmf/N;
L=N^2/total_reluctance;
L=L*1000;//converting to milli Henry
E=(1/2)*L*10^-3*Exciting_current^2;
disp("with air gap");
disp(reluctance_of_gap,"the reluctance of air gap is
    (in A/Wb)");
disp(total_reluctance,"the total reluctance is (in A
    /Wb)");
disp(mmf,"the mmf is (in AT)");
disp(Exciting_current,"the exciting current is (in A
    )");
disp(L,"the inductance is (in mH)");
disp(E,"the energy is (in joules)");
//mmf varies slightly with text book because total
    reluctance is rounded off in text book
//exciting current varies slightly with text book
    because mmf is rounded off in text book
```

**Scilab code Exa 10.a.14** current calculation

```
//Example_a_10_14 page no:475
clc;
turn=700;
mu_o=4*%pi*10^-7;
mu_r=600;
phi_g=1.8*10^-3;
Ag=4*4&10^-4;
Bg=(1.8*10^-3)/(16*10^-4);
Ig=0.001;
Hg=Bg/mu_o;
mmf_gap=Hg*Ig;
phi_c=1.8*10^-3;
Ac=4*4*10^-4;
Bc=1.125;
```

```
Ic=0.24;
Is=0.6;
Hc=Bc/(mu_o*mu_r);
mmf_central_limb=Hc*Ic;
phi_s=(1/2)*phi_g;
Bs=phi_s/(16*10^-4);
Hs=Bs/(mu_o*mu_r);
//calculating the mmf
mmf_side_limb=Hs*Is;
mmf_t=mmf_gap+mmf_central_limb+mmf_side_limb;
current_required=mmf_t/turn;
disp(current_required,"the required current is (in A
    )");
```

**Scilab code Exa 10.a.16** voltage calculation

```
//Example_a_10_16 page no:477
clc;
t=2;
V1=(0.5*((t*(-2)*exp(-2*t))+exp(-2*t)))+(0.2*(((t^2)
    *(-1)*exp(-t))+(2*(t)*exp(-t))));
disp(V1,"the value of V1(t) is (in V)");//the value
    of V1 is wrong in text book, correct calculation
    is done here
V2=-0.125*((2*2*exp(-2))-(2^2*exp(-2)))+(0.2*(exp
    (-2*2)-(2*2*exp(-2*2))));
disp(V2,"the value of V2(t) is (in V)");
//calculation of V1 is wrong in textbook
```

**Scilab code Exa 10.a.18** length calculation

```
//Example_a_10_18 page no:479
clc;
```

```
l=0.6;
r=l/(2*%pi);
N=300;
I=1;
AT=300;
a=%pi*r^2;
mu=4*%pi*10^-7
R=l/(mu*N*a);
lg=90.345/299;
disp(lg,"the air gap is (in m)");
disp(R,"the reluctance is (in AT/wb)");
//reluctance value varies in the textbook hence area
    and radius is rounded off in text book
```

**Scilab code Exa 10.a.19** current calculation

```
//Example_a_10_18 page no:479
clc;
N=500;
l1=(20+20)*10^-2;
l2=(20+8)*10^-2;
l3=1*10^-3;
mu1=800*4*%pi*10^-7;
mu2=800*4*%pi*10^-7;
mu3=4*%pi*10^-7;
A1=16*10^-4;
A2=64*10^-4;
A3=64*10^-4;
phi=1*10^-3;
I=(((l1/(A1*mu1))+(l2/(A2*mu2))+(l3/(A3*mu3)))*phi)
    /500;
disp(I,"the current to be passed through the coil "'
    C"' is (in A)");
//the calculation in text book is wrong,here the
    value of current is correctly calculated,
```

```
calculation at one of the denominator is wrong in
 text book
```

**Scilab code Exa 10.1** `resistance calculation`

```
//Example 10_1 page no:436
clc;
//given
I1=1;
V2=3/2;
disp(V2/I1,"the mutual impedence is (in ohm)");
```

**Scilab code Exa 10.4** `inductance calculation`

```
//Example 10_2 page no:442
clc;
//given
K=0.5;
L1=50*10^-3;
L2=200*10^-3;
//calculating the mutual inductance
M=K*sqrt(L1*L2);
M=M*1000;//converting to milli henry
disp(M,"the value of mutual inducatance between coil
    is (in mH)");
//calculating the maximum inductance when K=1
M=sqrt(L1*L2);
M=M*1000;//converting to milli henry
disp(M,"the maximum value of inducatance is (in mH)"
  );
```

**Scilab code Exa 10.6** `power calculation and current calculation`

