Scilab Textbook Companion for Basic Electrical Engineering by D. C. Kulshreshtha[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 2

Ohms law

Scilab code Exa 2.1 Resistance

```


                              // Example  2.1

a1=%pi*2^2/4;               // Relative area of wire-A
a2=%pi*1/4;                 // Relative area of wire-B
l1=1;                       // Relative lenght of wire-B
l2=4;                       // Relative lenght of wire-B
R1=5;                       // Resistance of wire
r=(l2/a2)/(l1/a1);
disp('The ratio of resistances (R2/R1) = '+string(r)
   +' ohm');
R2=r*R1;
disp('Resistance(R2) = '+string(R2)+' ohm');





              // p  16            2.1
```

Scilab code Exa 2.2 Resistance

```
                        // Example   2.2


a1=%pi*3/4;             // Relative area of wire-A
a2=%pi*1/4;             // Relative area of wire-B
l1=1;                   // Relative lenght of wire-A
l2=3;                   // Relative lenght of wire-B
R1=10;                  // Resistance of wire
r=(l2/a2)/(l1/a1);
disp('The ratio of resistances (R2/R1) = '+string(r)
    +' ohm');
R2=r*R1;
disp('Resistance(R2) = '+string(R2)+' ohm');







              //   p 16           2.2
```

Scilab code Exa 2.3 Resistance

```
                          // Example   2.3

            //    Rp=(4+4)||(8+4)

```

```
Rp=(8*12)/(8+12);      // By Voltage divider rule
disp(' voltage Across Foue resisrance = '+string(Rp)
   +' Ohm');





           //    p 20        2.3
```

Scilab code Exa 2.4 Voltage And Current

```


                              // Example  2.4

v=8.8*{2/(2+2.4)};      // by voltage divider rule
disp(' Anknown Voltage across the R1 = '+string(v)+'
     volt');

v1=8.8*{2.4/(2+2.4)};   // by voltage divider rule
disp(' Anknown Voltage across the R1 = '+string(v1)+
   ' volt');
i=4.8/4;                // I=V/R
disp(' Anknown Current I1 = '+string(i)+' Amp');
i1=4.8/6;               // I=V/R
disp(' Anknown Current I2 = '+string(i1)+' Amp');





                    // p 20       2.4
```

Scilab code Exa 2.5 Resistance

```

                    //  Example 2.5

              // From the diagram 2.14

rp=(1/20)+(1/10)+(1/20);          // Parallel resistance
Rp=1/rp;                          // The resistance Rp
Rs=15;                            // Series resistance
Rab=Rs+Rp;                        // Effective resistance between A & B
disp('(a) Effective resistance between A & B for diagram (a) = '+string(Rab)+' Ohms');

             // for diagram (b) network above line AB i.e R1=[(R+R)||R]+R
R1=5/3;                           // Resistance of network
R2=R1;                            // The lower part is also same as R1
R12=5/6;                          // Combination of R1 & R2
Rab1=(R12*1)/(R12+1);             // Effective resistance between A & B for diagram (b)
disp('(b) Effective resistance between A & B for diagram (b) = '+string(Rab1)+' R');

            // for diagram (c)
r1=(3*6)/(3+6);                   // Parallel combination of 3 & 6 Ohms Resistance
Ri=r1+18;                         // series of r1 & 18 Ohms Resistance
```

```
rab=(20*20)/(20+20);              // Parallel combinatuion of Ri & 20 Ohms Resistance
Rab2=rab+5;                        // series of rab & 2 Ohms Resistance
disp('(c) Effective resistance between A & B for diagram (c) = '+string(Rab2)+' Ohms');




                    //    p 23                       2.5
```

Scilab code Exa 2.6 Current

```

                                  // Example   2.6

d=(1/12)+(1/20)+(1/30);
Reff=2+(1/d);     // Effective Resisrence
v=100;
I=v/Reff;
                      //   ( but 12 i1= 20i2= 30i3 )
                      // i2= 12/20 *i1  &  i3= 12/30 *i1
                      // but  10=i1+i2+i3
                      // 0.6i1+0.4i1+i1=10     i.e  i1=5
i1=5;
disp(' Current of I1 if = '+string(i1)+' Amp');
i2=0.6*i1;
disp(' Current of I2 if = '+string(i2)+' Amp');
i3=0.4*i1;
disp(' Current of I3 if = '+string(i3)+' Amp');



             //   p 24        2.6
```

Scilab code Exa 2.7 Current

```
                        // Example  2.7

            //  p=i1^2*Rl    i.e   i1=p/Rl

Rl=5;                  // Load resistance
p=20;                  // Power
i1=p/Rl;
           // i1= i*(R/R+Rl)    i.e   i= i1*(R+Rl)/R
i=2*(10+5)/10;
disp(' Supply Current is = '+string(i)+' Amp');


          // p 25     2.7
```

Scilab code Exa 2.8 Voltage

```
                       // Example  2.8

v=120;                 // Supply voltage
p=60;                  // Power
R=v^2/p;               // Resistance

       // the combination R of bulb B & C is Rbc
          =240/2     i.e Rbc=120
       //  vb=vc

Rbc=240/2;             // R of each bulb
```

```
k=240+120;
vc=Rbc*(120/k);          // volt across Vc & Vb     {
   using Volt Divider Rule }
va=120-40;               // volt across Va
disp(' the Voltage across bulb A & B = '+string(vc)+
   ' Volt');
disp(' the Voltage across bulb C = '+string(va)+'
   Volt');
vb=40;
p=(va)^2/240+(vb)^2/240+(vc)^2/240;       //   p=pa+pb
   +pc    total power

disp(' Totale Power Dissipated is = '+string(p)+'
   Watt');



      //    p 25        2.8
```

Scilab code Exa 2.9 Resistance

```

                    //   Example 2.9

              // From the diagram 2.18
              // Minimum value of Req is obtained if R
                 =0
              // Maximum value of Req is obtained if R
                 = Open ckt

R1=30;                       // Given the value of R1
   & R1+R2= 75
R2=75-R1;                    // The value of R2
disp(' The value of R1 is = '+string(R1)+' Ohms ');
disp(' The value of R2 is = '+string(R2)+' Ohms ');

```

```
            // From the diagram 2.19

Req= (30+75)/2;             // Required value of Req
    is Req= (30+75)/2
Rp=Req-R1;                  // Hance the parallel
    combination of R2 & R
disp(' The value of Rp is = '+string(Rp)+' Ohms ');
disp('The value of Rp is exactly half of R2= 45,
    hance the value of R should be '+string(R2)+'
    Ohms ');




                            //  p 26             2.9
```

Scilab code Exa 2.10 Resistance

```

                            // Example  2.10

                           //  Rx=R+(R||2Rx)
                           //  i.e  2*Rx^2-3R Rx-R^2 =0
R=1;
Rx={3*R+sqrt(9*R*R+8*R*R)}/4;     // Using Roots of
    codratic Equation

disp(' Equivalent R is = '+string(Rx)+' R');





                 // p 26      2.10
```

Scilab code Exa 2.11 Resistance

```


                        // Example   2.11

            // To convet Pi- Section in to T-
               Section.
            // We have to Find Ra, Rb & Rc for T-
               Section
R2=9;       // Resistance of 9 Ohms
R3=6;       // Resistance of 6 Ohms
R1=3;       // Resistance of 3 Ohms

Ra=(R2*R3)/(R1+R2+R3);
disp(' Value of Ra is = '+string(Ra)+' Ohm');
Rb=(R1*R3)/(R1+R2+R3);
disp(' Value of Rc is = '+string(Rb)+' Ohm');
Rc=(R2*R1)/(R1+R2+R3);
disp(' Value of Rc is = '+string(Rc)+' Ohm');



           // p 26      2.11
```

Scilab code Exa 2.12 Resistance

```


                        // Example   2.12

Reff= 100/10;               // Effective R
```

```
            //  P=v^2/R    i.e Power of coil
v=100;
R=600;
R1=v^2/R;
                               // 2 Coil are connected
                                   parallel
R2=(R1*10)/(R1-10);            // Using parallel R
    formula

disp(' Resistance of each coil = '+string(R2)+' Ohm'
    );



          //    p 27      2.12
```

Scilab code Exa 2.13 Cost

```



                          // Example  2.13

v=115;          // Voltage
i=12;           // current
t=6;            // Time Required
w=v*i*t;        // Energy
Rate=2.50;
Cost=w*Rate;
disp(' cost of boiler Operation is = '+string(Cost
    /1000)+' Rs/kwh');
```

```
                  //  p 27         2.13
```

Scilab code Exa 2.14 Rating

```



                          // Example  2.14

v=240;
p=1000;          //toaster reted at 1000 w
R=v^2/p;         // resistanc raring
Imax=p/v;        // Current rating
v1=220;
I=v1/R;          // Current at 220 v
p1=v1*I;
disp(' Power rating is = '+string(p1)+' Watt');
disp(' there for the Power rating is less then
   original power. ');





          //      p 28         2.14
```

Scilab code Exa 2.15 Resistance

```

                          // Example  2.15

```

```
               //     To find the Value of Resister
               // We Sghould know About Colour Code

Y=4;               // Yelow colour
V=7;               // Violet colour
O=10^3;            // Orenge colour
r=(10*Y+V)*O;
R=r*(5/100);
disp(' The value of Resistance is = '+string(R)+'
   ohm');




              //  p 30      2.15
```

Scilab code Exa 2.16 Resistance

```


                         // Example  2.16

                    // To find the Value of Resister
                    // We Sghould know About Colour
                       Code
Gr=8;               // Gray colour
B=6;                // Blue colour
G=10^-1;            //Gold colour
r=(10*Gr+B)*G;
R=r*(5/100);
disp(' The value of Resistance is = '+string(R)+'
   ohm');



```

```
// p 30 2.16
```

Scilab code Exa 2.17 Resistance

```
// Example 2.17

R1=126;    // Resistance of 126 Ohms
T1=20;     // temperature at 126 ohms resistor
T2=-35;    // Temperature ( -35 Digree)
ao=0.00426;
           // By using Temprerature Formula i.e R1/(1+aoT1) =R2/(1+aoT2)
z=(1+ao*T2)/(1+ao*T1);
R2=R1*z;
disp('Resistance of the line (at T=-35) = '+string(R2)+' Ohm');





// p 31 2.17
```

Scilab code Exa 2.18 Temperature

```
// Example 2.18

R1=3.42;    // Resistance of 3.42 Ohms
```

```
T1=20;          // temperature at 3.42 ohms resistor
R2=4.22;        // Resistance R2
ao=0.00426;

      // By using Tempreratuer Formula  ==> i.e  R1
         /(1+aoT1) =R2/(1+aoT2)

z=(R2/R1)*(1+ao*T1);
T2=(z-1)/ao;
T=T2-T1;        // Temperature Rise
disp(' The Temperature Rise is = '+string(T)+'
   Digree Celsius');





      // p 32        2.18
```

Chapter 3

Network Analysis

Scilab code Exa 3.1 capacitor

```


                                    // Examle 3.1

A=0.113;                          // Area of parallel plate
eo=8.854*10^-12;                  // Permittivity of free
    space
er=10;                            // Relative Permittivity
d=0.1*10^-3;                      // Distance between 2
    Plate
C=(eo*er*A)/d;                    // The value of capacitor
     Using case-1
disp('The value of capacitor Using case-1 = '+
    string(C*1000000)+' uF');

w=0.05;                           // Energy stored
v=100;                            // Voltage
C1=(2*w)/v^2;                     // The value of capacitor
     Using case-2
disp('The value of capacitor Using case-2 = '+
    string(C1*1000000)+' uF');
```

```
i=5*10^-3;                    // Current
dv=100;                       // Increase iv voltage
dt=0.1;                       // Time required
C2=i/(dv/dt);                 // The value of capacitor
    Using case-3
disp('The value of capacitor Using case-3 = '+
   string(C2*1000000)+' uF');






              //   p 53      3.1
```

Scilab code Exa 3.2 Inductor

```


                                // Examle 3.2

w=0.2;                          // Energy stored
i=0.2;                          // Current
L1=(2*w)/i^2;                   // The value of
   Inductor Using case-1
disp('The value of Inductor Using case-1 = '+string
   (L1)+' H');

v=10;                           // Voltage
di1=0.1;                        // Increase current
dt1=0.2;                        // Time required
L2=v/(di1/dt1);                 // The value of
   Inductor Using case-2
disp('The value of Inductor Using case-2 = '+string
```

```
(L2)+' H');


p=2.5;                          // Power
di2=0.1;                        // Increase current
dt2=0.5;                        // Time required
L3=p/(di2*dt2);                 // The value of Inductor Using case-3
disp(' The value of Inductor Using case-3 = '+string(L3)+' H');




                  //  p 54       3.2
```

Scilab code Exa 3.3 Inductor

```

                                      // Examle 3.3

                                  // Given L1= 2L2
                                  // From the Diagram Leq= 0.5+ (L1*L2)/(L1+L2)
                                  // there for (L1*L2)/(L1+L2)= 0.2 ,( where Leq= 0.7)
                                  // i.e (2*L2*L2)/3L2= 0.2;
                                  // it means L2= 0.3 H

L2=0.3;                           // Value of Inductor 1
L1=2*L2;                          // Value of Inductor 2
disp(' Value of Inductors are  L1= '+string(L1)+' H  &   L2= '+string(L2)+' H');

```

```
// p 55 3.3
```

Scilab code Exa 3.4 Voltage

```

// Examle 3.4

C1=0.05;                           // Capacitor
    1 ( in Micro )
C2=0.1;                            // Capacitor
    2 ( in Micro )
C3=0.2;                            // Capacitor
    3 ( in Micro )
C4=0.05;                           // Capacitor
    4 ( in Micro )
C=(1/C1)+(1/C2)+(1/C3)+(1/C4);     // Addition
    of capacitors
Cs=1/C;                            // Equivalent
     capacitor
disp(' Equivalent capacitor = '+string(Cs)+' uF');

V=220;                             // Supply
    voltage
Q=Cs*V;                            // Charge
    transfer
V1=Q/C1;                           // Voltage
    drop across capacitor 1
disp(' Voltage drop across capacitor 1 = '+string(V1
    )+' Volt');

```

```
V2=Q/C2;                                    // Voltage drop across capacitor 2
disp(' Voltage drop across capacitor 2 = '+string(V2)+' Volt');

V3=Q/C3;                                    // Voltage drop across capacitor 3
disp(' Voltage drop across capacitor 3 = '+string(V3)+' Volt');

V4=Q/C4;                                    // Voltage drop across capacitor 4
disp(' Voltage drop across capacitor 4 = '+string(V4)+' Volt');




                  //    p 55        3.4
```

Scilab code Exa 3.5 Voltage

```

                               // Examle 3.5

C1=2*10^-6;                    // Value of capacitor-1
C2=10*10^-6;                   // Value of capacitor-2
Q1=400*10^-6;                  // Charge of capacitor-1
Q2=200*10^-6;                  // Charge of capacitor-2
Q=Q1+Q2;                       // Total Charge of capacitors
C=C1+C2;                       // Equivalentss capacitor
V=Q/C;                         // Voltage across the capacitor
disp(' Voltage across the capacitor = '+string(V)+'
```

```
    Volt');






                    //   p 55         3.5
```

Scilab code Exa 3.6 Voltage And Energy

```

                                        // Examle 3.6

C1=2*10^-6;                                       // Capacitor 1
C2=8*10^-6;                                       // Capacitor 2
C=(C1*C2)/(C1+C2);                                // Equivalentss capacitor
V=300;                                            // Supply voltage
Q=C*V;                                            // Charge on each capacitor
disp('(a)  Charge on each capacitor = '+string(Q*1000000)+' uC');

V1=Q/C1;                                          // Voltage drop across capacitor 1
disp('(b).1  Voltage drop across capacitor 1 = '+string(V1)+' Volt');

V2=Q/C2;                                          // Voltage drop across capacitor 2
disp('(b).2  Voltage drop across capacitor 2 = '+
```

```
string(V2)+' Volt');

V1=240;
w1=0.5*C1*V1^2;                          // Energy stored in capacitor-1
disp('(c).1  Energy stored in capacitor-1 = '+string(w1*1000)+' mJ');

V2=60;
w2=0.5*C2*V2^2;                          // Energy stored in capacitor-2
disp('(c).2  Energy stored in capacitor-2 = '+string(w2*1000)+' mJ');






                  //    p 56          3.6
```

Scilab code Exa 3.7 Capacitor

```


                                  // Examle 3.7

                                // Given that Ceq= 1 uF between A & B
                                // By reducing the circuit will get 2 capacitor.
                                // that is C & C13= 32/9 uF
                                // there for (1/1)= 1/C+
```

```
                                        9/32
                                    // Hance 1/C= 1-9/32
C=1/{1-(9/32)};                     // Value of Capacitor-C
disp(' Value of Capacitor C = '+string(C)+' uF');







                  // p 56        3.7
```