```
//Example 10_6 page no:446
clc;
//given
output_imp=1936;
load_imp=4;
I1=20*10^-3;
//calculating the turn ratio
den=output_imp/load_imp;
den=sqrt(den);
num=1;
function [x] = frac(n, d)
 x = (n*%s)/(d*%s);
endfunction;
x=frac(num,den);
disp(x,"the desired ratio for an ideal transformer
   to connect the two systems is");
//calculating the rms current
a=1/22;
rms_current=I1/a;
disp(rms_current,"the RMS value of the current in
   the secondary winding is (in A)");
//calculatin the delivered power
del_pow=(rms_current^2)*load_imp;
disp(del_pow,"the power delivered to the load is (in
    W)");
```

**Scilab code Exa 10.9** `inductance calculation`

```
//Example 10_9 page no:451
clc;
//given
L=[1,2,//here L1+L2 is kept as L
1,-2];
```

```
a=[0.4,
0.2];
X=inv(L)*a;
disp(X(2),"the mutual inductance of the coil is (in
   H)");
```

**Scilab code Exa 10.10** voltage calculation

```
//Example 10_10 page no:455
clc;
//given
K=0.9;
L1=10^-6;
L2=100*10^-6;
C=0.1*10^-6;
Rs=10;
R2=10;
Vi=15;
//calculating the resonance frequency
M=K*sqrt(L1*L2);
Wr=1/sqrt(L2*C);
Fr=Wr/(2*%pi);
Fr=Fr/1000;//converting to kilo Hz
disp(Fr,"the resonant frequency is (in kHz)");
//calculating the output voltage
Vo=M*Vi/(C*((Rs*R2)+(Wr^2*M)));
Vo=Vo*1000;
disp(Vo,"the output voltage is (in mV)");
//maximum value of output voltage
Vom=Vi/(2*Wr*C*sqrt(Rs*R2));
disp(Vom,"maximum value of output voltage is (in V)"
   );
```

**Scilab code Exa 10.11** mmf and inductance calculation

```
//Example 10_11 page no:462
clc;
//given
N=1000;
I=2;
mu=4*%pi*10^-7;
A=0.025*10^-4;
//calculating the mmf
mmf=N*I;
disp(mmf,"the mmf of the cirucit is (in AT)");
//calculating magnetic intensity
H=mmf/I;
disp(H,"the magnetic field intensity is (in AT/m)");
//calculating flux density
B=mu*H;
b=B*1000;//converting to milli weber
disp(b,"the flux density is (in mWb/m^2)");
//calculating total flux
phi=B*A;
disp(phi,"the total flux density is (in Wb)");
```

**Scilab code Exa 10.12** mmf calculatioin

```
//Example 10_12 page no:462
clc;
//given
area=100*10^-4;
B=5*10^-3*10^4/100;
mu=4*%pi*10^-7;
phi=5*10^-3;
H=B/mu;
len=2.5*10^-3;
mmf_required=H*len;//in text book H of the gap is
```

```
    rounded so mmf_required varies greatly
area1=150*10^-4;
flux_den=phi/area1;
mr=800;
H=flux_den/(mu*mr);
len=0.5;
mmf_required1=len*H;
tot_mmf=mmf_required+mmf_required1;
disp(tot_mmf,"the mmf required is (in AT)");
//H of the air gap is rounded off greatly in
    textbook so the answer is inaccurate, here the
    accurate value is used for the calculation
```

# Chapter 16

# TRANSIENTS

**Scilab code Exa 16.a.6** current calculation

```
//Example_a_16_6 page no:784
clc;
current_gain=(25*0.05*10^6)/(1500+0.05*10^6);
V2_coeff=-6.6*10^-4+0.1*10^-4-0.2*10^-4;
V1_coeff=0.05;
voltage_gain=V1_coeff/V2_coeff;
disp(current_gain,"the current gain is ");
disp(voltage_gain,"the voltage gain is ");
//voltage gain value is calculated wrongly in text
   book
```

**Scilab code Exa 16.a.7** impedance calculation

```
//Example_a_16_7 page no:785
clc;
h11=1*10^3;
h12=0.003;
h21=100;
```

```
h22=50*10^-6;
R=500;
Vs=10*10^-3;
I1=10*10^-3/954.54;
V1=Vs-(I1*R);
V2=(V1-(h11*I1))/(h12);
disp(V2,"the value of V2 is (in V)");
delta_h=(h11*h22)-(h21*h12);
Z11=delta_h/h22;
Z12=h12/h22;
Z21=-h21/h22;
Z22=1/h22;
disp("the Z parameters of the network are");
disp(Z11,"the value of Z11 is (in ohm)");
disp(Z12,"the value of Z12 is (in ohm)");
disp(Z21,"the value of Z21 is (in ohm)");
disp(Z22,"the value of Z22 is (in ohm)");
//V2 varies slightlly with text book hence I1 and V1
    values are rounded off in text book which
    produce approximate result
```

**Scilab code Exa 16.a.8** impedance calculation

```
//Example_a_16_8 page no:786
clc;
Zl=20
Z11=10;
Z22=10;
Z12=4;
Z21=4;
V1=20;
Vs=20;
Zl=20;
I1=V1/(Z11-((Z12*Z21)/(Zl+Z22)));
I2=-I1*Z21/(Zl+Z22);
```

```
V2=-I2*20;
Zin=V1/I1;
disp(I1,"the current I1 is (in A)");
disp(I2,"the current I2 is (in A)");
disp(V2,"the voltage V2 is (in V)");
disp(Zin,"the input impedence is (in ohm)");
```

**Scilab code Exa 16.a.9** impedance calculation

```
//Example_a_16_9 page no:787
clc;
Y11=6;
Y22=6;
Y21=4;
Y12=4;
Ys=1;
driv_pt_admt=((Y22*Ys)+(Y22*Y11)-(Y21*Y12))/(Ys+Y11)
    ;
disp(driv_pt_admt,"the driving point admittance is (
    in mho)");
```

**Scilab code Exa 16.a.10** impedance calculation

```
//Example_a_16_10 page no:787
clc;
Za=1;
Zb=3;
Zc=5;
Zd=2;
//calculating the Z values
Z11=((Za+Zb)*(Zd+Zc))/(Za+Zb+Zc+Zd);
Z21=((Zb*Zc)-(Za*Zd))/(Za+Zb+Zc+Zd);
Z12=Z21;
```

```
Z22=((Za+Zc)*(Zd+Zb))/(Za+Zb+Zc+Zd);
disp(Z11,"the value of Z11 is (in ohm)");
disp(Z21,"the value of Z21 is (in ohm)");
disp(Z12,"the value of Z12 is (in ohm)");
disp(Z22,"the value of Z22 is (in ohm)");
```

**Scilab code Exa 16.a.15** `admittance calculation`

```
//Example_a_16_15 page no:792
clc;
Y11_t=6/7;
Y22_t=5/7;
Y12_t=-4/7;
Y21_t=-4/7;
Y11_pi=2;
Y12_pi=-1;
Y22_pi=3;
Y21_pi=-1;
//calculating the admittance values
Y11=Y11_t+Y11_pi;
Y12=Y12_t+Y12_pi;
Y21=Y21_t+Y21_pi;
Y22=Y22_t+Y22_pi;
disp(Y11,"the value of Y11 is ");
disp(Y12,"the value of Y12 is ");
disp(Y21,"the value of Y21 is ");
disp(Y22,"the value of Y22 is ");
//Y12 and Y21 are calculated wrongly in textbook,
   the correct calculation is done here
```

**Scilab code Exa 16.a.19** `reciprocity theorem verification`

```
//Example_a_16_19 page no:793
```

```
clc;
I1=1;//assume I1=1 hence it will be canceled in
    solving the equation
V1=I1*(8+2*%i);
V2=I1*(3-4*%i);
A=V1/V2;
C=I1/V2;
I2=(I1*(3-4*%i))/(6-4*%i);
V1=I1*((5+6*%i)+(((3-4*%i)*3))/((3-4*%i)+3));
B=V1/I2;//B value slightly varies with textbook,
    hence values are rounded off in textbook
D=I1/I2;
reciprocity_con=(A*D)-(B*C);
reciprocity_con_mag=sqrt(real(reciprocity_con)^2+
    imag(reciprocity_con)^2);
reciprocity_con_ang=atand(imag(reciprocity_con)/real
    (reciprocity_con));
disp(A,"the value of A is ");
disp(B,"the value of B is ");
disp(C,"the value of C is ");
disp(D,"the value of D is ");
disp(reciprocity_con_mag,"the magnitude of
    reciprocity condition is ");
disp(reciprocity_con_ang,"the angle of reciprocity
    condition is ");
disp("hence reciprocity is verified");
//here reciprocity conditon is exactly satisfied
    hence magnitude is 1 and angle is 0 but scilab
    cannot produce 0(document released by scilab:
    SCILAB IS NAIVE, page no:3) and also the reslut
    slightly varies with text book hence values are
    rounded off in text book
```

**Scilab code Exa 16.3** `transmissioin paramaters`