Scilab code Exa 3.8 Voltage And Current

```

                                      // Examle 3.8

                                    // for the extreme value
                                       of Rl voltage (Vl) &
                                       Current (Il)
E=3;                                // Supply voltage
Ri=1;                               // I/p Resistance
Rl1=100;                            // Minimum load
    resistance
Il1=E/(Rl1+Ri);                     // Current at minimum
    load Rl1
Vl1=E-(Il1*Ri);                     // Voltage at minimum
    load Rl1

Rl2=1000;                           // Maximum load
    resistance
Il2=E/(Rl2+Ri);                     // Current at maximum
    load Rl2
Vl2=E-(Il2*Ri);                     // Voltage at maximum
```

```
load Rl2

Il={(Il1-Il2)/Il1}*100;      // Change in current Il
disp(' The % chenge (a Decrease ) in Il = '+string(Il)+' % ');

Vl={(Vl1-Vl2)/Vl1}*100;     // Change in voltage Vl
disp(' The % chenge (a Increase ) in Vl = '+string(-Vl)+' % ');

rl1=0.001;                  // Minimum load resistance (for 2nd case)
il1=E/(rl1+Ri);             // Current at minimum load rl1
vl1=E-(il1*Ri);             // Voltage at minimum load rl1

rl2=0.01;                   // Maximum load resistance (for 2nd case)
il2=E/(rl2+Ri);             // Current at maximum load rl2
vl2=E-(il2*Ri);             // Voltage at maximum load rl2

il={(il1-il2)/il1}*100;     // Change in current il
disp(' The % chenge (a Decrease ) in Il = '+string(il)+' % ');

vl={(0.003-0.03)/0.003}*100;  // Change in voltage vl  ==> (vl1=0.003 & vl2=0.03)
disp(' The % chenge (a Increase ) in Vl = '+string(-vl)+' % ');
```

```
                  //     p  59          3.8
```

Scilab code Exa 3.9 Voltage And Power

```


                               // Examle 3.9

Is=3;                       // Source current
Rs=2;                       // Source resistance
Vs=Rs*Is;                   // Source voltage
Rl=4;                       // Load resistance
R=(Rs*Rl)/(Rs+Rl);          // Eqviualent resistance
Il1=(Is*Rs)/(Rs+Rl);        // Load current in case-1
disp('Load current in case-1 = '+string(Il1)+' Amp');

Vl1=1*Rl;                   // Load voltage in case-1
disp('Load voltage in case-1 = '+string(Vl1)+' Volt');

Ps1=Is^2*R;                 // Power delivered in case-1
disp('Power delivered in case-1 = '+string(Ps1)+' Watt');

Il2=Vs/(Rs+Rl);             // Load current in case-2
disp('Load current in case-2 = '+string(Il2)+' Amp');

Vl2=Vs*(Rl/(Rl+Rs));        // Load voltage in case-2
disp('Load voltage in case-2 = '+string(Vl2)+' Volt');

Ps2=Vs^2/(Rs+Rl);           // Power delivered in case
```

```
-2
disp(' Power delivered in case-2 = '+string(Ps2)+' Watt');




                    //          p 61          3.9
```

Scilab code Exa 3.10 Current

```

                                    // Examle 3.10


Rl=6;                            // Load resistance
Rs=2;                            // Source resistance
Is=16;                           // Source current
I2=Is*(Rl/(Rl+Rs));              // Current through Rs
disp(' Current through Rs (with Current as source ) = '+string(I2)+' Amp');

I6=Is-I2;                        // Current through Rl
disp(' Current through Rl (with Current as source ) = '+string(I6)+' Amp');

              // After transforming the current source in to voltage source

Vs=32;                           // Source voltage
i2=Vs/(Rl+Rs);                   // Current through Rs
i6=i2;                           // Current through Rl
disp(' Current through Rs & Rl (with voltage as source ) = '+string(i2)+' Amp');

```

```
                    //      p 62          3.10
```

Scilab code Exa 3.13 Current And Power

```


                                  // Examle 3.13

                              // From Diagram (3.26) Apply KVL to get 24−4I −2I+18I= 0
I=(-24/12);                   // Current
disp(' The value of Current = '+string(I)+' Amp');

V1=4*I;                       // Voltage across 4 Ohm Resistor
p=-(4.5*V1*I);                // Power absorbed
disp(' Power absorbed by dependent source = '+string(p)+' Watt');

V=24;                         // Independent voltage source
R=V/I;                        // Resistence Seen from Independent source
disp(' Resistence Seen from Independent source = '+string(R)+' Ohm');




                  //          p 67      3.13
```

Scilab code Exa 3.14 Voltage

```
                                    // Examle 3.14

                                // From Diagram (3.28)
                                   Apply KVL to get 100−40
                                   I−60I= 0
I=100/100;                      // Current
disp(' The value of Current = '+string(I)+' Amp');

R=60;                           // Resistor
V1=I*R;                         // Voltage across 60 ohm
    resistor
disp(' Voltage across 60 ohm resistor = '+string(V1)
    +' Volt');

                                // By using Voltage
                                   divider concept
Vab=-10+V1+0*10+30;             // Voltage Vab
disp(' Voltage across open−circuit Vab = '+string(
    Vab)+' Volt');



                // p 68            3.14
```

Scilab code Exa 3.15 Voltage

```
// Examle 3.15

// From Diagram (3.29) let us confirm that the given voltage satisfy KVL
// 10-6-4= 0  , satisfy KVl
// From Diagram Apply KVL to right loop get { -(-4)+4+Vx= 0 }

Vx=-4-4;                    // Voltage Vx
disp(' Voltage across Vx = '+string(Vx)+' Volt');

// To find Vcd Stand a point d & walk towards c  i.e { Vcd= -4+6 }

Vcd=-4+6;                   // Voltage Vcd
disp(' Voltage across Vcd = '+string(Vcd)+' Volt');






//       p 69          3.15
```

Scilab code Exa 3.16 Current

```
// Examle 3.16

// From the diagram (3.30) Apply KVL to all the 3 loop.
```

```
                 // Loop-1     5Ix+0Iy-10I1-=100..............(i
                 // Loop-2     7Ix+ 2Iy-2I1=-50..............(ii
                 // Loop-3     3Ix-5Iy-3I1=-50...............(iii

                 // By using matrix form will get A*X = B formate

delta=[5 0 10 ; 7 2 -2 ; 3 -5 -3 ];                    // value of A
d=det(delta);                                          // Determinant of A

delta1=[100 0 10 ; -50 2 -2 ; -50 -5 -3 ];             // value of A1 (when 1st colomn is replace by B)
d1=det(delta1);                                        // Determinant of A1

delta2=[5 100 10 ; 7 -50 -2 ; 3 -50 -3 ];              // value of A2 (when 2nd colomn is replace by B)
d2=det(delta2);                                        // Determinant of A2

Ix=d1/d;                                               // Current (Ix)
disp(' The value of Current (Ix)  = '+string(Ix)+' Amp');

Iy=d2/d;                                               // Current (Iy)
disp(' The value of Current (Iy) = '+string(Iy)+' Amp');




```

```
//   p 71      3.16
```

Scilab code Exa 3.17 Resistance

```

                    // Examle 3.17

        // From the diagram (3.31) Apply KCL to node B & C
        // will get { I1+I2= 20 }  &  { I3-I2= 30 }
        // Apply KVL to Bigger loop will get i.e { I1-3I2-2I3= -100 }
        // By solving All the 3 equation we get

I1=10;              // Current in loop-1
disp(' The value of Current (I1) = '+string(I1)+' Amp');

I2=10;              // Current in loop-2
disp(' The value of Current (I2) = '+string(I2)+' Amp');

I3=40;              // Current in loop-3
disp(' The value of Current (I3) = '+string(I3)+' Amp');

        // For Resistors Apply KVL to loop-1 & loop-3
        // we get { -0.1I1-20R1+110= 0 }  &  { 0.2I3-120+30R2= 0 }

R1=(110-0.1*I1)/20;      // Resistence (R1)
disp(' The value of Resistence (R1) = '+string(R1)+'
```

```
    Ohm');

R2=(120-0.2*I3)/30;      // Resistence (R2)
disp(' The value of Resistence (R2) = '+string(R2)+'
    Ohm');




                //    p 71         3.17
```

Scilab code Exa 3.18 Current

```


                                // Examle 3.18

                  // From the diagram (3.33a) Apply KVL
                     to Bigger loop i.e (For I1 )
                  // Will get { 10-5(I1-2)-8I1= 0 }
                  // Using loop-circuit analysis

I1=20/13;         // Current through 8 ohm resistor
disp(' Current through 8 ohm resistor (I1) = '+
   string(I1)+' Amp');




                  //    p 74          3.18
```

Scilab code Exa 3.19 Voltage

```
                                // Examle 3.19

                    // From the diagram (3.34a) Apply KVL
                       to loop-2 i.e (For I )
                    // Will get { -2I-3I+6-1(I+5-4)= 0 }
                    // Using loop-circuit analysis

I=5/6;              // Current in loop-2
V=3*I;              // Unknown voltage.
disp(' Unknown voltage V = '+string(V)+' Volt');



                    //   p 74          3.19
```

Scilab code Exa 3.20 Current

```


                                // Examle 3.20

                    // From the diagram (3.38) Apply KVL
                       to all the 3 loop.
                    // Loop-1     19I1-12I2+0I3-=
                       60................(i
                    // Loop-2     -12I1+18I2-6I3=
                       0...............(ii
                    // Loop-3     0I1-6I2+18I3=
                       0................(iii

                    // By using matrix form will get A*X =
                        B  formate
```

```
delta=[19 -12 0 ; -12 18 -6 ; 0 -6 18 ];          // value of A
d=det(delta);                                      // Determinant of A

delta1=[60 -12 0 ; 0 18 -6 ; 0 -6 18 ];            // value of A1 (when 1st colomn is replace by B)
d1=det(delta1);                                    // Determinant of A1

Is=d1/d;                                           // Current drawn from source (Is=I1)
disp(' Current drawn from source (Is)  = '+string(Is)+' Amp');





        //   p 79     3.20
```

Scilab code Exa 3.21 Current

```


                                  // Examle 3.21

                   // From the diagram (3.39) Apply KVL to all the 3 loop.
                   // Loop-1     7I1-4I2+0I3-=67...................(i
                   // Loop-2     -4I1+15I2-6I3=-152................(ii
                   // Loop-3     0I1-6I2+13I3=
```

```
                    74..................(iii

                //By using matrix form will get A*X = B  formate

delta=[7 -4 0 ; -4 15 -6 ; 0 -6 13 ];          //value of A
d=det(delta);                                   //Determinant of A

delta1=[7 -4 67 ; -4 15 -152 ; 0 -6 74 ];       //value of A1 (when 3rd colomn is replace by B)
d1=det(delta1);                                 //Determinant of A1

I3=d1/d;                                        //Current through 7 ohm resistor (I3)
disp('Current through 7 ohm resistor = '+string(I3)+' Amp');





        //   p 79      3.21
```

Scilab code Exa 3.22 Voltage

```

                              // Examle 3.22

                //From the diagram (3.40b) Apply KCL to node a
                // will get { (va-0)/2+ (va-vb)/3 = 5 }............(1
```

```
                    // Similarly apply KCL at node b
                    // will get { (vb−va)/3+ vb−0)/4 = −6
                      }............(2

                    // After solving these 2 equation
                      will have

Va=2.44;                          // Voltage at node a
Vb=-8.89;                         // Voltage at node b
Vab=Va-Vb;                        // Voltage across 3 ohm
     resistor
disp(' Voltage across 3 ohm resistor = '+string(Vab)
    +' Volt');




                            //    p 80          3.22
```

Scilab code Exa 3.23 Current

```

                                  // Examle 3.23

                    // From the diagram (3.41) Apply KCL
                      to node
                    // will get { (v1−0)/12+ (v1−60)/3+ (
                      v1−0)/4 = 5 }
                    // After solving above equation we
                      get V1= 18 V

V1=18;                          // Voltage at node 1
I1=(V1-0)/12;                   // Current through 12 ohm
     resistor (I1)
disp(' Current through 12 ohm resistor = '+string(I1
```

```
)+' Amp');




                    //    p 81         3.23
```

Scilab code Exa 3.24 Current

```


                                  // Examle 3.24

                    // From the diagram (3.42) Node
                       voltages are
                    // Have { va-vb+0vc = 6
                       }.......................(1
                    // Apply KCL at Super node
                    // will get { 0.33va+0.25vb-0.25vc =
                       2  }.......(2
                    // Apply KCL at node c
                    // will get { 0va-0.25vb+4.5vc = -7
                       }..........(3

                   // By using matrix form will get A*X =
                       B  formate

delta=[1 -1 0 ; 0.33 0.25 -0.25 ; 0 -0.25 0.45];
   // value of A
d=det(delta);
   // Determinant of A

delta1=[1 6 0 ; 0.33 2 -0.25 ; 0 -7 0.45];
   // value of A1 (when 2nd colomn is replace by B)
d1=det(delta1);
```

```
    // Determinant of A1

delta2=[1 -1 6 ; 0.33 0.25 2 ; 0 -0.25 -7];
    // value of A2 (when 3rd colomn is replace by B)
d2=det(delta2);
    // Determinant of A2

Vb=d1/d;
    // Voltage at node-b
Vc=d2/d;
    // Voltage at node-c

I=(Vb-Vc)/4;
    // Current through 4 ohm resistor (I)
disp(' Current through 4 ohm resistor = '+string(I)+
    ' Amp');



                        //    p 82          3.24
```

Scilab code Exa 3.25 Voltage

```

                                  // Examle 3.25

                   // From the diagram (3.43b) Apply KCL
                       to node a
                   // will get { (va-6)/1+ (va-0)/5 =4-5
                       }

Va=(6-1)/1.2;                      // Voltage at node a

                  // by using voltage divider rule

```

```
V=Va*(3/(2+3));                    // Voltage across 3
   ohm resistor
disp(' Voltage across 3 ohm resistor = '+string(V)+'
    Volt');





                        //     p 82             3.25
```

Scilab code Exa 2.26 Current

```


                                      // Examle 3.26

                   // Reffer Diagram (3.44a)
                   // First of all convert all resistor
                      in to conductor
                   // From the obtained diagram (3.44c)
                      Apply KCL to node 1 & 2
                   // Node-1      0.7S1-0.2S2-=
                      3..................(i
                   // Node-2      -0.2S1-1.2S2=
                      2..................(ii

                   // By using matrix form will get A*X =
                      B  formate

delta=[0.7 -0.2 ; -0.2 1.2 ];             // value of A
d=det(delta);                             //
   Determinant of A

delta1=[3 -0.2 ; 2 1.2 ];                 // value of
```

```
A1 (when 1st colomn is replace by B)
d1=det(delta1);                          // Determinant of A1

delta2=[0.7 3 ; -0.2 2 ];                // value of A2 (when 2nd colomn is replace by B)
d2=det(delta2);                          // Determinant of A2

V1=d1/d;                                 // Voltage at node-1
V2=d2/d;                                 // Voltage at node-2

I=(V1-V2)/5;                             // Current through 5 ohm resistor (I)
disp(' Current through 5 ohm resistor = '+string(I)+' Amp');




        //    p 84       3.26
```

Scilab code Exa 2.27 Current

```


                                    // Examle 3.27

                          // From the diagram (3.45) Apply KCL to the circuit
                          // will get (V-10)/2 +(V-0)/4 +(V-8)/6 = 0
                          // Using nodal analysis
```

```
                              // hance we can get V= 6.91
V=6.91;                       // Voltage at the node
I=V/(1+3);                    // Current (I)
disp(' Current (I) = '+string(I)+' Amp');




            //  p 84           3.27
```

Chapter 4

Network Theorems

Scilab code Exa 4.1 Current

```

                                // Examle 4.1

                    // Reffer the diagram (4.2a)
                    // Using Superpositon theorem

I=-0.5;                          // Source current
I1=I*(0.3/(0.1+0.3));            // When 0.5-A Current
    source is on { by voltage divider }

V=80*10^-3;                      // Voltage source
I2=(V/(0.1+0.3));                // When 80-mV voltage
    source is on { by ohm's law }

i=I1+I2;                         // Current in the
    circuit  { by Superpositon theorem }
disp(' Current in the circuit = '+string(i)+' Amp');




```

```
             //   p 105           4.1
```

Scilab code Exa 4.2 Current

```


                              // Examle 4.2

               // Reffer the diagram (4.3)
               // Using Superpositon theorem

V=10;                         // Voltage source
I1=(V/(50+150));              // When 10-V voltage source is on { by ohm's law }

i1=40;                        // Source current
I2=i1*(150/(50+150));         // When 40-A Current source is on { by current divider }

i2=-120;                      // Source current
I3=i2*(50/(50+150));          // When (-120)-A Current source is on { by current divider }


I=I1+I2+I3;                   // Current in the circuit  { by Superpositon theorem }
disp(' Current in the circuit = '+string(I)+' Amp');





             //   p 106           4.2
```

Scilab code Exa 4.3 Voltage

```


                    //   Example 4.3

              // From the diagram 4.5
              // Using super position theorem
              // 4-A current source is active

i=4/{1+(2+3)};          // Current
R=3;                    // Rsistance of 3 Ohms
V4=i*R;                 // Voltage across 3 Ohms resistance in Case-1

              // 5-A current source is active
i5=5;                        // 5-A current source
V5=(-i5)*{1/[1+(2+3)]*3};    // Voltage across 3 Ohms resistance in Case-2

              // 6-V voltage source is active
i6=6;                       // 6-A current source
V6=i6*{3/[1+(2+3)]};        // Voltage across 3 Ohms resistance in Case-3

V=V4+V5+V6;                 // Voltage across 3 Ohms resistance
disp(' Voltage across 3 Ohms resistance is = '+string(V)+' Volt');




                  //  p 106            4.3
```

Scilab code Exa 4.4 Current

```


                                 // Examle 4.4

                 // From the diagram (4.6a)
                 // Using Superpositon theorem

V=10;                              // Voltage source
I1=(V/(2+4+6));                    // When 10-V voltage
    source is on { by ohm's law }

                                   // we have to find Is=
                                      ?
                                   // When Is-A Current
                                      source is on
                                   // will have { I2=
                                      -(2/3)Is }
                                   // given that I1+I2= 0
                                   //  there for 5/6 -
                                      (2/3)Is= 0
Is=(5*3)/(6*2);                    // Source current
disp(' The value of source current (Is)  = '+string(
    Is)+' Amp');





             //   p 108           4.4
```

Scilab code Exa 4.5 Voltage

```

                                // Examle 4.5

                // From the diagram (4.8)
                // Using thevenin's equivalent theorem

V1=50;                              // Voltage source V1
V2=10;                              // Voltage source V2
I1=(V1-V2)/(10+10+20);              // Current through the ckt ( when Current source is off )

i=1.5;                              // Current source i
I2=i*(10/(10+(10+20)));             // Current through the ckt ( when Current source is active )
I=I1+I2;                            // Addition of I1 & I2
Vth= I*20;                          // Thevenin's voltage at 20 Ohms R

Rth=(20*(10+10))/(20+(10+10));      // Thevenin's resistance

Vl=Vth*(5/(5+10));                  // Voltage across Rl
disp(' Voltage across olad resistor (Rl) = '+string(Vl)+' Volt');
```

```
                    // p 110            4.5
```

Scilab code Exa 4.6 Voltage

```

                                    // Examle 4.6

                    // From the diagram (3.24a)
                    // Using thevenin's equivalent
                       theorem

Vth=5;                                     // Thevenin's
   voltage ==> { by Circuit reduction }

Rth=3;                                     // Thevenin's
   resistance ==> { by Circuit reduction }

Vl=Vth*(3/(3+3));                        // Voltage across
   Rl
disp('Voltage across olad resistor (Rl) = '+string(
   Vl)+' Volt');






                    // p 111            4.6
```

Scilab code Exa 4.7 Current

```

                                    // Examle 4.7
```

```

                    // From the diagram (4.11a)

                                // Using Nortan's equivalent theorem

R1=5;                           // Resistance R1
R2=10;                          // Resistance R2
V1=10;                          // Voltage source V1
I1=V1/R1;                       // Current I1

V2=5;                           // Voltage source V2
I2=V2/R2;                       // Current I2
IN=I1+I2;                       // Nortan's current

RN=(R1*R2)/(R1+R2);             // Nortan's resistance

Rl=5;                           // Load resistance
Il=IN*(RN/(RN+Rl));             // Load current
disp(' Load current (Il) = '+string(Il)+' Amp');



          // p 113              4.7
```

Scilab code Exa 4.8 Power

```

                                  // Examle 4.8

Voc=12.6;                       // Voltage of car battery
Isc=300;                        // Short-circuit current
Ro=Voc/Isc;                     // O/p resistance

                                // { P=Vht^2/4Rth } , but
```

```
                                 here Vth= Voc & Rth= Ro
Pavl=Voc^2/(4*Ro);          // Available power
disp(' Available power is = '+string(Pavl)+ ' Watt')
   ;





                  //   p 114              4.8
```

Scilab code Exa 4.9 Power

```

                                    // Examle 4.9

n=8;                         // No.Of dry cells
E=1.5;                       // Emf of cell
Voc=n*E;                     // open-circuit Voltage
   of battery
r=0.75;                      // Internal resistance
Ro=r*n;                      // O/p resistance

              // ==> { P=Vht^2/4Rth } , but here Vth
                 = Voc & Rth= Ro

Pavl=Voc^2/(4*Ro);           // Available power
disp(' Available power is = '+string(Pavl)+ ' Watt')
   ;





                  //   p 115              4.9
```

Scilab code Exa 4.10 Voltage And Power

```

                    // Examle 4.10

                  // From Diagram 4.12

P=25;                                  // Power
Rl=8;                                  // Load resistance
Vth=P*4*Rl;                            // Thevenin's equivalent voltage

               // If Load is Short-ckt (RL=0)
Vo=0;                                  // Voltage
IL=1;                                  // load current
Po1=Vo*IL;                             // O/p power

               // If Load is Open-ckt ( RL=infinity )
IL1=0;                                 // Load current
Vo1=1;                                 // Voltage
Po2=Vo1*IL1;                           // O/p power

x=[0 2 4 6 8 16 32 ];                  // Diffrent value of RL
y=[0 16 22.22 24.49 25 22.22 16 ]      // Value of Power

plot2d(x,y);                           // To plot graph
xlabel('RL (in Ohms )--->');           // For X-Label
ylabel('Po (in W ---->')               // For Y-Label



                  //  View  p 115          4.10
```

Scilab code Exa 4.11 Current And Resistance

```

                               // Examle 4.11

                // From the diagram (4.14)

Req=2+{(12*4)/(12+4)}+4;                 // Equivalent resistance (for 4.14a )
v=36;                                    // Voltage source
i=v/Req;                                 // Current supply by the voltage source
I=i*(12/(12+4));                         // Current in branch B ==> { by current divider }
disp(' Current in branch B = '+string(I)+' Amp');

Req1=3+{(12*6)/(12+6)}+1;                // Equivalent resistance (for 4.14b )
i1=v/Req1;                               // Current supply by the voltage source
I1=i1*(12/(12+6));                       // Current in branch A ==> { by current divider }
disp(' Current in branch A = '+string(I1)+' Amp');

Rtr=v/I;                                // Transfer resistance
disp(' Transfer resistance from Branch A to B = '+string(Rtr)+' Ohm');



                        // p 117          4.11
```

Chapter 5

Electromagnetism

Scilab code Exa 5.1 Current

```


                         // Example  5.1

B=20*10^-3;         // Megnetic Field intensity
m=4*%pi*10^-7;      // Permeability of free Space
n=20*100;           // No.Of Turns per meter
I=B/(m*n);
disp(' Necessary Current is = '+string(round(I))+'
   Amp');



        //  p 187        5.1
```

Scilab code Exa 5.2 Megnetic Field Strength

```
                        // Example  5.2

l=4;                 // Layers of Solenoid
w=350;               // turns Winding
s=0.5;               // Length of Solenoid
n=(l*w)/s;           // No.Of turns
I=6;                 // Current in the Solenoid
mo=4*%pi*10^-7;      // Permeability of free Space
B=mo*n*I;            // Formula for Megnetic Field at
    the centre
disp('(a) Megnitude of field near the Centre of
    Solenoid = '+string(B)+' Tesla');
B1=B/2;              // Formula for Megnetic Field at
    the end
disp('(b) Megnitude of field at the end of Solenoid
    = '+string(B1)+' Tesla');
disp('(c) Megnetic Field outside the solenoid is
    Negligible');



        //    p 188       5.2
```

Scilab code Exa 5.3 Force

```


                        // Example  5.3

mo=4*%pi*10^-7;      // Permeability of free Space
i1=80;               // Current in 1st Wire
i2=30;               // Current in 2nd Wire
r=2;                 // Distance between 2 wires
```

```
F=(mo*i1*i2)/(2*%pi*r);
disp(' Force between 2 wires = '+string(F)+' N/m');





            // p 192          5.3
```

Scilab code Exa 5.4 Force

```



                              // Example  5.4

mo=4*%pi*10^-7;       // Permeability of free Space
i1=4;                 // Current in 1st Wire
i2=6;                 // Current in 2nd Wire
r=0.03;               // Distance between 2 wires

F=(mo*i1*i2)/(2*%pi*r);
l=0.15;            // Section of wire
Fnet=F*l;
disp(' Force on 15 cm of wire B is = '+string(Fnet)+
    ' N');





            // p 192          5.4
```

Scilab code Exa 5.5 Voltage

```
                       // Example  5.5

B=0.5;          // Megnetic Field
l=0.2;          // Length of conductor
v=5;            // velocity Conductor
Q1=0;           // Angle of Motion in case 1
Q2=90;          // Angle of Motion in case 2
Q3=30;          // Angle of Motion in case 3

e1=B*l*v*sind(Q1);
disp(' emf of conductor when move Parallel to
   Megnetic field = '+string(e1)+' Volt');
e2=B*l*v*sind(Q2);
disp(' emf of conductor when move Perpendicular to
   Megnetic field = '+string(e2)+' Volt');
e3=B*l*v*sind(Q3);
disp(' emf of conductor when move at an Angle 30 to
   Megnetic field = '+string(e3)+' Volt');





          // p 198          5.5
```

Scilab code Exa 5.6 Voltage

```
                       // Example  5.6

B=38*10^-6;                 // Megnetic Field
l=52;                       // Length of conductor
Q=90;                       // Angle of Motion in case 1
v=(1100*1000)/3600;         // velocity in m/s
e=B*l*v*sind(Q);            // Formula of emf
disp(' emf Generated between wing-tips = '+string(e)
   +' Volt');





            // p 198        5.6
```

Scilab code Exa 5.7 Voltage

```





                       // Example  5.7

                   // We know that Area of Ring is (A
                      =Pi*R*R)
                   //  i.e  A=%pi*R*R*(Q/2%pi)=0.5*R*
                      R*Q;
                   // Hance by using Faraday's Law
                   // e= dQ/dt= d(BA)/dt.
```

```
                        //  0.5*B*R*R*(dq/dt).

B=1;
R=1;
f=50;
e=0.5*B*R*R*f*2*%pi;     //  by using Faraday's Law

disp(' emf Devloped between Centre & ring  = '+
   string(round(e))+' Volt');


          // p 198         5.7
```

Scilab code Exa 5.8 Voltage Time And Force

```


                        // Example  5.8


B=0.5;                      // Megnetic Field
l1=0.03;                    // Length of conductor
v=0.01;                     // velocity in m/s
e1=B*l1*v;                  // Formula of emf
disp('(a) The induced emf is = '+string(e1)+' Volt')
   ;
l2=0.1;                     // Length
t1=l2/v;
disp(' Time for which the induced Voltage lasts is =
    '+string(t1)+' Second');

e2=B*l2*v;                  // Formula of emf
disp(' (b) The induced emf is = '+string(e2)+' Volt'
   );
t2=l1/v;
```

```
disp(' Time for which the induced Voltage lasts is =
    '+string(t2)+' Second');
disp(' (c) Because of the gap, No Current can flow.
   there for no force Required to Pull the coil.');
R=0.001;
F1=(B*B*l1*l1*v)/R;          // Formula of Force
disp(' (d.1) Force Required to pull the loop 1 = '+
   string(F1)+' N');
F2=(B*B*l2*l2*v)/R;          // Formula of Force
disp(' (d.2) Force Required to pull the loop 1 = '+
   string(F2)+' N');


         //       p 199       5.8
```

Chapter 6

Magnetic Circuits

Scilab code Exa 6.1 Megnetic Field Strength And Flux

```

                      // Example  6.1

N=200;              // No.Of turns
I=4;                // Current of a Coil
l=.06;              // circumference of Coil
H=(N*I)/l;          // Formula of Megnetic Field
   Strength
disp('(a) The Megnetic Field Strength = '+string(H)+
   ' A/m');
mo=4*%pi*10^-7;     // Permeability of free Space
mr=1;               //Permeability of coil
B=mr*mo*H;          // Formula of Flux Density
disp('(b) The Flux Density is = '+string(B)+' Tesla'
   );
A=500*10^-6;        // Area of Coil
Q=B*A;              // Total Flux
disp('(c) The total Flux is = '+string(Q)+' Wb');



```

```
              //   p  211          6.1
```

Scilab code Exa 6.2 Megnetomotive Force

```


                       // Example   6.2

Q=0.015;              // Flux
A=200*10^-4;          // Area of Conductor
mo=4*%pi*10^-7;       // Permeability of free Space
B=Q/A;                // Megnetic Flux Density
H=B/mo;               // Megnetic Field Strength
l=2.5*10^-3;          // Air Gap
F=H*l;                // Formula of Magnetomotive Force (mmf)

disp(' Magnetomotive Force (mmf) is = '+string(round(F))+' At');




                  // p 212        6.2
```

Scilab code Exa 6.3 Reluctance And Current

```



                       // Example   6.3

Q=800*10^-6;          // Flux
```

```
A=500*10^-6;        // Area of Coil
mo=4*%pi*10^-7;     // Permeability of free Space
mr=380;             // Permeability of of Coil
l=0.4;              // circumference of Coil
R=l/(mr*mo*A);      // Formula of Reluctance
disp(' Reluctance of Ring is = '+string(R)+' A/Wb');
F=Q*R;              // Formula of Magnetomotive Force (mmf)
N=200;              // No.Of turns
I=F/N;              // Formula of Magnetising Current
disp(' Magnetising Current is = '+string(I)+' At');
               // p 212       6.3
```

Scilab code Exa 6.4 Current

```
                              // Example  6.4
B=0.9;              // Megnetic Flux Density
N=4000;             // No.Of turns
mo=4*%pi*10^-7;     // Permeability of free Space
Hc=820;             // Megnetic Field Strength for Core
lc=0.22;            // Length of Circuit
Ac=50*10^-6;        // Area of Circuit
Fc=Hc*lc;           // Magnetomotive Force (mmf) for Core
lg=0.001;           // Length of Air Gap
Ag=50*10^-6;        // Area of Megnetic Circuit
Hg=B/mo;            // Megnetic Field Strength for Air Gap
```

```
Fg=Hg*lg;            // Magnetomotive Force (mmf) for
    Air Gap
F=Fc+Fg;             // Total Magnetomotive Force (mmf
    )
I=F/N;               // Formula of Magnetising Current
disp(' Magnetising Current is = '+string(I)+' Amp');




          // p 215     6.4
```

Chapter 7

Self And Mutual Inductances

Scilab code Exa 7.1 Voltage

```
                        // Example  7.1

L=4;                    // Induction of a Coil
di=10-4;                // Decrease in Current
dt=0.1;                 // time Required to Decrease
    Current
e=L*(di/dt);            // Formula of Self induction
disp(' emf induced in a Coil is = '+string(e)+' Volt
    ');



        //  p 228      7.1
```

Scilab code Exa 7.2 Inductor And Voltage

```
                        // Example   7.2

N=150;                   // turns of Coil
Q=0.01;                  // Flux of Coil
I=10;                    // Current in Coil
L=N*(Q/I);               // Induction of a Coil
di=10-(-10);             // Decrease in Current
dt=0.01;                 // time Required to Decrease
    Current
e=L*(di/dt);             // Formula of Self induction
disp(' Induction of a Coil = '+string(L)+' H');
disp(' emf induced in a Coil is = '+string(e)+' Volt
    ');



        //  p 228      7.2
```

Scilab code Exa 7.3 Inductor And Voltage

```




                        // Example   7.3

N=100;                   // turns of Coil
dQ=0.4-(-0.4);           // Flux of Coil
di=10-(-10);             // Decrease in Current
L=N*(dQ/di)*10^-3;               // Induction of a Coil
disp(' (a) induction of a Coil is = '+string(L)+' H'
    );
```

```
dt=0.01;                    // time Required to Decrease
    Current
e=L*(di/dt);                // Formula of emf (using Self
    induction)
disp('(b) emf induced in a Coil is = '+string(e)+'
    Volt');



        //  p 229      7.3
```

Scilab code Exa 7.4 Inductor And Energy

```


                              // Example  7.4

r=0.75*10^-2;          // Radius  of Solenoid
A=%pi*r*r;             // area of Solenoid
N=900;                 // No,of turns
l=0.3;                 // Length of Solenoid
mo=4*%pi*10^-7;        // Permeability of free Space
L=(N*N*mo*A)/l;        // Formula of Induction of a Coil
I=5;                   // Current of Coil
disp(' Induction of a Coil = '+string(L)+' H');
w=0.5*L*I*I;           // Energy Store
disp(' Energy Stored is = '+string(w)+' J');



        // p 229     7.4
```

Scilab code Exa 7.5 Megnetic Field Strength And Voltage

```
                      // Example  7.5

r=1*10^-2;              // Radius  of rod
A=%pi*r*r;              // area of rod
N=3000;                 // No.of turns
I=0.5;                  // Current in the rod
l=0.2;                  // Diameter of rod
B=1.2;                  // Megnetic Flux Density
H=(N*I)/l;              // Megnetic Field Strength
m=B/H;                  // Permeability of rod
disp(' (a) Permeability of iron = '+string(m)+' Tm/A
    ');
mo=4*%pi*10^-7;         // Permeability of free Space
mr=m/mo;                // relative Permeability
disp(' (b) Relative Permeability of iron = '+string(
    round(mr)));
Q=B*A;                  // Flux
dQ=Q*0.9;               // Chenge in Flux
L=(N*Q)/I;              // Formula of Induction of a
    Coil
disp(' (c) Induction of a Coil = '+string(L)+' H');
di=0.01;
e=N*(dQ/di)            // Formula of emf (using Self
    induction)
disp(' (d) Voltage in a Coil = '+string(e)+' Volt');



      //   p 229     7.5
```

Scilab code Exa 7.6 Voltage

```
                        // Example  7.6

i=1;                        // Current in A Coil
R=3;                        // R of Coil
L=0.1*10^-3;                // Inductance of Coil
di=10000;                   // Decrease in Current
dt=1;                       // time Required to Decrease Current
V=(i*R)+L*(di/dt);          // Formula Of Potential Diffrence
disp(' Potential Diffrence Across the Terminal is = '+string(V)+' Volt');




     // p 230      7.6
```

Scilab code Exa 7.7 Inductor And Voltage

```

                        // Example  7.7

k=1;                      // Constant
N1=2000;                  // turns of Solenoid
N2=500;                   // turns of Coil
mo=4*%pi*10^-7;           // Permeability of free Space
A=30*10^-4;               // Area of aCoil
l=0.7;                    // Length of Solenoid
z=k*N1*N2*mo*A;           // alphabet for simplicity
M=z/l;                    // Formula of Mutual Inductance
disp('(a) Mutual induction of a Coil = '+string(M)+' H');
dit=260;                  // Rate of Chenge of Current
```

```
e=M*dit;                    // Formula of emf (using
   Mutual induction)
disp('(b) emf induced in a Coil is = '+string(e)+'
   Volt')




       // p232         7.7
```