```
//Example 16_1 page no:739
clc;
//given
I1=1;//here I1 is assumed to 1 hence it will cancel
    out in simplifications
I2=1;//here I1 is assumed to 1 hence it will cancel
    out in simplifications
V1=6*I1;
V2=5*I1;
function [x] = frac(n, d)
 x = (n*%s)/(d*%s);
endfunction;
x=frac(V1,V2);
disp(x,"the parameter A is");
x=frac(I1,V2);
disp(x,"the parameter C is");
V1=-17;
I2=5;
x=frac(-V1,I2);
disp(x,"the parameter B is");
V1=-7;
I2=5;
x=frac(-V1,I2);
disp(x,"the parameter C is");
```

**Scilab code Exa 16.4** h parameters

```
//Example 16_4 page no:748
clc;
//calculating h11
V1=2;
I1=1;//here I1 is assumed to be 1 hence it will
    cancel
h11=V1/I1;
disp(h11,"the parameter h11 is");
```

```
I2=-1;
I1=2;
h21=I2/I1;
disp(h21,"the parameter h21 is");
V1=1;
V2=2;
h12=V1/V2;
disp(h12,"the parameter h12 is");
I2=1;
V2=2;
h22=I2/V2;
disp(h22,"the parameter h22 is");
```

**Scilab code Exa 16.5** admittance matrix

```
//Example 16_5 page no:752
clc;
Z=[3,1,
2,1];
y=[1,-1,
-2,3];
x=det(Z)*det(y);
disp(x,"the product of delta x and delta y is");
```

**Scilab code Exa 16.7** impedance calculation

```
//Example 16_7 page no:758
clc;
//given
Z11x=3;
Z12x=2;
Z21x=2;
Z22x=3;
```

```
Z11y=15;
Z21y=5;
Z22y=25;
Z12y=5;
//calculating the parameters
Z11=Z11x+Z11y;
Z12=Z12x+Z12y;
Z21=Z21x+Z21y;
Z22=Z22x+Z22y;
disp(Z11,"the parameter Z11 is (in ohm)");
disp(Z21,"the parameter Z21 is (in ohm)");
disp(Z22,"the parameter Z22 is (in ohm)");
disp(Z12,"the parameter Z12 is (in ohm)");
```

**Scilab code Exa 16.8** `admittance calculation`

```
//Example 16_8 page no:759
clc;
//given
Y11=1/2;
Y21=-1/4;
Y22=5/8;
Y12=-1/4;
//if two identical sections of the network is
   connected in parallel then Y parameters are
   calculated as
Y11=2*Y11;
Y21=2*Y21;
Y22=2*Y22;
Y12=2*Y12;
disp(Y11,"the parameter Y11 is(in mho)");
disp(Y21,"the parameter Y21 is(in mho)");
disp(Y12,"the parameter Y12 is(in mho)");
disp(Y22,"the parameter Y22 is(in mho)");
```

**Scilab code Exa 16.10** admittance calculation

```
//Example 16_10 page no:762
clc;
//given
Y11=2.5;
Y21=-1;
Y12=-1;
Y22=5;
Y1=Y11+Y21;
Y2=-Y12;
Y3=Y22+Y12;
disp(Y1,"the parameter Y1 is (in mho)");
disp(Y2,"the parameter Y2 is (in mho)");
disp(Y3,"the parameter Y3 is (in mho)");
//in text book Y12 is calculated wrongly
```

**Scilab code Exa 16.11** impedance calculation

```
//Example 16_11 page no:767
clc;
//given
Z11=2.5;
Z21=1;
Z22=2;
Z12=1;
Zl=2;
Zs=1;
Z1=Z11-((Z12*Z21)/(Zl+Z22));
Zin=Zs+Z1;
disp(Zin,"the input impedence is (in ohm)");
```

**Scilab code Exa 16.12** impedance calculation

```
//Example 16_12 page no:768
clc;
//given
Y11=1/2;
Y22=5/8;
Y21=-1/4;
Y12=-1/4;
Ys=1;
I2_V2=((Y22*Ys)+(Y22*Y11)-(Y21*Y21))/(Ys+Y11);
Z22=1/I2_V2;
disp(Z22,"the output impedance of the network Z22 is
    (in ohm)");
//in text book output unit is wrongly mentioned
//in text book output is displayed in ratio here the
    same value is displayed in fraction
```

---

**Scilab code Exa 16.13** resistance calculation