Scilab code Exa 7.8 Inductor

```

                           // Example  7.8

N2=1700;                       // turns of Coil 1
Q2=0.8*10^-3;                  // total Megnetic Flux
I2=6;                          // Current in A Coil 2
L2=N2*(Q2/I2);                 // Formula for (Self
   Inductance of Coil 1)
disp('(a) Self Induction of a Coil 2 = '+string(L2)+
   ' H');
N1=600;                        // turns of Coil 2
L1=L2*(N1^2/N2^2);             // Formula for(Self
   Inductance of Coil 2)
disp('(b) Self Induction of a Coil 1 = '+string(L1)+
   ' H');
Q21=0.5*10^-3;                 // Megnetic Flux in 1st
   Coil
k=Q21/Q2;                      // Constant
disp( '(c) Perposnality Constant (k) = '+string(k));
M=k*sqrt(L1*L2);               // Mutual Inductance of
   Coil 1 & 2
disp('(d) Mutual induction of a Coil = '+string(M)+'
   H');
```

```
// p 233         7.8
```

Scilab code Exa 7.9 Inductor

```



                    // Example  7.9

N2=800;                          // turns of Coil 2
N1=1200;                         // turns of Coil 1
Q2=0.15*10^-3;                   // Megnetic Flux in Coil 2
Q1=0.25*10^-3;                   // Megnetic Flux in Coil 1
I2=5;                            // Current in A Coil 2
I1=5;                            // Current in A Coil 1

L1=N1*(Q1/I1);                   // Formula for (Self
    Inductance of Coil 1)
disp('(a) Self Induction of a Coil 1 = '+string(L1)+
    ' H');

L2=N2*(Q2/I2);                   // Formula for (Self
    Inductance of Coil 2)
disp('(b) Self Induction of a Coil 2 = '+string(L2)+
    ' H');

k=0.6;                           // Coefficient of Coupling
     Constant
Q12=k*Q1;                        // Formula for (Megnetic
    Flux in 2nd Coil)
M=N2*(Q2/I1);                    // Formula for (Mutual
    Inductance of Coils)
disp('(c) Mutual induction of a Coil = '+string(M)+'
```

```
    H');

k1=M/sqrt(L1*L2);          // Mutual Inductance of
   Coil 1 & 2
disp('(d) Coefficient of Coupling between the Coil =
    '+string(k1)+' H');



       // p 233        7.9
```

Scilab code Exa 7.10 Inductor

```


                       // Example  7.10

La=1.4;                // Inductance of 2 Similar
   Coupled Coil in Series
Lo=0.6;                // Inductance of 2 Similar
   Coupled Coil in Opposing
M=(La-Lo)/4;           // Formula for (Mutual
   Inductance of Coils)
disp('(a) Mutual induction of a Coil = '+string(M)+'
    mH');

                  // Since La= L1+L2+2M      but (M=0.2
                      mH)
                  // there for L1= L2= 5 mh

L1=0.5*10^-3;                 // Self Inductance of
   Coil 1
L2=0.5*10^-3;                 // Self Inductance of
   Coil 2
k=(M*10^-3)/sqrt(L1*L2);      // Mutual Inductance of
```

```
     Coil 1 & 2
disp('(b) Coefficient of Coupling between the Coils
   = '+string(k));




                    // p136      7.10
```

Scilab code Exa 7.11 Inductor

```


                             // Example  7.11

                    // Net Induction When in Same
                       Direction  i.e 1.8= L1+L2+2M
                    // Net Induction When in Opposite  i.e
                        0.8= L1+L2-2M
                    // by Solving 2 equation we get M=
                       0.25
k=0.6;
M=0.25;
disp('(a) Mutual induction of a Coil = '+string(M)+'
    H');
                          // by Adding Eq 1 & 2 will get L1
                             +L2= 1.3 H
                          // we know that k= M/(L1*L2)
L1L2=M^2/k^2;             // using above Formula
                          // By using L1L2 & L1+L2
L12=1.3;                  // L1+L2
L1_L2=sqrt(L12^2-4*L1L2);   // Value of  L1-L2

                  // by using L1+L2 & L1-L2 will get

```

```
L1=1.149;
L2=0.151;
disp('(b.1) Self Induction of a Coil 1 = '+string(L1
   )+' H');
disp('(b.2) Self Induction of a Coil 2 = '+string(L2
   )+' H');



              // p 237      7.11
```

Scilab code Exa 7.12 Inductor

```


                     // Example   7.12

k=0.433;                    // Coefficient of
   Coupling Constant
L1=8;                       //Self Inductance of
   Coil 1
L2=6;                       //Self Inductance of
   Coil 2
M=k*sqrt(L1*L2);            // Mutual Inductance of
   Coil 1 & 2

Lpa=(L1*L2-M^2)/(L1+L2-2*M);      // Mutual Induction
    assists Self Induction
disp('(a) Mutual Induction assists Self Induction  =
    '+string(Lpa)+' H');

Lpo=(L1*L2-M^2)/(L1+L2+2*M);      // Mutual Induction
    Opposes Self Induction
disp('(b) Mutual Induction Opposes Self Induction  =
    '+string(Lpo)+' H');
```

```
        // p 239        7.12
```

Chapter 8

DC Transients

Scilab code Exa 8.1 Voltage

```
                  // Example 8.1

          // From diagram 8.3

          //  Equivalent resistance i.e Req= 20+
             (20||10)

Req= 20+{(20*10)/(20+10)};        // Equivalent
   resistance
V=24;                             // Supply voltage
I=V/Req;                          // Supply current
R=20;                             // Resistance
R1=20+10;                         // Total
   Resistance   [ from Fig 8.3b ]
Il=I*{20/(20+10)};                // Current through
    inductor
io=Il;                            // Open-ckt
   current
disp(' Open-ckt current = '+string(io)+' Amp');

```

```
Vr=-io*R;                              // Voltage across 20 Ohms resistor
disp(' Voltage across 20 Ohms resistor = '+string(Vr)+' Volt');

          // Voltage across inductor is given by  i.e [ e=L*{io*(R/L)} ]
          // that is [ e= io*R ]

e=io*R1;                               // Voltage across inductor
disp(' Voltage across inductor = '+string(e)+' Volt');




              //  p 276            8.1
```

Scilab code Exa 8.2 Current And Power

```

               //  Example 8.2


R=0.8;                    // Resistance
L=1.6;                    // Inductor
t1=L/R;                   // Time

             // Instantaneous current is ( it= Io*e(-t/2) )

Io=20/exp (0.5);          // The current ( at t= -1 & i= 20A )
disp(' The value of current at t=0 i(0) = '+string(
```

```
    Io)+' Amp');

i1=Io*exp (-0.5);      // Current through inductor at
    t= 1S
i=7.36;                // i1=7.357 we have taken as (
    i=7.36 )
p1=i*i*R;              // Power absorbed by Resistor
disp(' Power absorbed by inductor at t= 1S P(1) = '+
    string(-p1)+' Watt');

            // We know that w=0.5*L*it^2;  w= 100 J

it=sqrt(200/1.6);      // Flow of current
t=log (Io/it)*2;       // Time required to store
    Energy 100J
disp(' Time required to store Energy 100J = '+string
    (t)+' Second');



                 //          p 277              8.2
```

Scilab code Exa 8.3 Current And Time

```


                 //   Example 8.3

R=10;                        // Resistance
L=14;                        // Inductor
t1=L/R;                      // Time

V=140;                       // Voltage
Io=V/R;                      // Steady State current
t2=0.4;                      // Time
```

```
i=Io*(1-exp (-t2/t1));        // Value of current at t
   = 0.4
disp(' Value of current at (t=0.4) = '+string(i)+'
   Amp');

                // ==> We have formula  it=Io*exp (-t/
                   t1) .
it=8;                         // Current of 8 Amp
t=-log(it/14)*t1;             // Time taken to rech at
    i=8 A
disp('Time taken to rech at i=8 A = '+string(t)+'
   Second');




                  //   p 279          8.3
```

Scilab code Exa 8.4 Current

```

                //   Example 8.4

           // From the diagram 4.5

V1=20;                                      // Source
   voltage
R=80;                                       // Series
   resistance
io1=V1/R;                                   // Steay state
    current
disp(' Steay state current (at t=0- ) = '+string(io1
   )+' Amp');

          // Because current in inducor can't charge
```

```
instantaneously

disp(' Steay state current (at t=0+ ) = '+string(io1)+' Amp');

V2=40;                                  // Source voltage
Io2=(V1+V2)/R;                          // Steay state current at t= infinity
disp(' Steay state current (at t= infinity ) = '+string(Io2)+' Amp');

L=40*10^-3;                             // Inductor
t1=L/R;                                 // Time COnstant
t=0.001;                                // Time of 1 ms
            // By the formula ==>  i(1 ms)= io1*(io1-Io2)*(1-e-(t/t1))

Ims=io1+(Io2-io1)*(1-exp (-t/t1));     // Steay state current (at t=1ms)
disp(' Steay state current (at t= 1ms ) = '+string(Ims)+' Amp');



                //  p 279                 8.4
```

Scilab code Exa 8.5 Current

```

                //  Example 8.5

        // From the diagram 4.6
```

```

V=20;                           // Source Voltage
Io=V/(25+5);                    // Current iL(0-)
disp('Current iL(0-) is = '+string(Io)+' Amp');

R1=30;                          // Resistance of 30 Ohms
i2=V/R1;                        // Current i2(0-)
disp('Current i2(0-) is = '+string(i2)+' Amp');

          // Because current in inducor can't charge instantaneously.
disp('Current iL(0+) is = '+string(i2)+' Amp');

R12=60;                          // Resistance of 60 Ohms
R3=30;                           // Resistance of 30 Ohms
R45=30;                          // Resistance of 30 Ohms
Req=R45+[(R12*R3)/(R12+R3)];     // Equivalent Resistance
L=2;                             // Inductor
t=L/Req;                         // Time constant
t1=0.02;                         // Current of 20 mA
I1=0.667*exp(-t1/t);                // Inductor current ( iL(t)= Io*e-t1/t )
disp('Inductor current iL(t) is = '+string(I1)+' Amp');

           // ==> [ By using Current divider ]
I2=-I1*(R12/(R12+R3));           // Inductor current at( t=20 mA)
disp('Inductor current at( t=20 mA) is = '+string(I2)+' Amp');


                 //  p 280            8.5
```

Scilab code Exa 8.6 Voltage And Current

```



                                    // Examle 8.6

Vo=3;                          // Supply voltage
vo=0;                          // Voltage at V(o+)  { Because instantly capacitor can't charge }
disp(' Voltage across capacitor at V(o+) = '+string(vo)+' Volt');

R=1500;                        // Resistance
Io=Vo/R;                       // Current of capacitor
io=Io;                         // Current of capacitor at i(o+)
disp(' Current across capacitor at i(o+) = '+string(io)+' Amp');

C=5*10^-6;                     // Capacitor
t=R*C;                         // Time constant
disp(' Time constant = '+string(t)+' Second');

t1=15*10^-3;                   // Time instant          ==> { v=Vo*(1-e-(t1/t)) }
v=Vo*(1-0.135);                // Voltage at Time t1       { e-(t1/t)=0.135 }
disp(' Voltage across capacitor at ( t=15 mS ) = '+string(v)+' Volt');

i=Io*0.135;                   // Current at Time t1     ==> { i=Io*e-(t1/t) }
disp(' Current of capacitor at ( t=15 mS ) = '+
```

```
string(i)+' Amp');



// p 284 8.6
```

Scilab code Exa 8.7 Voltage And Current

```
// Examle 8.7

Vo=3;                    // Supply voltage
vo=Vo;                   // Voltage at V(o+)
vio=Vo;                  // Voltage at V(o-)
disp('Voltage across capacitor at V(o+) = '+string(
   vo)+' Volt');

R=100;                   // Resistance
Io=Vo/R;                 // Current of capacitor
io=-Io;                  // Current of capacitor at i
   (o+)
disp('Current across capacitor at i(o+) = '+string(
   io)+' Amp');

C=5*10^-6;               // Capacitor
t=R*C;                   // Time constant
disp('Time constant = '+string(t)+' Second');

t1=1.2*10^-3;            // Time instant        ==> {
    v=Vo*e-(t1/t) }
v=Vo*0.0907;             // Voltage at Time t1      {
```

```
    e-(t1/t)=0.0907 }
disp('Voltage across capacitor at ( t=1.2 mS ) = '+
    string(v)+' Volt');

i=-Io*0.0907;               // Current at Time t1  ==> {
    i=-Io*e-(t1/t) }
disp('Current of capacitor at ( t=1.2 mS ) = '+
    string(i)+' Amp');






                          //  p 285         8.7
```

Scilab code Exa 8.8 Current

```

                   //  Example 8.8

             // From the diagram 8.15

R1=1000;                               // Resistance of 1
    kilo-Ohms
R2=10000;                              // Resistance of 10
    kilo-Ohms
R3=1000;                               // Resistance of 1
    kilo-Ohms
Rth=[(R1+R2)*R3]/(R1+R2+R3);           // Equivalent
    resistance
C=10*10^-6;                            // capacitor
t=Rth*C;                               // Time constant
V=30;                                  // Source voltage
Vc=V*(R1/(R1+R2));                     // Voltage across
```

```
    the capacitor

            // Apply KVL to outer loop
            // we get 30-Io*R1-15= 0
Io=15/R1;                         // Current in the outer loop
Iin=V/(R1+R2+R3);                 // Open=ckt current

            // We know that  ==> it=Iin+[Io-Iin]*e(-t1/t)
t1=0.001;                         // Assume t1=1 mS
it=Iin+[Io-Iin]*exp(-t1/t);       // Current i(t)
disp(' Current i(t) is = '+string(it)+' Amp   oR   i(t)= 2.5+(15-2.5)*e(-t/9.17ms) mA');




                    // p 287              8.8
```

Chapter 9

Alternating Voltage And Current

Scilab code Exa 9.1 Voltage And Angle

```

                            // Example  9.1

                          // Given v= 20 sinwt
Q=asind(10/20);           // Angle
disp('(a) The Angle at which (v=10v) is = '+string(Q)+' Digree');
disp('(b.1) The maximum value is (Vm)= 20 Volt');
disp('(b.2) This Occurs twice in acycle i.e at( wt = 90 or 270)');



            // p 305          9.1
```

Scilab code Exa 9.2 Voltage Time And Frequency

```
                        // Example 9.2

                            // Given v=0.04 sin(2000t
                               +60)V

w=2000;                     // Angular Velocity
disp(' The Angular Velocity is = '+string(w)+' rad/s
   ');

f=w/(2*%pi);                // frequency
disp(' Frequency is = '+string(f)+' Hz');

v=0.04*sind(2000*160*10^-6*(180/%pi)+60);      //
   Voltage at (t=160 us)
disp(' Voltage at (t=160 us) = '+string(v*1000)+' mV
   ');

T=1/f;                      // Time Period
t=(60/360)*T;               // Time represent y 60
   phase Angle
disp(' Time represent y 60 phase Angle = '+string(t
   *1000)+' mS');






             // p 305    9.2
```

Scilab code Exa 9.3 Voltage

```


```

```
                        // Example  9.3

vm=20/2;                // Maximum value of Voltage
T=2*5*10^-3;            // Timwe Period
f=1/T;                  // Frequency
w=2*%pi*f;              // Angular Frequency
disp('Angular Frequency is = '+string(w)+' rad/s');
disp('instantaneous value of Voltage  is v= 10 sin (628.3t+Q)');

            // at (t=0 v= -3.6 V)   i.e v=10sinQ

Q=asind(-0.36);     // Angle at (t=0)  ( ==> in Book Q=-158.9 given Which is wrong)
v= 10*sind(628.3*0.012*(180/%pi)-Q);
disp('the Voltage at (t=12 mS) = '+string(-v)+' Volt');




      // p306     9.3
```

Scilab code Exa 9.4 Current And Time

```


                        // Example  9.4

f=60;                   // Frequency
w=2*%pi*f;              // Angular Frequency
disp(' Angular Frequency is = '+string(w)+' rad/s');

disp(' instantaneous value of Voltage  is i= 12 sin (377t)A');
```

```
i= 12*sind(377*(1/360)*(180/%pi));    // Formula of Current
disp(' The Value ofCurrent After (t=1/360 s) = '+string(i)+' Amp');

i1=9.6;                                    // Current
t={asind(i1/12)*%pi}/(377*180);            // formula of Time Derived from Current Eq
disp(' Time Required to Rech at (t=9.6) = '+string(t*1000)+' mS');




        // p306        9.4
```

Scilab code Exa 9.5 Time

```

                        // Example  9.5

                       // Given I1=4 Sin(100*pi*t+30)
                       // Given I2= 6 sin(100*pi*t)
f=50;                        // Frequency
w=2*%pi*f;                   // Angular Frequency
T=1/f;                       // Time Period
t=20*10^-3*(30/360);         // Time for 30 Digree Revolution
disp('Time for 30 Digree Revolution = '+string(t*1000)+' mS');
disp('The Phasor i1 Leads the Phasor i2 by 30 Digree or (t=1.67 mS)');


```

```
            // p 312          9.5
```

Scilab code Exa 9.6 Power

```


                      // Example   9.6

R=10;                // Resistance
i=4+%i*3;            // Current
I=sqrt(4^2+3^2);     // Absolute Value of Current
Ir=4;                // Real Component of Current
Ii=3;                // Imaginary Component of Current
Q=atand(3/4);        // Phase Angle
Pr=Ir^2*R;           // Power Due to Real Component
disp('Power Due to Real Component is = '+string(Pr)+' Watt');

Pi=Ii^2*R;           // Power Due to Imaginary Component
disp('Power Due to Imaginary Component is = '+string(Pi)+' Watt');

P=I^2*R;             // total PowerConsumed
disp('total Power Consumed is = '+string(P)+' Watt');



               // p 316          9.6
```

Scilab code Exa 9.7 Current

```


                    // Example 9.7

I1=10+%i*0;                    // Sinusoidal Current I1
I2=10+(%i*10*sqrt(3));         // Sinusoidal Current I2
I=I1+I2;                       // Resultant Current
disp('resultant Current is = '+string(I)+' Amp OR ('+string(abs(I))+' <'+string(atand(imag(I),real(I)))+' Amp )');





         // p 318 9.7
```

Scilab code Exa 9.8 Current

```


                    // Example 9.8

I1=10+%i*0;               // Current i1=14.14 sin(wt) A
I2=10+%i*17.32;           // Current i2=28.28 sin(wt+60) A
I=I1+I2;                  // Summation of 2 Current
disp('Summation of 2 Current is = '+string(I)+' Amp or 37.42<40.9 ');

```

```
            // I= 20+i17.32    i.e I= 37.42<40.9

disp(' Expration for Sum of 2 Current i= 37.42 Sin(wt+40.9)A');
Im=37.42;                    // Absolute Value of I
i=Im/sqrt(2);                // RMS value I
disp(' Rms Value of sum is = '+string(i)+' Amp');




          // p 318      9.8
```

Scilab code Exa 9.9 Current

```

                            // Example   9.9

I1=3.535+%i*0;                  // Rectangular form RMS of I1   i.e I1= 5/1.14<0
I2=3.061+%i*1.768;              // Rectangular form RMS of I2   i.e I2= 5/1.14<30
I3=-1.768-%i*3.061;             // Rectangular form RMS of I3   i.e I3= 5/1.14<-120
I=I1+I2+I3;                     // Resultant of Current
disp(' Resultant Rms Value of Cuttent = '+string(I)+' Amp   OR  ('+string(abs(I))+' <'+string(atand(imag(I),real(I)))+' Amp )');





        // p 318      9.9
```

Scilab code Exa 9.10 Current

```


                        // Example   9.10


                          // Given  i= 10+10SinQ  A
                          // Since  it  is  Unsymetrical waveform
                          // Average  can  be  found  over 1  cycle
                          // i.e  Average  Value  of Current  is  i= 10  Amp
I1=10;                    // Dc  Current  10  Amp
I2=10/1.414;              // Sinusoidal  Current  10/root(2)
Irms=sqrt(I1^2+I2^2);     // Rms  Value  of  resultant Current
disp(' Average value of Resultant Current = '+string(I1)+' Amp');
disp(' Rms  value of Resultant Current = '+string(Irms)+' Amp');





            // p 319       9.10
```

Scilab code Exa 9.11 Voltage

```


                    // Example  9.11

T=8*10^-3;                    // Time period
A01=10*10^-3;                 // Area between t= 0-1
A13=-5*2*10^-3;               // Area between t= 1-3
A34=20*10^-3;                 // Area between t= 3-4
A45=0*10^-3;                  // Area between t= 4-5
A58=5*3*10^-3;                // Area between t= 5-8
A=A01+A13+A34+A45+A58;        // Total Area of waveform
V=A/T;                        // Average value of waveform
disp(' Average value of waveform = '+string(V)+' Volt');






          // p 230       9.11
```

Scilab code Exa 9.12 Voltage

```


                    // Example  9.12

T=20*10^-3;                     // Time period
A0_10=40*100*10^-3;             // Area between t= 0-10
A10_20=100*10*10^-3;            // Area between t= 10-20
A=A0_10+A10_20;                 // Total Area of waveform
```

```
V=A/T;                          // Average value of
    waveform
disp(' Average value of waveform = '+string(V)+'
    Volt');

v=sqrt(V);                      // Rms value
disp(' Rms value of waveform = '+string(v)+' Volt');





          // p 230     9.12
```

Scilab code Exa 9.13 Current And Power Factor

```

                        // Example  9.13

T=3;                    // Time period
A1=10;                  //Current under Area between t=
     0-2
A2=0;                   //Current under Area between t=
     2-3

Irms=sqrt((A1*A1*2+A2*A2)/3);          // Rms value
disp(' Rms value of waveform = '+string(Irms)+' Amp'
    );

Iav=(A1*2+A2*1)/3;                     // Average Value
disp(' Average value of waveform = '+string(Iav)+'
    Amp');

F=Irms/Iav;                            // Form Factor
disp(' Form Factor of waveform = '+string(F));
```

```
            // p 321       9.13
```

Scilab code Exa 9.14 Voltage And Power Factor

```


                      // Example   9.14


T=5*10^-3;                  // Time period
Vm=10;                      // Peak Value

Vav=Vm/2;                   // Average Value
disp('Average value of waveform = '+string(Vav)+'
   Volt');

Vrms=Vm/sqrt(3);            // Rms value of Saw-tooth
   waveform
disp('Rms value of waveform = '+string(Vrms)+' Volt
   ');

F=Vrms/Vav;                 // Form Factor
disp('Form Factor of waveform = '+string(F));

Pf=Vm/Vrms;                 // Peak Factor
disp('Peak Factor of waveform = '+string(Pf));




        //  p 321     9.14
```

Scilab code Exa 9.15 Power And Power Factor

```

                        // Example 9.15

                       // Given v= 55 Sin(wt)V & i= 6.1Sin(wt-pi/5)A
Q=%pi/5;                        // Phase Angle
Vm=55;                          // Peak Value of Voltage
Im=6.1;                         // Peak Value of Current
V=Vm/sqrt(2);                   // Rms value of Voltage
I=Im/sqrt(2);                   // Rms value of Current

Pav=V*I*cos(Q);                 // Average Value of power
disp(' Average value of Power = '+string(Pav)+' Watt');

Pa=V*I;                         // Apparent Value of power
disp(' Apparent value of Power = '+string(Pa)+' VA');

P=Pav-(V*I*cos(0.6-Q));         // Instant Power at (wt = 0.3)
disp(' Instant Power at (wt= 0.3) = '+string(P)+' VA');

pf=cos(Q);                      // Power Factor
disp(' Power Factor = '+string(pf*100)+' %');


```

```

        // p 323      9.15
```

Chapter 10

AC Circuits

Scilab code Exa 10.1 Current Power And Power Factor

```

            // Example 10.1

        // From Diagram 10.2a

Vm=141+%i*0;                // Peak value of Voltage
V=Vm/1.414;                 // Rms value of Voltage
v=100+%i*0;                 // Here will have V=99.70, but we took v=100
R=3;                        // Resistance
wL=0.0127*100*%pi;                  // Reactance
Z=R+%i*wL;                  // Impedence
I=v/Z;                      // Current
disp(' The value of current = '+string(I)+' Amp    OR    '+string(abs(I))+'<'+string(atand(imag(I),real(I)))+' Amp');

        // Study state current is I=20A & Q=53.1 Lagging.
disp(' Expression for instantaneous current ==> [ 28.28 sin(100%pi*t -53.1)A ]  ');
```

```
P=abs(v)*abs(20)*cosd(53.1);          // Average power
    ==> (I=20.032 ,so take I=20 )
disp(' Average power is = '+string(P)+' Watt');

pf=cosd(53.1);          // Power factor
disp(' Power factor is = '+string(pf)+' Lagging');




                    //  p 342           10.1
```

Scilab code Exa 10.2 Current Power And Power Factor

```


                    // Example  10.2

P=750;                  // Rated  Power
V=230;                  // Supply Voltage
f=50;                   // Frequency
Vr=100                  // Rated Voltage
I=P/Vr;                 // Rated Current
Vc=sqrt(V^2-Vr^2);      // Voltage across Capacitor
Xc=Vc/I;                // Capacitve Reactance
C=1/(2*%pi*f*Xc);       // Capacitance
disp(' Required Capacitance = '+string(C)+' F');

Q=acosd(Vr/V);           // Phase Angle
disp(' Phase Angle = '+string(Q)+' Didree');

pf=cosd(Q);              // Power Fector
disp(' Power Factor = '+string(pf)+' Leading');

```

```
Pa=V*I;                    // Apparent power
disp(' Apparent value of Power = '+string(Pa)+' VA');

Pr=V*I*sind(Q);            // Reactive Power
disp(' Reactive Power = '+string(round(Pr))+' VAR');



        // p 344    10.2
```

Scilab code Exa 10.3 Resistance Voltage And Power

```


                             // Example  10.3

R=120;                       // Resistance
Xc=250;                      // Capacitve Reactance
Q=-64.4;                     // Phase Angle
I=0.9+%i*0;                  // Current
Z=R-%i*Xc;                   // Impedance
disp(' The Impedance is = '+string(Z)+'  or  ('+string(abs(Z))+' <'+string(atand(imag(Z),real(Z)))+' Amp )');

pf=cosd(Q);                  // Power Fector
disp(' Power Factor = '+string(pf)+' Leading');

V=I*Z;                       // Supply Voltage
disp(' Supply Voltage = '+string(V)+'  or  ('+string(abs(V))+' <'+string(atand(imag(V),real(V)))+' Amp )');
v=249.6;                     // Peak value of Voltage

```

```
Vr=I*R;                         // Voltage at Resistor
disp(' Voltage across Resistor = '+string(Vr)+' Volt ');

Vc=I*Xc;                        // Voltage across Capacitor
disp(' Voltage across Capacitor = '+string(Vc)+'  or ('+string(abs(Vc))+' < -90 Amp )');
Pa=v*I;                         // Apparent power
disp(' Apparent value of Power = '+string(Pa)+' VA');

Pac=v*I*cosd(Q);                // Active Power
disp(' Active Power = '+string(Pac)+' Watt');

Pr=v*I*sind(Q);                 // Reactive Power
disp(' Reactive Power = '+string(-Pr)+' VAR');



         //  p 345        10.3
```

Scilab code Exa 10.4 Resistance Power And Power Factor

```


                          // Example  10.4

                           // Given V= 160+i120 & I= -4+i10
Vi= 160+%i*120;           // Sinusoidal Voltage  i.e 200<36.87
Ii= -4+%i*10;             // Sinusoidal Current   i.e 10.77<111.8
Z=Vi/Ii;                    // Impedance
```

```
Q=-74.93;                   // Phase Angle
V=200;                      // peak Value of Voltage
I=10.77;                    // peak Value of Current
disp(' Impedance = '+string(Z)+' Ohms');

pf=cosd(Q);                 // Power Fector
disp(' Power Factor = '+string(pf)+' Leading');
disp(' the Circuit is Capacitive , Becuase Imaginary
    part of impedance is negative .');

Pa=V*I*cosd(Q);             // Active Power
disp(' Active Power = '+string(Pa)+' Watt');

Pr=V*I*sind(Q);             // Reactive Power
disp(' Reactive Power = '+string(-Pr)+' VAR');





        //    p 348       10.4
```

Scilab code Exa 10.5 Reluctance And Inductor

```

                         // Example  10.5


                       /// Given Z=R+iXl;  i.e Z= 10+i10
R=10;                       // Resistance
Xl=10;                      // Inductance
f=50;                       // Frequency
L=Xl/(2*%pi*f);             // Value of Inductor
disp(' The Value of Resistor is = '+string(R)+' Ohm'
   );
```

```
disp(' The Value of Inductor is = '+string(L)+' H');



        // p 348    10.5
```

Scilab code Exa 10.6 Resistance And Capacitor

```

                             // Example   10.6

                    // Given Z=R+iX;   i.e Z= 10-i10

R1=10;                          // Resistance
Xl=10;                          // Inductance
f=50;                           // Frequency
Z= 10-%i*10;                    // Impedance
Y=1/Z;                          // Admitance
disp(' The Admitance of Circuit is = '+string(Y)+' S
   ');
G=0.05;                         // here G=1/R
B=0.05;                         // here B= 1/C
R=1/G;                          // Resistance
disp(' The Resistance of Circuit is = '+string(R)+'
   Ohm');

C=B/(2*%pi*f);                  // Capacitance
disp(' The Capacitance of Circuit is = '+string(C)+'
   F');



        // p 348        10.6
```

Scilab code Exa 10.7 Resistance Power And Power Factor

```


                        // Example  10.7

L=0.15;                              // Inductance
w=100*%pi;                           // Angular Frequancy
C=100*10^-6;                         // Capacitance
R=12;                                // Resistance
V=100;                               // Voltage
Xl=w*L;                              // Indctive reactance
Xc=1/(w*C);                          // capacitive
   reactance
Z=R+%i*(Xl-Xc);                      // Impedance
disp(' The Value of Impedance is = '+string(Z)+'  or
     ('+string(abs(Z))+' <'+string(atand(imag(Z),
   real(Z)))+' Amp )');
r=12;                                // peak Value of
   impedance

I=V/Z;                               // Current
disp(' The Value of Current is = '+string(I)+'  or
   ('+string(abs(I))+' <'+string(atand(imag(I),real(
   I)))+' Amp )');
i=5.15;                              // peak Value of
   Current

Q=atand(15.3/12);                    // Phase Angle
disp(' Phase Angle = '+string(-Q)+' Didree');

Vr=i*r;                              // Voltage at Vr
disp(' Voltage at Vr = '+string(Vr)+' Volt');

```

```
Vc=i*Xc;                            // Voltage at Vc
disp(' Voltage at Vc = '+string(Vc)+' Volt');

Vl=i*Xl;                            //Voltage at Vl
disp(' Voltage at Vl = '+string(Vl)+' Volt');

pf=cosd(Q);                         // Power Fector
disp(' Power Factor = '+string(pf)+' Lagging');

Pa=V*i;                             // Apparent power
disp(' Apparent value of Power = '+string(Pa)+' VA')
    ;

Pav=V*i*pf;                         // Average Value of
    power
disp(' Average value of Power = '+string(Pav)+' Watt
    ');




        // p 349     10.7
```

Chapter 11

Resonance in AC Circuits

Scilab code Exa 11.1 Frequence And Voltage

```

               //  Example 11.1

L=0.15;                          // Inductor
C=100*10^-6;                     // Capacitor
fo=1/{2*%pi*sqrt(L*C)};          // Resonance frequency
disp('Resonance frequency (fo) = '+string(fo)+' Hz');

R=12;                            // Circuit resistance
V=100;                           // Source voltage
Io=V/R;                          // Maximum current by source
disp('Maximum current by source = '+string(Io)+' Amp');

r1=R^2/(2*L^2);                      // for easy calculation
r2=(1/(L*C));                        // for easy calculation
fc=(1/6.28)*sqrt(r2-r1);             // Frequency for
```

```
maximum capacitor voltage
disp('Frequency for maximum capacitor voltage = '+string(fc)+' Hz');


r3=(R^2*C^2)/2;                    // for easy calculation
fl=1/{2*%pi*sqrt((L*C)-r3)};       // Frequency for maximum capacitor voltage
disp('Frequency for maximum capacitor voltage = '+string(fo)+' Hz');

Xl=2*%pi*fo*L;                     // Inductive reactance
disp('Inductive reactance = '+string(Xl)+' Ohms');

Xc=1/(2*%pi*fo*C);                 // Inductive reactance
disp('Capacitive reactance = '+string(Xc)+' Ohms');

Q=Xl/R;                            // Quality factor
disp('Quality factor = '+string(Q));

VLC=Q*V;                           // Voltage drop across the elements
disp('Voltage drop across the elements = '+string(VLC)+' Volt');



                          // p 378              11.1
```

Scilab code Exa 11.2 Capacitor Voltage And Q FActor

```

                          // Example   11.2
```

```

L=0.5;                          // Inductance
V=100;                          // Supply Voltage
R=4;                            // Resistance
f=50;                           // Frequency
C=1/(4*%pi^2*f^2*L);            // Capacitance
disp('Capacitance is = '+string(C*10^6)+' uF');

I=V/R;                          // Current at Resonance Frequency
disp(' Current at Resonance Frequency = '+string(I)+' Amp');

wo=2*%pi*f;                     // Angular Frequency
Xl=157;                         // Indctive Reactance
Vc=I*Xl;                        // Voltage across Capacitor
disp(' Voltage across Capacitor = '+string(Vc)+' Volt');

Vl=Vc;                          // Voltage across Inductance
disp(' Voltage across Inductance = '+string(Vl)+' Volt');


Q=(wo*L)/R;                     // Q-Factor
disp(' Q-Factor is  = '+string(Q));






            //    p 378     11.2
```

Scilab code Exa 11.3 Inductor Current And Voltage

```

                    // Example  11.3


V=0.85;                         // Supply Voltage
f=175*10^3;                     // Frequency
C=320*10^-12;                   // Capacitance

L=1/(4*3.14^2*f^2*C);           // Inductance
disp('Inductance is = '+string(L*10^3)+' mH');

Xl=2*3.14*f*L;                  // Indctive reactance
Q=50;                           // Q-Factor
R=Xl/Q;                         // Resistance

I=V/R;                          // circuit current
disp(' Circuit current is = '+string(I*1000)+' mA');

Vc=Q*V;                         // Voltage across Capacitor
disp(' Voltage across Capacitor = '+string(Vc)+' Volt');




        //     p379      11.3
```

Scilab code Exa 11.4 Capacitor Current And Enegy

```

                    // Example  11.4

```

```
L=1*10^-3;                    // Inductance
V=120;                        // Supply Voltage
R=2;                          // Resistance
f=5*10^3;                     // Frequency
C=1/(4*%pi^2*f^2*L);          // Capacitance
disp('Capacitance is = '+string(C*10^9)+' nF');

I=V/R;                        // Current at Resonance
    Frequency
disp(' Current at Resonance Frequency = '+string(I)+
    ' Amp');

Emax=L*I^2;                   // Maximum Instantaneous
    Energy
disp(' The Maximum Instantaneous Energy = '+string(
    Emax)+' J');





        //    p 379         11.4
```