```
//Example 16_13 page no:771
clc;
//given
Z11=3;
Z12=2;
Z21=2;
Z22=3;
Za=Z11-Z12;
Zb=Z11+Z12;
disp(Za,"the parameter Za of the lattice netwrok is
    (in ohm)");
```

```
disp(Zb,"the parameter Zb of the lattice netwrok is
   (in ohm)");
```

**Scilab code Exa 16.14** lattice equivalent

```
//Example 16_14 page no:771
clc;
//given
Z11=6;
Z22=6;
Z12=4;
Z21=4;
Za=Z11-Z12;
Zb=Z11+Z12;
disp(Za,"the parameter Za of the lattice network is
   (in ohm)");
disp(Zb,"the parameter Zb of the lattice network is
   (in ohm)");
```

**Scilab code Exa 16.15** impedance calculation

```
//Example 16_15 page no:775
clc;
//given
A=6/5;
B=17/5;
C=1/5;
D=7/5;
Zl1=sqrt((A*B)/(C*D));
disp(Zl1,"the parameter Zl1 is (in ohm)");
Zl2=sqrt((B*D)/(A*C));
disp(Zl2,"the parameter Zl2 is (in ohm)");
phi=atanh(sqrt((B*C)/(A*D)));
```

```
disp(phi,"the angle is");
```

# Chapter 17

# FILTERS AND ATTENUATORS

**Scilab code Exa 17.a.1** inductance and capacitance calculation

```
//Example_a_17_1 page no:863
clc;
fc=2*10^3;
K=400;
L=K/(%pi*fc);
L=L*1000;
C=1/(K*%pi*fc);
C=C*10^6;
disp(L,"the inductance is (in mH)");
disp(C,"the capacitance is (in microFarad)");
```

**Scilab code Exa 17.a.2** inductance and capacitance calculation

```
//Example_a_17_2 page no:864
clc;
fc=1.5*10^3;
```

```
k=500;
fa=1600;
m=sqrt(1-(fc/fa)^2);
L=k/(%pi*fc);
C=1/(%pi*k*fc);
//calculating T−section elements
L_t=m*L/2;
L_t=L_t*1000;
C_t=m*C;
C_t=C_t*10^6;
L1_t=(1-m^2)*L/(4*m);//the inductance value is wrong
    in text book, correct calculation is done here
L1_t=L1_t*1000;
//calculating pi−section elements
C_pi=m*C/2;
C_pi=C_pi*10^6;
L_pi=m*L;
L_pi=L_pi*1000;
C1_pi=(1-m^2)*C/(4*m);
C1_pi=C1_pi*10^6;
disp("the elements of T−section are");
disp(L_t,"the inductance is (in mH)");
disp(L1_t,"the inductance connected in serial with
   capacitor is (in mH)");
disp(C_t,"the capacitance is (in microFarad)");
disp("the elements of pi−section are");
disp(C_pi,"the capacitance is (in microFarad)");
disp(C1_pi,"the capacitance connected in parallel
   with inductor is (in microFarad)");
disp(L_pi,"the inductance is (in mH)");
//the inductance value is wrong in text book,
   correct calculation is done here
```

**Scilab code Exa 17.a.3** `inductance and capacitance calculation`

```
//Example_a_17_3 page no:865
clc;
f1=1000;
f2=5*10^3;
k=500;
f0=sqrt(f1*f2);
B_omega=f2-f1;
//calculating T-section elements
L1=k*(f2-f1)/(%pi*f1*f2);
C1=1/(4*%pi*k*(f2-f1));
//calculating pi-section elements
L2=k/(4*%pi*(f2-f1));
C2=(f2-f1)/(%pi*k*(f2*f1));
disp("T-Section filter is given by");
disp(L2*1000,"the inductance is (in mH)");
disp(C2*10^6,"the capacitance is (in microFarad)");
disp("pi-Section filter is given by");
disp(2*L2*1000,"the inductance is (in mH)");
disp(C2*10^6/2,"the capacitance is (in microFarad)")
    ;
```

**Scilab code Exa 17.a.4** `impedance calculation`

```
//Example_a_17_4 page no:866
clc;
f=1.5*10^3;
L=40*10^-3;
C=0.12*10^-6;
fc=1/(%pi*sqrt(L*C));
ZoT=sqrt(L/C)*sqrt(1-(f/fc)^2);
phase_shift=2*asind(f/fc);
disp(fc/1000,"the cut off frequency is (in kHz)");
disp(ZoT,"the iterative impedence is (in ohm)");
disp(phase_shift,"the phase shift is (in degree)");
```

**Scilab code Exa 17.a.6** inductance and capacitance calculation