Scilab code Exa 11.5 Frequence And Q Factor

```


                        // Example  11.5

R1=0.51;                        // Resistance -1
R2=1.3;                         // Resistance -2
R3=0.24;                        // Resistance -3
Req=R1+R2+R3;                   // Eqviualent
    Resistance
L1=32*10^-3;                    // Inductance -1
```

```
L2=15*10^-3;                    // Inductance-2
Leq=L1+L2;                      // Eqviualent Inductance
C1=62*10^-6;                    // Capacitance-1
C2=25*10^-6;                    // Capacitance-2
Ceq=(C1*C2)/(C1+C2);            // Eqviualent Capacitance

fo=1/(2*%pi*sqrt(Leq*Ceq));          // Resonance Frequency
disp('Resonance Frequency is = '+string(round(fo))+' Hz');

Q=(1/Req)*sqrt(Leq/Ceq);             // Over all Q-Factor
disp('Over all Q-Factor is  = '+string(round(Q)));

wo=2*%pi*fo;
Q1=(wo*L1)/R1;                       // Q-Factor of Coil-1
disp('Q-Factor of Coil-1 is  = '+string(Q1));

Q2=(wo*L2)/R2;                       // Q-Factor of Coil-2
disp('Q-Factor of Coil-2 is  = '+string(Q2));




                  // p 380      11.5
```

Scilab code Exa 11.6 Frequence

```

                       // Example  11.6
```

```

f=150*10^3;                    // Frequency
Bw=75*10^3;                    // Band width
Q=f/Bw;                        // Q-Factor
disp(' Q-Factor is  = '+string(Q));
               // since Q < 10   there for we need
                  to solve by Equation
               // 75= f2-f1    &   150= root(f1*f2)
               // will get Eq ( f1^2+ 75f1- 22500= 0
                  ) by Eliminating f2
               // by factorization we have f1=(
                  117.1kHz or -192.1kHz )
f1=117.1;
f2=75+f1;
disp(' The half Power Frequencies are f1= '+string(
   f1)+' kHz   &  f2= '+string(f2)+' kHz');



      //   p 382      11.6
```

Scilab code Exa 11.7 Resistance Current And Capacitor

```

                         // Example  11.7

V=230;                         // Supply Voltage
L=200*10^-6;                   // Inductance
R=20;                          // Resistance
f=1*10^6;                      // Frequency
Xl=2*%pi*f*L;                  // Indctive reactance
C=1/(4*%pi^2*f^2*L);           // Capacitance
disp(' Required Capacitance = '+string(C*10^12)+' pF
   ');

```

```
Q=Xl/R;                              // Q-Factor
disp(' Q-Factor is  = '+string(Q));

Zo=L/(C*R);                          // dynamic Impedance
disp(' Dynamic Impedance is = '+string(Zo)+' Ohm');
Zs=8000;                             // Soures Resistance
Z=Zo+Zs;                             // Total Resistance

I=V/Z;                               // Total Line Current
disp(' Total Line Current is = '+string(I*1000)+' mA
    ');



                  //   p 388           11.7
```

Scilab code Exa 11.8 Frequence And Q Factor

```


                         // Example  11.8

L=0.24;                        // Inductance
C=3*10^-6;                     // Capacitance
R=150;                         // Resistance
f=1/(2*%pi*sqrt(L*C));         // Frequency
fo=f*sqrt(1-R^2*(C/L));        // Resonance Frequency
disp(' Resonance Frequency = '+string(fo)+' Hz');

Xl=2*%pi*fo*L;                 // Indctive reactance
Q=Xl/R;                        // Q-Factor
disp(' Q-Factor is  = '+string(Q));

Bw=fo/Q;                      // Band width
disp(' Band width is = '+string(Bw)+' Hz');
```

```
// p 387       11.8
```

Chapter 12

Three Phase Circuits And System

Scilab code Exa 12.1 Current

```

                        // Example  12.1

                          // Given Z= 32+i24
R=32;                     // Real Part of Z
X=24;                     // Imaginary Part of Z
z=R+%i*X;                 // Impedance
Z=abs(z);                 // Absolute value of Z
Vl=400;                   // Supply Voltage
Vph1=Vl/1.732;            // Voltage in Y−Connection
Iph1=Vph1/Z;              // Current in Y−Connection
Il1=Iph1;                 // Load Current in Y−
   Connection
disp(' Current Drawn ( for Y−Connection ) = '+string
   (Il1)+' Amp');
Vph2=Vl;                  // Voltage in Delta−Connection
Iph2=Vph2/Z;              // Current in Delta−Connection
Il2=1.732*Iph2;           // Load Current in Delta−
   Connection
```

```
disp(' Current Drawn (for Delta-Connection ) = '+string(Il2)+' Amp');




        //  p 409        12.1
```

Scilab code Exa 12.2 Current

```


                          // Example  12.2

Vl=415;                     // Supply Voltage
Vph=Vl/sqrt(3);             // Phase Voltage
p1=10000;                   // Load of 10-kW
p2=8000;                    // Load of 8-kW
p3=5000;                    // Load of 5-kW

IR=p1/Vph;                  //Current by ( 10-kW Load )
disp(' Current by ( 10-kW Load ) = '+string(IR)+' Amp');

IY=p2/Vph;                  // Current by ( 8-kW Load )
disp(' Current by ( 8-kW Load ) = '+string(IY)+' Amp');

IB=p3/Vph;                  // nCurrent by ( 5-kW Load )
disp(' Current by ( 5-kW Load ) = '+string(IB)+' Amp');

IH=IY*cosd(30)-IB*cosd(30);          // Horizontal Current
IV=IR-IY*sind(30)-IB*sind(30);       // Vertical
```

```
   Current
IN=sqrt(IH^2+IV^2);                    // Current in
   Neutral Conductor
disp(' Current in Neutral Conductor = '+string(IN)+'
    Amp');




          //    p 410       12.2
```

Scilab code Exa 12.3 Current

```

              // Example 12.3

Z1=100;                    // Impedence Z1 in Delta-
   connection load
R2=20;                     // Resistance R2 in Delta-
   connection load
f=50;                      // Frequency
L2=0.191;                  // Inductance
X2=2*%pi*f*L2;             // Reactance X2 in Delta-
   connection load
Z2=sqrt(R2^2+X2^2);        // Impedence Z2 in Delta-
   connection load
Q2=atand(60/20);           // Phase angle
C3=30*10^-6;               // Capacitor
Z3=1/(2*%pi*f*C3);         // Impedence Z3 in Delta-
   connection load
Q3=90;                     // Leading phase angle
I1=415/Z1;                 // Phase current I1 in loads RY
disp(' Phase current I1 in loads RY = '+string(I1)+'
    Amp');

```

```
I2=415/Z2;              // Phase current I2 in loads YB
disp(' Phase current I2 in loads YB = '+string(I2)+' Amp');

I3=415/Z3;              // Phase current I3 in loads BR
disp(' Phase current I3 in loads BR = '+string(I3)+' Amp');

IR=sqrt(I1^2+I3^2+(2*I1*I3*cosd(30)));        // Current in the liner conductor R
disp(' Current in the liner conductor R = '+string(IR)+' Amp');

QY=Q2-60;               // Phase diffrence between I2-I1
IY=sqrt(I1^2+I2^2+(2*I1*I2*cosd(QY)));        // Current in the liner conductor Y
disp(' Current in the liner conductor Y = '+string(IY)+' Amp');

QB=180-QY-30;           // Phase diffrence between I2-I3
IB=sqrt(I2^2+I3^2+(2*I2*I3*cosd(QB)));        // Current in the liner conductor B
disp(' Current in the liner conductor B = '+string(IB)+' Amp');




                    // p 411              12.3
```

Scilab code Exa 12.4 Current Power And Power Factor

```

```

```
            //  Example 12.4

          // ==> For star-connection
disp('   ** For star-connection   ** ');
Vl=400;                    // Voltage at load
Vph=Vl/1.732;              // Phase voltage
Zph=sqrt(20^2+15^2);       // Impedence per phase
Il=Vph/Zph;                // Line current
disp(' The line current (Il) = '+string(Il)+' Amp');

Rph=20;                    // Resistance per phase
CosQ=Rph/Zph;              // Power factor
disp(' Power factor = '+string(CosQ)+' Lagging');

P=1.732*Vl*Il*CosQ;        // Total active power
disp(' Total active power = '+string(P/1000)+' kW');

           // ==> For Delta-connection
disp('   ** For Delta-connection   ** ');
Vph1=Vl;                   // Phase voltage
Iph=Vph1/Zph;              // Phase current
IL=1.732*Iph;              // Load current
disp(' The Load current (IL) = '+string(IL)+' Amp');

disp(' Power factor = '+string(CosQ)+' Lagging');

P1=1.732*Vl*IL*CosQ;        // Total active power
disp(' Total active power = '+string(P1/1000)+' kW')
   ;


             //  p 412              12.4
```

Scilab code Exa 12.5 Power And Power Factor

```
// Example 12.5

p1=3000;                            // Load of 3-kW
p2=1500;                            // Load of 1.5-kW
P=p1+p2;                            // Total Load
disp(' Total Power Consumed = '+string(P)+' Watt');

Q=atand(1.732*(p1-p2)/(p1+p2));     // Power Factor Angle
pf=cosd(Q);                         // Power Factor
disp(' Power Factor is = '+string(pf));




      // p 417        12.5
```

Scilab code Exa 12.6 Current Power And Power Factor

```
// Example 12.6

Vl=415                              // Supply Voltage
p1=5200;                            // Load of 5.2-kW
p2=-1700;                           // Load of 1.7-kW

P=p1+p2;                            // Total Load
disp(' Total Power Consumed = '+string(P)+' Watt');

Q=atand(1.732*(p1-p2)/(p1+p2));     // Power Factor
```

```
Angle

pf=cosd(Q);                                    // Power Factor
disp(' Power Factor is = '+string(pf));

                                               // P= root(3)*Vl
                                                  *Il*Cos(Q)
Il=P/(1.732*Vl*pf);
disp(' Line Current is  = '+string(Il)+' Amp');




       // p 417          12.6
```

Chapter 13

Transformers

Scilab code Exa 13.1 Megnetic Flux And Voltage

```


                          // Example  13.1

E=6400;                                     // Supply Voltage
f=50;                                       // Frequency
N1=480;                                     // No.Of turns in Primary Coil
N2=20;                                      // No.Of turns in Secondary Coil

Qm=E/(4.44*f*N1);                           // The Peak Value of Flux
disp(' The Peak Value of Flux = '+string(Qm)+' Wb');

E1=4.44*f*N2*Qm;                            // Voltage induced in Secondary winding
disp(' Voltage induced in Secondary winding = '+string(E1)+' Volt');


```

```
            // p 487          13.1
```

Scilab code Exa 13.2 Flux Density Current And Voltage

```

                    // Example  13.2

E1=230;                          // Supply Voltage
f=50;                            // Frequency
N1=30;                           // No.Of turns in Primary Coil
N2=350;                          // No.Of turns in Secondary Coil
A=250*10^-4;                     // Area of the Core

Qm=E1/(4.44*f*N1);               // The Peak Value of Flux
Bm=Qm/A;                         // The Peak Value of Flux Density
disp(' The Peak Value of Flux Density = '+string(Bm)+' Tesla');

E2=E1*(N2/N1);                   // Voltage induced in Secondary winding
disp(' Voltage induced in Secondary winding = '+string(E2/1000)+' kV');

I2=100;                          // Current in Secondary Coil
I1=I2*(N2/N1);                   // Primary
```

```
   Current
disp(' Primary Current is  = '+string(I1/1000)+' kA'
   );




        // p 490        13.2
```

Scilab code Exa 13.3 Turns Ratio

```


                    // Example  13.3

Rl=800;                         // Load Resistance
Req=50;                         // O/P Resistance
K=sqrt(Rl/Req);                 // Ratio Constant
N21=K;                          // urns ratio of
   Transformer
disp(' Turns ratio of Transformer (N2/N1) = '+string
   (N21));





               // p 490        13.3
```

Scilab code Exa 13.4 Current

```

                    // Example  13.4'
```

```

                               // From the circuit Diagram Ip=30<0/{20+i20+2^2*(2-i10)}

Ip= 30/{20+%i*20+2^2*(2-%i*10)};    // Phase Current

Il=2*Ip;                             // Load current
disp('The Load current is Il = '+string(Il)+' Amp or ('+string(abs(Il))+' <'+string(atand(imag(Il),real(Il)))+' Amp )');








             // p 491       13.4
```

Scilab code Exa 13.5 Power

```

                         // Example  13.5

f=50;                                // Frequency
N1=30;                               // No.Of turns in Primary Coil
N2=66;                               // No.Of turns in Secondary Coil
A=0.015;                             // Area of the Core
Zl=4;                                // Load Impedance
Bm=1.1;                              // The Peak Value of Flux Density
Qm=Bm*A;                             // The Peak Value
```

```
of Flux

V2=4.44*f*N2*Qm;                          // O/P Voltage
I2=V2/Zl;                                 // O/P current
Ova=V2*I2;                                // Output Volt-Amperes
disp(' Output Volt-Amperes is = '+string(Ova/1000)+' kVA');





                 //   p 491        13.5
```

Scilab code Exa 13.6 Turns

```

                              // Example  13.6

f=50;                                     // Frequency
A=9*10^-4;                                // Area of the Core
Bm=1;                                     // The Peak Value of Flux Density
Qm=Bm*A;                                  // The Peak Value of Flux

E3=6;                                     // Voltage in Tertiary winding
N3=E3/(4.44*f*Qm);                        // No.Of Turns in Tertiary winding
disp(' No.Of Turns in Tertiary winding = '+string(round(N3*2)) +' turns');

```

```
E1=230;                          // Voltage in Primary winding
N03=round(N3);                   // Round figure
N1=(N03*E1)/E3;                  // No.Of Turns in Primary winding
disp(' No.Of Turns in Primary winding = '+string(round(N1)) +' turns');


E1=230;
E2=110;                          // Voltage in Secondary winding
N2=(N03*E2)/E3;                  // No.Of Turns in Secondary winding
disp(' No.Of Turns in Secondary winding = '+string(round(N2)) +' turns');





          //  p 491       13.6
```

Scilab code Exa 13.7 Current And Power Factor

```


                      // Example  13.7

VA=350;               // VA rating
V1=230;               // I/p Voltage
Io=VA/V1;             // I/p Current
Pi=110;               // I/p power
                      // Core Loss = I/p power at
```

```
                    no load
                              // Pi= V1*Io*CosQ
pf=Pi/VA;                     // Power factor
disp(' Power factor at no laod = '+string(pf));

Iw=Io*pf;                     // Loss component of no-load Current
disp(' Loss component of no-load Current = '+string(Iw)+' Amp');

Im=sqrt(Io^2-Iw^2);           // Magnetising component of no-load Current
disp(' Magnetising component of no-load Current = '+string(Im)+' Amp');



                    //   p 493        13.7
```

Scilab code Exa 13.8 Power

```


                              // Example  13.8

                               // We Know that Pi= Ph+ Pe=( Af+ Bf^2 )
                               // there for at 60Hz   100= 60A+ 3600B
                               //            at 40Hz   60 = 40A+ 1600B
                               // After Solving Equation We have
A=1.167;                       // Alphabet for Simlicity
B=0.00834;                     // Alphabet for Simlicity
```

```
f=50;                        // Frequency
Ph=A*f;                      // Hysteresis Loss
disp('Hysteresis Loss ( at 50 Hz ) = '+string(Ph)+' Watt');

Pe=B*f^2;                    // Eddy−Current Loss
disp('Eddy−Current Loss ( at 50 Hz ) = '+string(Pe)+' Watt');






                    //    p 495         13.8
```

Scilab code Exa 13.9 Current And Power Factor

```

                            // Example  13.9

pf1=0.2;                    // Power factor at 5 A
pf2=0.8;                    // Power factor at 120 A
Q1=acosd(pf1);              // Angle for 0.2 Power factor
Q2=acosd(pf2);              // Angle for 0.8 Power factor
V2=110;                     // Voltage in Secondary winding
V1=440;                     // Voltage in Primary winding
k=V2/V1;                    // Ratio Constant
I2=120;                     // Current in Secondary winding
i1=k*I2;                    // Current in primary winding
io=5;                       // No load Current
I1=23.99-%i*18;             // Current in primary winding in complex form
```

```
Io=1-%i*4.899;          // No load Current in complex
    form

I=I1+Io;                // Primary Current
disp(' Primary Current = '+string(I)+' Amp  or  '+
   string(abs(I))+'<'+string(atand(imag(I),real(I)))
   +' Amp');

pf=cosd(-42.49);        // Primary Power factor
disp(' Primary Power factor = '+string(pf));




         /// p 498       13.9
```

Scilab code Exa 13.10 Resistance And Power

```

                        // Example  13.10

kVA=50000;              // Single Phase supply
V1=4400;                // Voltage in primary winding
V2=220;                 // Voltage in Secondary
   winding
R1=3.45;                // primary Resistance
R2=0.009;               // Secondary Resistance
X1=5.2;                 // primary Reactance
X2=0.015;               // Secondary Reactance
I1=kVA/V1;              // primary Current
I2=kVA/V2;              // Secondary Current
k=V2/V1;                // Turns constant

Re1=R1+(R2/k^2);            // Equivalent Resistance
   referred to Primary
```

```
disp(' Equivalent Resistance referred to Primary = '+string(Re1)+' Ohm');

Re2=k^2*R1+R2;                // Equivalent Resistance referred to Secondary
disp(' Equivalent Resistance referred to Secondary = '+string(Re2)+' Ohm');

Xe1=X1+(X2/k^2);              // Equivalent Impedance referred to Primary
disp(' Equivalent Impedance referred to Primary = '+string(Xe1)+' Ohm');

Xe2=k^2*X1+X2;                // Equivalent Reactance referred to Secondary
disp(' Equivalent Reactance referred to Secondary = '+string(Xe2)+' Ohm');

Ze1=sqrt(Re1^2+Xe1^2);        // Equivalent Impedance referred to Primary
disp(' Equivalent Impedance referred to Primary = '+string(Ze1)+' Ohm');

Ze2=sqrt(Re2^2+Xe2^2);        // Equivalent Impedance referred to Secondary
disp(' Equivalent Impedance referred to Secondary = '+string(Ze2)+' Ohm');

i2=227.27;                    // Round off value of I2
i1=11.36;                     // Round off value of I1
r1=3.45;                      // Round off value of R1
r2=0.009;                     // Round off value of R2

P=i1^2*r1+round(i2)^2*r2; // Total Copper loss
disp(' Total Copper loss = '+string(round(P))+' Watt');

re1=7.05;                     // Round off value of Re1
```

```
P1=i1^2*re1;                  // Total Copper loss By Equivalent Re1
disp(' Total Copper loss By Equivalent Re1 = '+string(P1)+' Watt');

re2=0.0176;                   // Round off value of Re2
P2=i2^2*re2;                  // Total Copper loss By Equivalent Re2
disp(' Total Copper loss By Equivalent Re2 = '+string(round(P2))+' Watt');



         // p 503          13.10
```

Scilab code Exa 13.11 Regulation

```

                    // Example 13.11

R1=10;                              // Resistance of 10 Ohms
R2=0.02;                            // Resistance of 0.02 Ohms
Xe=35                               // Reactance of primary coil
n1=250;                             // No.Of turns in Primary coil
n2=6600;                            // No.Of turns in 2ry coil
k=n1/n2;                            // Turns ratio
P=40000;                            // Single-Phase power
I2=P/n1;                            // Full-load current
Re2=k^2*R1+R2;                      // Resistance Re2
Xe2=k^2*Xe;                         // Reactance Xe2
```

```
SinQ=0;                              // SinQ=0
CosQ=1;                              // Power factor
Reg={(I2*Re2*CosQ)+(I2*Xe2*SinQ)}/n1;                //  % Regulation.
disp(' % Regulation (pf=1) = '+string(Reg*100)+' %');

CosQ1=0.8;                           // Leading Power factor
SinQ1=sqrt(1-CosQ1^2);               // SinQ=0.6 +ve

Reg1={(I2*Re2*CosQ1)+(I2*Xe2*SinQ1)}/n1;             //  % Regulation.
disp(' % Regulation (pf=0.8) = '+string(Reg1*100)+' %');

SinQ2=-sqrt(1-CosQ1^2);              // SinQ=0.6 -ve

Reg2={(I2*0.0343*CosQ1)+(I2*Xe2*SinQ2)}/n1;  // % Regulation.
disp(' % Regulation for (pf=0.8) = '+string(Reg2*100)+' %');



            //   p 506                    13.11
```

Scilab code Exa 13.12 Efficiency And Power

```

             // Example 13.12

            // We know that E=4.44*f*N*Qm

Qm=0.06;                             // Megnetic flux
```

```
f=50;                              // Frequency
E2=250;                            // Voltage
N2=E2/(4.44*f*Qm);                 // No.Of of turns in 2ry coil
disp('No.Of turns (N2) = '+string(round(N2))+' turns');

E1=5000;                           // Voltage
N1=(E1/E2)*19;                     // No.Of turns in 1ry coil
disp('No.Of turns (N1) = '+string(N1)+' turns');

kVA=150*10^3;                           // kVA Rating
pf=1;                              // Power factor
Po=0.5*kVA*pf;                     // O/p power
Cfl=1800;                          // Full-load Copper losses
Pc=0.5*0.5*Cfl;                    // Copper losses
Pi=1500;                           // Iron losses
n=Po/(Po+Pc+Pi);                   // Efficiency
disp('Efficiency at half kVA = '+string(n*100)+' %');

pf1=0.8;                           // Power factor
Po1=kVA*pf1;                       // O/p power
Pc1=1800;                          // Copper losses
n1=Po1/(Po1+Pc1+Pi);                // Efficiency
disp('Efficiency at Full-load & at(pf=0.8) = '+string(n1*100)+' %');

              // We know that x^2 x 1800= 1500
x=sqrt(1500/1800);                 // Value of x
kVA1=kVA*x;                        // kVA Load for Maximum efficiency
disp('kVA Load for Maximum efficiency = '+string(round(kVA1/1000))+' kVA');


```

```
                    // p 509                    13.12
```

Scilab code Exa 13.13 Efficiency

```

                  // Example 13.13

                 // For 80-kW load at pf=1 (for 6 hours)
t=6;                       // Time in Hours
p=80;                      // Power in kW
Eo=p*t;                    // O/p energy
pf=1;                      // Power factor
kVA=p/pf;                  // kVA rating
kVAo=200;                  // kNA at full-load
Pcl=3.02;                  // Copper losses at full-load
Pc=(kVA/kVAo)^2*Pcl;       // Copper losses
Pi=1.6;                    // Iron losses
Pl=Pc+Pi;                  // Total losses
Tloss=Pl*6;                // Total losses in 6 hours

                 // For 160-kW load at pf=0.8 (for 8 hours)
p1=160;                      // Power in kW
E1=p1*8;                     // O/p energy
pf1=0.8;                     // Power factor
kVA1=p/pf;                   // kVA rating
Pcl1=3.02;                   // Copper losses at full-load
Pc1=Pcl1;                    // Copper losses
Pl1=Pc1+Pi;                  // Total losses
Tloss1=Pl1*8;                // Total losses in 6 hours

                 // For No-load (for 10 hours)
```

```
E2=0;                          // O/p Energy
Pc2=0;                         // Copper losses
Pl2=Pc2+Pi;                    // Total losses
Tloss2=Pl2*10;                 // Total losses in 10
   hours
Wo=Eo+E1+E2;                   // Total O/P energy
W1=Tloss+Tloss1+Tloss2;        // Total energy losses
n=Wo/(Wo+W1);                  // All-Day efficiency
disp('All-Day efficiency = '+string(n*100)+' %');


                  //      p 510          13.13

              // For 160-kW load at pf=1 (for
t=6;                         // Time in Hours
```

Scilab code Exa 13.14 Power

```

                         // Example  13.14


kVA=12000;               // Single Phase supply
V1=120;                  // Voltage in primary winding
I2=kVA/V1;               // Currnet in Secondary
   winding
I1=I2;                   // Current in primary winding
V2=240;                  // Voltage in Secondary
   winding
Pi=V2*I2;                // I/p apparent power
disp(' I/p apparent power = '+string(Pi/1000)+' kVA'
   );

Po=V1*I1*2;              // O/p apparent power
disp(' O/p apparent power = '+string(Po/1000)+' kVA'
```

```
);





//    p 511       13.14
```

Scilab code Exa 13.15 Voltage

```


// Example  13.15

Vl1=3300;                   // The supply voltage
Vph1=Vl1/1.732;             // Primary phase voltage
N1=840;                     // No.Of Turns in Primary winding
N2=72;                      // No.Of Turns in secondary winding
Vph2=Vph1*(N2/N1);          // Secondary phase voltage
Vl2=Vph2;                   // Secondary line voltage
disp(' Secondary line voltage on No load for (star/delta) = '+string(Vl2)+' Volt');

vph1=Vl1;                   // Primary phase voltage
vph2=vph1*(N2/N1);          // Secondary phase voltage
vl2=vph2*1.732;             // Secondary line voltage
disp(' Secondary line voltage on No load for (delta/star) = '+string(round(vl2))+' Volt');
```

```
          // p 514      13.15
```

Scilab code Exa 13.16 Current And Resistance

```

                // Example 13.16

V1=200;                  // Supply voltage
Wo=120;                  // Wattmeter reading
Iw=Wo/V1;                // Core loss current
disp(' Core-loss current (Iw) = '+string(Iw)+' Amp');

Io=1.3;                  // Open-ckt current
Im=sqrt(Io^2-Iw^2);      // Megnetising current
disp(' Megnetising current (Im) = '+string(Im)+' Amp');

Ro=V1/Iw;                    // Resistance
Xo=V1/1.15;                  // Reactance
disp(' Equivalent resistance of exciting circuit = '+string(round(Ro))+' Ohms');
disp(' Equivalent reactance of low voltage winding = '+string(round(Xo))+' Ohms');

V2=400;                      // Supply voltage
k=V1/V2;                     // Transformation Ratio
kVA=12000;                   // kVA rating
Ifl=kVA/V2;                  // Full-load current
Wsc=200;                     // Short-ckt power
Re1=Wsc/Ifl^2;               // Equivalent resistance at full-load
Vsc=22;                      // Short-ckt voltage
```

```
Ze1=Vsc/Ifl;                    // Equivalent impedeance at full-load
Xe1=sqrt(Ze1^2-Re1^2);          // Short-ckt reactance
Re2=k^2*Re1;                    // Equivalent resistance of low voltage winding
disp('Equivalent resistance of low voltage winding = '+string(Re2)+' Ohms');

Xe2=k^2*Xe1;                    // Equivalent ractance of low voltage winding
disp('Equivalent reactance of low voltage winding = '+string(Xe2)+' Ohms');


                    //    p 516           13.16
```

Chapter 14

Alternators And Synchronous Motors

Scilab code Exa 14.1 Speed

```

                     // Example  14.1

F=60;                  // Frequency
P=6;                   // No.Of poles
ns=(120*F)/P;          // Speed Of rotation
disp('Speed Of rotation Is = '+string(ns)+' Rpm');
F1=20;                 // Decreased frequency
P1=(120*F1)/ns;        // Number Of poles
disp('Number Of poles = '+string(P1));





            //  p 546    Ex14.1
```

Scilab code Exa 14.2 Distribution Factor

```
                    // Example  14.2

alfa=20;                  // Slot angle
q1=120/20;                // No.Of slots for group p
sa=sind((q1*alfa)/2);
sb=sind(alfa/2);
kd1=sa/(q1*sb);           // Three phase Winding (with
    120 phase group)
disp('(a) A Three phase Winding (with 120 phase
   group) = '+string(kd1));
q2=60/20;                 // No.Of slots for group q
sa1=sind((q2*alfa)/2);
kd2=sa1/(q2*sb);          // TThree phase Winding (
   with 60 phase group)
disp('(b) A Three phase Winding (with 60 phase group
   ) = '+string(kd2));




        //  p 554    Ex 14.2
```

Scilab code Exa 14.3 Speed Emf And Voltage

```
                    // Example  14.3

f=50;                       // Frequency
p=20;                       // No.Of poles
Ns=(120*f)/p;               // Speed Of rotation
disp('(a) Speed of Rotation is = '+string(Ns)+' rpm'
   );
```

```
p1=180/20;                    // No.Of slots per pole
Q=180/p1;                     // Slot angle
q1=p1/3;                      // No.Of slots per pole for group q
sa=sind((q1*Q)/2);
sb=sind(Q/2);
kd=sa/(q1*sb);                // Generated emf per phase
disp('(b) Generated emf per phase = '+string(kd)+' Volt');

g=0.025;                      // Flux per poles
T=240;                        // No.Of turns per phase
kp=1;
E=(4.44*f*g*kp*T*0.96);       // Rms value of emf per phase
El=sqrt(3)*E;                 // Line emf
disp('(b) Generated emf per phase = '+string(E)+' Volt');
disp('(c) Line emf = '+string(El)+' Volt');


        //    p 554       14.3
```

Scilab code Exa 14.4 Voltage Regulation

```


                        // Example  14.4‘

I=15.7;                          // Phase current
Vt=22*10^3/sqrt(3);              // Phase voltage
Zs=0.16;                         // Impedance
V=12.7;                          // Terminal Voltage per phase on full load
Vz=I*Zs;                         // Voltage drop per
```

```
   phase on full load
OC=0.014;                    // Star winding resistence
OG=0.16;                     // Synchronous impedance
Q=acosd(OC/OG);              // Phase angle
pf1=0.8;                     // Lagging power factor
q1=acosd(pf1);               // Lagging angle
alfa1=Q-q1;                  // Resultant angle
Cos1=cosd(alfa1);            // power factor for Resultant
E1=(sqrt(V*V+Vz*Vz+2*V*Vz*Cos1));
Er1=(E1-V)/V;                    // the Voltage Regulation (0.8 Lagging)
disp('(a) the Voltage Regulation (0.8 Lagging) is = '+string(Er1*100)+' per Cent');

pf2=1;                       // Leading power factor
q2=acosd(pf2);               // Leading angle
alfa2=Q-q2;                  // Resultant angle
Cos2=cosd(alfa2);            // power factor for Resultant
E2=(sqrt(V*V+Vz*Vz+2*V*Vz*Cos2));
Er2=(E2-V)/V;                // the Voltage Regulation (1 Lagging)
disp('(b) the Voltage Regulation (1 Lagging) is = '+string(Er2*100)+' per Cent');

alfa3=Q+q1;                  // Resultant angle
Cos3=cosd(alfa3);            // power factor for Resultant
E3=(sqrt(V*V+Vz*Vz+2*V*Vz*Cos3));
Er3=(E3-V)/V;                // the Voltage Regulation (0.8 Leading)
disp('(c) the Voltage Regulation (0.8 Leading) is = '+string(Er3*100)+' per Cent');

                //  p 560       14.4
```

Scilab code Exa 14.5 Voltage Regulation

```
// Example 14.5

I=100;                          // Full-rated short-circuit current
V=3.3*10^3/sqrt(3);             // Three phase voltage
R=0.9;                          // Remature resistance
Zs=5.196;                       // Impedance
Vz=I*Zs;                        // Voltage drop per phase on full load
Q=acosd(R/Zs);                  // Phase angle
pf1=0.8;                        // Lagging power factor
q1=acosd(pf1);                  // Lagging angle
alfa1=Q-q1;                     // Resultant angle
Cos1=cosd(alfa1);               // power factor for Resultant
E1=(sqrt(V*V+Vz*Vz+2*V*Vz*Cos1));
Er1=(E1-V)/V;                   // the Voltage Regulation (0.8 Lagging)
disp('(a) the Voltage Regulation (0.8 Lagging) is = '+string(Er1*100)+' per Cent');
alfa3=Q+q1;                     // Resultant angle
Cos3=cosd(alfa3);               // power factor for Resultant
E3=(sqrt(V*V+Vz*Vz+2*V*Vz*Cos3));
Er3=(E3-V)/V;                   // the Voltage Regulation (0.8 Leading)
disp('(b) the Voltage Regulation (0.8 Leading) is =
```

```
'+string(Er3*100)+' per Cent');




              //  p 563          14.5
```

Scilab code Exa 14.6 Emf And Angle

```


                    // Example  14.6

po=9000;                              // O/p power
n=0.9;                                // Efficiency of
   motor
pi=po/n;                              // I/p power
X=3;                                  // Reactance
Vl=400;                               // Phase voltage
R=0.4;                                // Resistance
Cos1=0.8;                             // Leading power
   factor
I=pi/(sqrt(3)*Vl*Cos1);               // I/p current per
    phase
q1=acosd(0.8);                        // Leading angle
Zs=sqrt(R*R+X*X);                     // Impedance
Q=atand(X/R);                         // Phase angle
V=400/sqrt(3);                        // Supply voltage
   per phase
Er=I*Zs;                              // Voltage drop
   per phase across the synchronous impedance

E=(sqrt(V*V+Er*Er+2*V*Er*cosd(180-Q-q1)));
El=sqrt(3)*E;                         // Exitation emf
disp(' Exitation emf = '+string(El)+' volt');
```

```
Qr=asind((Er*sind(Q+q1))/E);        // Angle of rotor
disp(' Angle of rotor = '+string(Qr)+' Digree');



                // p 568    14.6
```

Scilab code Exa 14.7 Emf

```


                          // Example  14.7

Zph=24*(12/3);                    // The No.Of conductors
   in series
T=Zph/2;                          // No.Of turns per phase
p1=24/4;                          // No.Of slots/pole
Q=180/p1;                         // Slot angle
q1=p1/3;                          // No.Of slots/pole for
   group q
sa=sind((q1*Q)/2);                // Distribution factor (
   Numerator part )
sb=sind(Q/2);                     // Distribution factor (
   denominator part )
kd=sa/(q1*sb);                    // Distribution factor
p=4;                              // No.Of poles
Ns=1500;                          // Speed
g=0.1;                            // Flux per pole
f=(p*Ns)/120;                     // Pitch factor
kp=1;                             // Constant
E=(4.44*f*g*kp*T*kd);             // Generated emf per
   phase
El=sqrt(3)*E;                     // line emf (at
   alternator 1500 rpm)
```

```
disp(' line emf (at alternator 1500 rpm) = '+string(
    round(El))+' Volt');





            // p 572     14.7
```

Scilab code Exa 14.8 Emf

```

                    // Example  14.8

Q=30;                       // Angle between 2 slots
q1=6;                       // No.Of coils
sa=sind((q1*Q)/2);          // Distribution factor (
    Numerator part )
sb=sind(Q/2);               // Distribution factor (
    denominator part )
kd=sa/(q1*sb);              // Distribution factor
Vc=6*10;                    // Voltage induced in 6
    coils
Er=kd*Vc;                   // Net emf induced in
    Six coils
disp(' Net emf induced in Six coils = '+string(Er)+'
     Volt');





            //  p 573          14.8
```