```
//Example_a_17_6 page no:867
clc;
fc=6000;
k=500;
fa=1.75*fc;
L=k/(%pi*fc);
C=1/(%pi*k*fc);
m=sqrt(1-(fc/fa)^2);
L_t=m*L/2;//inductance value varie slightly with
    text book, hence values are rounded off in text
    book
C_t=m*C;
L1_t=(1-m^2)*L/(4*m);
disp("the elements of m-derived LPF(T-Section) are")
    ;
disp(L_t*1000,"the inductance is (in mH)");
disp(C_t*10^6,"the capacitance is (in microFarad)");
disp(L1_t*1000,"the inductance connected in series
    with capacitance is (in mH)");
//inductance value varie slightly with text book,
    hence values are rounded off in text book
```

**Scilab code Exa 17.a.7** attenuation constant calculation

```
//Example_a_17_7 page no:867
clc;
f=12*10^3;
L=10*10^-3;
C=0.32*10^-6;
fc=1/(%pi*sqrt(L*C));
```

```
k=sqrt(L/C);
atten_cont=2*acosh(f/fc);
disp(fc/1000,"the cut off frequency is (in kHz)");
disp(k,"nominal impedance is (in ohm)");
disp(atten_cont,"the attenuation constant is (in
    nepers)");
```

**Scilab code Exa 17.a.8** `impedance calculation`

```
//Example_a_17_8 page no:868
clc;
L=60*10^-3;
C=0.16*10^-6;
f=2*10^3;
fc=1/(%pi*sqrt(L*C));
Zot=sqrt(L/C)*sqrt(1-(f/fc));
phase_shift=2*asind(f/fc);
disp(fc/1000,"the cut off frequency is (in kHz)");
disp(Zot,"nominal impedance is (in ohm)");
disp(phase_shift,"the attenuation constant is (in
    nepers)");
//impedence varie slightly henc fc value is rounded
    off in text book
```

**Scilab code Exa 17.a.9** `inductance and capacitance calculation`

```
//Example_a_17_9 page no:869
clc;
Ro=600;
omega=800;
atten_const=12;
N=10^(atten_const/10);
L1=(Ro*sqrt(N-1))/(2*%pi*omega);
```

```
C1=L1/Ro^2;
C1=C1*10^6;
disp(L1,"the inductance is (in H)");
disp(C1,"the capacitance is (in microFarad)");
```

**Scilab code Exa 17.a.10** `inductance and capacitance calculation`

```
//Example_a_17_10 page no:869
clc;
Ro=600;
atten_const=10;
f=600;
D=10;
N=10^(D/10);
L1=(Ro*sqrt(N-1))/(2*%pi*f);
C1=sqrt(N-1)/(2*%pi*Ro*f);
C1=C1*10^6;
disp(L1,"the inductance is (in H)");
disp(C1,"the capacitance is (in microFarad)");
```

**Scilab code Exa 17.a.11** `capacitance calculation and resistance calculation`

```
//Example_a_17_11 page no:870
clc;
R1=2000;
L1=30*10^-3;
R2=300;
Ro=sqrt(R1*R2);
C1=L1/Ro^2;
C1=C1*10^6;
disp(Ro,"the value of resistance Ro is (in ohm)");
disp(C1,"the value of capacitance C1 is (in
   microFarad)");
```

**Scilab code Exa 17.a.12** `inductance calculation`

```
//Example_a_17_12 page no:871
clc;
R2=2;
C2=0.1;
Ro=2;
R1=Ro^2/R2;
L1=C2*Ro^2;
disp(R1,"the resistance is (in ohm)");
disp(C2,"the capacitance is (in F)");
disp(L1,"the inductance is (in H)");
```

**Scilab code Exa 17.1** `inductance and capacitance calculation`

```
//Example 17_1 page no:823
clc;
//given
k=500;//load resistance in ohm
fc=2000;//frequency in Hz
L=k/(%pi*fc);
L=L*1000;//converting to milli Henry
C=1/(%pi*fc*k);
C=C*10^6;//converting to micro farad
disp(L,"the inductance for low pass filter is (in mH
   )");
disp(C,"the capacitance for low pass filter is (in
   microFarad)");
```

**Scilab code Exa 17.2** inductance and capacitance calculation

```
//Example 17_2 page no:826
clc;
//given
Rl=600;
k=600;
fc=1000;
//calculating the impedence and capacitance
L=k/(4*%pi*fc);
L=L*1000;//converting to milli henry
C=1/(4*%pi*fc*k);
C=C*10^6;//converting to micro farad
disp(L,"the inductance required for high pass filter
    is (in mH)");
disp(C,"the capacitance required for high pass
   filter is (in microFarad)");
```

---

**Scilab code Exa 17.3** inductance and capacitance calculation

```
//Example 17_3 page no:831
clc;
//given
k=400;
fc=1000;
fx=1100;
//calculating m,L,C
m=sqrt(1-(fc/fx)^2)
L=k/(%pi*fc);
C=1/(%pi*k*fc);
//calculating T-section elements are
L1=m*L/2;
L1=L1*1000;//converting to milliHenry
C1=m*C;
C1=C1*10^6;//converting to microFarad
```

```
L2=(1-(m^2))*L/(4*m);
L2=L2*1000;//converting to milliHenry
disp("the values of T-section elements are");
disp(L1,"the inductance between which capacitance is
    connected is (in mH)");
disp(C1,"the capacitance connected between inductor
    is (in microFarad)");
disp(L2,"the inductance connected in series with
    capacitance is (in mH)");
//calculating the pi section elements are
C1=m*C/2;
C1=C1*10^6;//converting to microFarad
C2=(1-m^2)*C/(4*m);
C2=C2*10^6;//converting to microFarad
L1=m*L;
L1=L1*1000;//converting to milliHenry
disp("the values of pi section elements are");
disp(C1,"the capacitance connected in parallel is (
    in microFarad)");
disp(C2,"the capacitance connected in parallel to
    inductor is (in microFarad)");
disp(L1,"the inductor connected in parallel to
    capacitance is (in mH)");
```

**Scilab code Exa 17.4** inductance and capacitance calculation

```
//Example 17_4 page no:834
clc;
//given
k=500;
fc=10000;
m=0.4;
//Calculating the impedence and capacitance
L=k/(4*%pi*fc);
C=1/(4*%pi*fc*k);
```

```
//calculating T-section elements
C1=2*C/m;
L1=L/m;
C2=(4*m)*C/(1-m^2);
C1=C1*10^6;//converting to microFarad
L1=L1*1000;//converting to milliHenry
C2=C2*10^6;//converting to microFarad
disp("the T-section elements are");
disp(C1,"the capacitance between which inductance is connected is (in microFarad)");
disp(L1,"the inducatance connected in parallel is (in mH)");
disp(C2,"the capacitance connected in series is (in microFarad)");
//calculating the pi-section elements
L1=2*L/m;
L2=(4*m)*L/(1-m^2);
C1=C/m;
C1=C1*10^6;//converting to microFarad
L1=L1*1000;//converting to milliHenry
L2=L2*1000;//converting to milliHenry
disp("the value of pi section elements are");
disp(C1,"the capacitance connected in parallel to inductor is(in microFarad)");
disp(L1,"the inductance connected parallel to each other is (in mH)");
disp(L2,"the inductance connected parallel to capacitor is(in mH)");
```

**Scilab code Exa 17.5** inductance and capacitance calculation

```
//Example 17_5 page no:838
clc;
k=500;
f1=1000;
```

```
f2=10000;
L1=k/(%pi*(f2-f1));
C1=(f2-f1)/(4*%pi*k*f1*f2);
L2=C1*k^2;
C2=L1/k^2;
//calculating the T-section filter
L11=16.68/2;//inductance of T-section filter is
    calculated wrongly in text book
L11=L11;//converting to milliHenry
disp("the value of T-section element is");
disp(L11,"the inductance is (in mH)");
C11=2*C1;
C11=C11*10^6;//converting to microFarad
disp(C11,"the capacitance is (in microFarad)");
C2=0.0707;
L2=3.57;
disp(C2,"the shunt element capacitance is (in
    microFarad)");
disp(L2,"the shunt element inductance is (in mH)");
//calculating the pi-section filter
C1=0.143;
L1=16.68;
C2=0.0707/2;
L2=2*0.0358;
disp("the value of pi seciton element is");
disp(L11*2,"the inductance is (in mH)");
disp(C11/2,"the capacitance is (in microFarad)");
disp(C2,"the capacitance is(in microFarad)");
disp(L2,"the inductance is (in mH)");
//inductance of T-section filter is calculated
    wrongly in text book
```

**Scilab code Exa 17.6** inductance and capacitance calculation

```
//Example 17_6 page no:842
```

```
clc;
f1=2000;
f2=6000;
k=600;
L1=k*(f2-f1)/(%pi*(f2*f1));
C1=1/(4*%pi*k*(f2-f1));
L2=1/(4*%pi*k*(f2-f1));
C2=1*(f2-f1)/(k*%pi*(f1*f2));
//calculating T-section filter
L11=L1/2;
C11=2*C1;
L2=12;
C2=0.176;
L11=L11*1000;//converting to milliHenry
C11=C11*10^6;//converting to microFarad
disp("the T-section filter elements are");
disp(L11,"the inductace is (in mH)");
disp(C11,"the capacitance is (in microFarad)");
disp(L2,"the inductane is (in mH)");
disp(C2,"the capacitance is (in microFarad)");
//calculating the pi-section filter
L1=63;
C1=0.033;
L2=2*L2;
C2=C2/2;
disp("the pi section filter elements are");
disp(L1,"the inductace is (in mH)");
disp(C1,"the capacitance is (in microFarad)");
disp(L2,"the inductane is (in mH)");
disp(C2,"the capacitance is (in microFarad)");
```

**Scilab code Exa 17.7** `resistance calculation`

```
//Example 17_7 page no:845
clc;
```

```
D=60;
I2=20;
R0=500;
N=10^(D/20);
R1=R0*(N-1)/(N+1);
R2=(2*N)*R0/(N^2-1);
disp(R1,"Each of the series arm is given by (in ohm)
   ");
disp(R2,"the shunt arm resistor R2 is given by (in
   ohm)");
```

**Scilab code Exa 17.8** resistance calculation

```
//Example 17_8 page no:846
clc;
R0=100;
D=20;
N=10^(D/20);
R1=R0*(N^2-1)/(2*N);
R2=R0*(N+1)/(N-1);
disp(R1,"the resistance R1 is (in ohm)");
disp(R2,"the resistance R2 is (in ohm)");
```

**Scilab code Exa 17.9** resistance calculation

```
//Example 17_9 page no:847
clc;
R0=800;
D=20;
N=10^(D/20);
R1=R0*(N-1)/(N+1);
R2=R0*(N+1)/(N-1);
disp(R1,"the resistance R1 is (in ohm)");
```

```
disp(R2,"the resistance R2 is (in ohm)");
```

**Scilab code Exa 17.10** resistance calculation

```
//Example 17_10 page no:849
clc;
D=20;
R0=500;
N=10^(D/20);
Ra=R0*(N-1)
Rb=R0/(N-1);
disp(Ra,"the resistance Ra is (in ohm)");
disp(Rb,"the resistance Rb is (in ohm)");
```

**Scilab code Exa 17.11** resistance calculation

```
//Example 17_11 page no:850
clc;
D=20;
N=10^(D/20);
R0=600;
R1=R0*(N-1)/N;
R2=(R0/(N-1));
disp(R1,"the resistance R1 is (in ohm)");
disp(R2,"the resistance R2 is (in ohm)");
```

# Chapter 18

# ELEMENTS OF REALIZABILITY AND SYNTHESIS OF ONE PORT NETWORKS

**Scilab code Exa 18.1** foster network

```
//Example 18_1 page no:889
clc;
//calculating for first foster network
s=0;
P0=5*(s^2+4)*(s^2+25)/(s^2+16);
s=-%i*4;
P2=5*(s^2+4)*(s^2+25)/(s*(s-(%i*4)));
H=5;
Wn=8;
C0=1/P0;
Lx=H;
C2=1/(2*P2);
L2=2*P2/Wn^2*4;
disp("here the results are displayed in decimal
   values");
```

```
disp("the elements of first foster network is");
disp(C0,"the capacitance C0 is (in Farad)");
disp(Lx,"the inductance Linfinity is (in H)");
disp(C2,"the capacitance C2 is (in Farad)");
disp(L2,"the inductance L2 is(in H)");
//calculating for second foster network
s=-%i*2;
P1=1*(s*(s^2+16))/(5*(s+(-%i*2))*(s^2+25));
s=-%i*2;
P2=1*(s*(s^2+16))/(5*(s+(-%i*2))*(s^2+25));
L1=1/(2*P1);
C1=(2*P1)/4;
L2=(1/(1.5*P2));
C2=2*3/(70*25);
disp("the elements of second foster network is");
disp(C1,"the capacitance C1 is (in Farad)");
disp(L1,"the inductance L1 is (in H)");
disp(C2,"the capacitance C2 is (in Farad)");
disp(L2,"the inductance L2 is(in H)");
```