Scilab code Exa 14.9 Current Power And Torque

```


                        // Example  11.9

f=50;                           // Frequency
N=120;                          // Speed
p=(120*f)/N;                    // Number Of poles
disp('(a) The No.of Poles = '+string(p));

Pf=1;                           // Power fector
Va=100*10^6;                    // VA-Rating
Rt=Va*Pf;                       // kW-Rating
disp('(b) The kW rating = '+string(Rt)+' Watt');

Vl=11*10^3;                     // Star-connected voltage
Il=Va/(sqrt(3)*Vl);             // Current rating (Il)
disp('(c) The Current rating (Il) = '+string(round(
   Il))+' Amp');

po=100*10^6;                     // Power
n=0.97;                          // Efficiency of motor
Pi=po/n;                         // I/P Power (Pi)
disp('(d) The I/P Power (Pi) = '+string(Pi)+' Watt')
   ;

t=Pi/(2*3.14*N*0.0166);          // Prime Torque
disp('(e) The Prime Torque = '+string(t)+' Nm');



        // p 573        14.9
```

Chapter 15

Induction Motors

Scilab code Exa 15.1 Speed And Frequency

```


                  // Examle 15.1

p=6;                           // No.Of poles
f=50;                          // Frequency
Ns=(120*f)/p;                  // Synchronous speed
disp('(a) The Synchronous Speed (Ns) = '+string(Ns)+
    ' rpm');

s1=0.01;                       // Slip (s=1 %)
N1=Ns*(1-s1);                  // he No Load Speed (N)
disp('(b) The No Load Speed (N) = '+string(N1)+' rpm
    ');

s2=0.03;                       // Slip (s=3 %)
N2=Ns*(1-s2);                  // The Full Load Speed
disp('(c) The Full Load Speed (N) = '+string(N2)+'
    rpm');

s=1;                           // Slip (s=100 %)
```

```
fr1=s*f;                    // The Frequence of Rotor (at s=1 )
disp('(d) The Frequence of Rotor (at s=1 ) = '+string(fr1)+' Hz');

fr2=s2*f;                   // The Frequence of Rotor (at s=0.03 )
disp('(e) The Frequence of Rotor (at s=0.03 ) = '+string(fr2)+' Hz');




        // p 593     15.1
```

Scilab code Exa 15.2 Speed And Frequency

```

                    // Examle 15.2

p=12;                       // No.Of poles
f=50;                       // Frequency
Ns=(120*f)/p;               // Synchronous speed
disp(' The Synchronous Speed (Ns) = '+string(Ns)+' rpm');

N=485;                      // Speed of Motor
s=(Ns-N)/Ns;                // Slip
fr=s*f;                     // The Frequence of Rotor (fr)
disp(' The Frequence of Rotor (fr) = '+string(fr)+' Hz');



```

```
                    //   p 593      15.2
```

Scilab code Exa 15.3 Speed

```


                    // Examle 15.3

p=6;                          // No.Of poles
f=50;                         // Frequency
Ns=(120*f)/p;                 // Synchronous speed
disp(' The Synchronous Speed (Ns) = '+string(Ns)+' rpm');

fr=2;                         // Frequency of rotor at full-load
s=fr/f;                       // Slip at full-load
disp(' the Full Load Slip (s) = '+string(s*100)+' %');

N=Ns*(1-s);                   // The Speed of Rotor (fr)
disp(' The Speed of Rotor (fr) = '+string(N)+' rpm');




                    //    p 594    15.3
```

Scilab code Exa 15.4 Speed And Frequency

```

```

```

                    // Examle 15.4

p=4;                          // No.Of poles
f=50;                         // Frequency
Ns=(120*f)/p;                 // Synchronous speed
disp(' The Synchronous Speed (Ns) = '+string(Ns)+' rpm');

s1=0.04;                      // Slip
N1=Ns*(1-s1);                 // The Speed of Rotor
disp('(b) The Speed of Rotor (at s=0.04) = '+string(N1)+' rpm');

N=600;                        // Speed Of rotation
s=(Ns-N)/Ns;                  // When speed is (600 rmp) Then Slip
fr=s*f;                       // The Frequence of Rotor (fr)
disp('(d) The Frequence of Rotor (fr) = '+string(fr)+' Hz');




              //  p 594        15.4
```

Scilab code Exa 15.5 Current

```

                              // Examle 15.5


R2=0.05;                      // Resistance
s=0.04;                       // Slip
```

```
X20=0.1;                        // Standstill reactance
E1=100;                         // Voltage
E20=E1/1.732;                   // Induced emf per phase
Z2=sqrt(R2^2+(s*X20)^2);        // Impedance
E2=s*E20;                       // Emf with (s= 0.04)

I2=E2/Z2;                       // Rotor current for (s=0.04)
disp(' Rotor current for (s=0.04) = '+string(round(I2))+' Amp');

CosQ2=E2/Z2;                    // CosQ2=E2/Z2 = 0.998 ==> ,here take ( 0.99 )
Q2=acosd(0.99);                 // Phase diffrence for (s= 0.04)
disp(' Phase diffrence between rotor voltage & current for (s=0.04) = '+string(Q2)+' Digree');

s1=1;
E21=s1*E20;                     // Induced emf per phase for s=1
Z21=sqrt(R2^2+(s1*X20)^2);      // Impedance  ==>  Z21 = 57.73  ,but take (57.5)
I21=57.5/Z21;                   // Rotor current for (s=1)
disp(' Rotor current for (s=1) = '+string(round(I21))+' Amp');

Q21=acosd(R2/Z21);              // Rotor current for (s=1)
disp(' Phase diffrence between rotor voltage & current for (s=1) = '+string(Q21)+' Digree');




            // p 597      15.5
```

Scilab code Exa 15.6 Power And Speed

```

                                    // Examle 15.6

po=5*746;                 // O/p power
n=0.875;                  // Efficiency of motor at no
   load
pin=round(po/n);          // I/p power
p1=pin-po;                // Total losses
pm=0.05*p1;               // Mechanical losses
pe=p1-pm;                 // Electrical losses
pd=po+pm;                 // Devlopment power
disp(' Devlopment power = '+string(pd)+' Watt');

f=50;                     // Frequency
p=4;                      // No.Of poles
Ns=(120*f)/p;             // Synchronous speed
N=1470;                   // No.Of Revolution in rmp
s=(Ns-N)/Ns;              // The Slip

pg=pd/(1-s);              // Air-gap power
disp(' Air-gap power = '+string(pg)+' Watt');

pr=s*pg;                  // Rotor copper loss
disp(' Rotor copper loss = '+string(pr)+' Watt');

ps=pin-pg;               // Stator loss
disp(' Stator loss = '+string(ps)+' Watt');



             //    p 598      15.6
```

Scilab code Exa 15.7 Current Power And Speed

```


                                // Examle 15.7

v1=400/1.732;                              // Phase voltage
s=0.02;                                    // Slip
p=4;                                       // No.Of poles
f=50;                                      // Frequency
R2=0.332;                                  // Resistance R2
X2=0.464;                                  // Reactance X2
Ns=(120*f)/p;                              // Synchronous speed
N=Ns*(1-s);                                // Rotor speed
disp('The rotor speed is = '+string(N)+' rmp');

V1=231+%i*0;                               // Supply voltage
Xg=26.3;                                   // Reactance Xg
X1=1.106;                                  // Reactance X1
R1=0.641;                                  // Resistance R1
Vth={V1*(%i*Xg)}/(R1+%i*(X1+Xg));          // Thevenin's voltage
Zth={%i*Xg*(R1+%i*X1)}/(R1+%i*(X1+Xg));    //
```

```
Thevenin's impedance
Rl={(1-s)/s}*R2;                                    // Mechanical load

I1=Vth/(Zth+R2+%i*X2+Rl);                           // stator current
disp('Stator current = '+string(I1)+' Amp  or  ('+string(abs(I1))+' <'+string(atand(imag(I1),real(I1)))+' Amp )');


Q=atand(imag(I1),real(I1));                         // Power factor angle
pf=cosd(Q);                                         // Power factor
disp('Power factor is = '+string(pf)+' Lagging');

RL=340;                                             // Rotational losses
po=(3*12.84^2*Rl)-RL;                               // O/p power ==> ( taken I1=12.84 )
disp('O/p power = '+string(abs(po))+' Watt');

pin=3*V1*12.82*0.998;                               // I/p power ==> ( taken I1=12.82 & pf= 0.998)
disp('I/p power = '+string(abs(pin))+' Watt');

n=po/pin;                                           // Efficiency of motor
disp('Efficiency of motor = '+string(abs(n*100))+'%');





                    //    p 603      15.7
```

Scilab code Exa 15.8 Resistance

```
                                    // Examle 15.8

f=50;                        // Frequency
p=6;                         // No.Of poles
Ns=(120*f)/p;                // Synchronous speed
N=940;                      // No.Of Revolution in rmp

s=(Ns-N)/Ns;                 // The Slip
disp(' The Slip is = '+string(s));

R2=0.1;                     // Rotor resistance per phase
X20=R2/s;                   // Standing rotor reactance
disp(' Standing rotor reactance = '+string(X20)+'
   Ohm');





          //    p 608         15.8
```

Chapter 16

DC Machines

Scilab code Exa 16.1 Voltage Current And Power

```

                     // Example  16.1

          //   ==>   When Lap−wound  .

disp('∗ With the Armature Lap−wound, & Parallel
   pahts A=8  ');
Z=480;                // No.Of conductor
A=8;                  // No.Of poles
e=2.1;                // Average emf in each conductor
E=e*(Z/A);            // Terminal voltage on No load
disp('  Terminal voltage on No load = '+string(E)+'
   Volt');
If=200;               // Full−load current per conductor
Il=If*A;              // O/p current on full−load
disp('  O/p current on full−load = '+string(Il)+'
   Amp');
Po=Il*E;              // Total power on full−load
disp('  Total power generated on full−load = '+
   string(Po/1000)+' kW');

```

```
            // ==>  When Wave-wound .

disp('* With the Armature Wave-wound, & Parallel pahts A=2  ');
A1=2;                   // No.Of poles
E1=e*(Z/A1);            // Terminal voltage on No load
disp('  Terminal voltage on No load = '+string(E1)+' Volt');
Il1=If*A1;              // O/p current on full-load
disp('  O/p current on full-load = '+string(Il1)+' Amp');
Po1=Il1*E1;              // Total power on full-load
disp('  Total power generated on full-load = '+string(Po1/1000)+' kW');




        //  p 631    16.1
```

Scilab code Exa 16.2 Emf

```

                        // Example  16.2

s=65;                       // No.Of slots
nc=12;                      // Couductor per slot
z=s*nc;                     // Impedance
p=4;                        // No.Of poles
Q=0.02;                     // Megnetic flux
N=1200;                     // Speed of motor
E=(Q*z*N*p)/(60*p);         // Total emf Induced
disp('Total emf Induced = '+string(E)+' Volt');


```

```
          //  p 633      16.2
```

Scilab code Exa 16.3 Emf

```

                    // Examle 16.3


E1=180;                          // Induced emf
N1=500;                          // Speed of mechine N1=500
N2=600;                          // Speed of mechine N1=600
E2=(N2/N1)*E1;                   // Emf When Machine runs at (600 rpm)
disp('Emf When Machine runs at (600 rpm)= '+string(E2)+' Volt');



                    //     633        16.3
```

Scilab code Exa 16.4 Speed And increase in flux

```

                    // Examle 16.4

E1=220;                          // Induced emf at N=750 rpm
E2=250;                          // Induced emf (i.e E=250)
N1=750;                          // Speed of mechine at E1=220
N2=(E2/E1)*N1;                   // Speed at Constant emf E2=250
```

```
disp('Speed at Constant emf = '+string(round(N2))+' rpm');

                    // Using formula { Q2/Q1= E2/E1 x N1/N2 }

e=(E2*N1);                  // Numerator of above formula
n=(E1*600);                 // Dinominator of above formula { by taking N2= 600 }
E=e/n;                      // Induced emf
inc=(E-1.00)*100;           // % incriment in Flux
disp(' % incriment in Flux = '+string(round(inc))+' %');





                    //   p 633        16.4
```

Scilab code Exa 16.5 Voltage

```


                     // Examle 16.5

V=440;                  // Supply Voltage
Rsh=110;                // Resistance of Shunt field
Ish=V/Rsh;              // Current through Shunt field
Ra=0.02;                // Resistance of Armature winding
Il=496;                 // Generator current
Ia=Il+Ish;              // Armeture Current (Ia)
disp('Armeture Current (Ia) = '+string(Ia)+' Amp');
```

```

Eg=V+(Ia*Ra);          // generated emf (Eg)
disp('Generated emf (Eg) = '+string(Eg)+' Volt');



                    //          p 638     16.5
```

Scilab code Exa 16.6 Voltage And Current

```

                    // Examle 16.6

p=60;                  // Power supply
v=200;                 // supply voltage
I1=p/v;                // current through each lamp
Il=100*I1;             // Shunt field Current (Il)
disp('Shunt field Current (Il) = '+string(Il)+' Amp'
   );

Rsh=50;                // Resistance
Ish=v/Rsh;             // Shunt field Current
Ia=Il+Ish;             // Armature Current (Ia)
disp('Armature Current (Ia) = '+string(Ia)+' Amp');

a=4;                   // No.Of paraller path
Ic=Ia/a;               // Current per path (Ic)
disp(' Current per path (Ic) = '+string(Ic)+' Amp');

Ra=0.2;                // Armature resistance
dro=2;                 // Brush-drop
Eg=v+(Ia*Ra)+dro;      // Generated emf (Eg)
disp('generated emf (Eg) = '+string(Eg)+' Volt');


```

```
            // 638     16.6
```

Scilab code Exa 16.7 Emf

```

                // Examle 16.7

Il=100;                          // Series field current
Rse=0.1;                         // Resistance series field
Vse=Rse*Il;                      // Voltage drop across series field (Vse)
disp('Voltage drop across series field (Vse) = '+string(Vse)+' Volt');

V=250;                           // Supply voltage
Vsh=V+Vse;                       // Voltage drop across Shunt field (Vsh)
disp('Voltage drop across Shunt field (Vsh) = '+string(Vsh)+' Volt');

Rsh=130;                         // Resistance
Ish=Vsh/Rsh;                     // Shunt field Current (Ish)
disp(' Shunt field Current (Ish) = '+string(Ish)+' Amp');

Ia=Il+Ish;                       // Armature Current (Ia)
disp('Armature Current (Ia) = '+string(Ia)+' Amp');

Ra=0.1;                          // Armature resistance
dro=2;                           // Brush-drop
Eg=V+Vse+(Ia*Ra)+dro;            // Generated emf (Eg)
disp('Generated emf (Eg) = '+string(Eg)+' Volt');

```

```
            // p 638      16.7
```

Scilab code Exa 16.8 Voltage Efficiency And Power

```

                    // Examle 16.8

po=30000;               // o/p power
v=200;                  // Voltage
Il=po/v;                // Load Current (Il)
disp(' Load Current (Il) = '+string(Il)+' Amp');

Rsh=50;                              // Shunt field
    resistance R1
Ish=v/Rsh;                           // Shunt field Current
Ia=Il+Ish;                           // Armature Current (Ia
    )
Ra=0.05;                             // Shunt field
    resistance R2
Eg=v+(Ia*Ra);                        // Generated emf (Eg)
disp('Generated emf (Eg) = '+string(Eg)+' Volt');

Cu=Ish^2*Rsh+Ia^2*Ra;                // The copper Losses (
    Cu)
disp('The copper Losses (Cu) = '+string(Cu)+' W');

e=po*100/(1000+po+Cu);               // The Efficiency (e)
disp('The Efficiency (e) = '+string (e)+' %');



                // p 641      16.8
```

Scilab code Exa 16.9 Current And Resistance

```

                    // Examle 16.9


Vo=210;               // Supply voltage
Il=195;               // Full-load current
Po=Vo*Il;             // O/p power
n=0.9;                // Efficiency
Pin=Po/n;             // I/p power
Tl=Pin-Po;            // Total loss
Rsh=52.5;             // Shunt field resistance
Ish=Vo/Rsh;           // Shunt field current
Ia=Il+Ish;            // Armeture Current (Ia)
Cl=Ish^2*Rsh;         // Shunt field copper loss
Hl=710;               // Stray losses
CL=Cl+Hl              // Constant loss
Al=4550-CL;           // Armature copper loss
Ra=Al/Ia^2;           // Armature resistance
disp('Armature resistance = '+string(Ra)+' Ohms');

              // ==> for maximum effciency  (Ia^2*RA= Pc = 1550 )

Ia1=sqrt(CL/0.0757);  // Armeture Current for maximum efficiency ==>{Ra=0.0757557 ,but here we have Ra=0.0757}
disp(' Armeture Current = '+string(Ia1)+' Amp');

IL=Ia1-Ish;           // Load current
disp(' Load current (IL) = '+string(IL)+' Amp');


```

```
                    //   p  642          16.9
```

Scilab code Exa 16.10 Turns

```

                    // Examle 16.10

i1=4;                         // No load current
i2=6;                         // Full-load current
n=1500;                       // No.Of turns per poles
At1=i1*n;                     // Amper Turns per pole on No Load
disp(' Amper Turns per pole on No Load = '+string(At1)+' At');

At2=i2*n;                     // Amper Turns per pole on Full Load
disp(' Amper Turns per pole on Full Load = '+string(At2)+' At');

At=At2-At1;                   // Amper Turns per pole of seires winding
disp(' Amper Turns per pole of seires winding = '+string(At)+' At');

Nse=At/100;                   // Full Load Current
disp(' Full Load Current = '+string(Nse));





                  //    p  647       16.10
```

Scilab code Exa 16.11 Voltage

```


                    // Examle 16.11

V=250;                      // Supply voltage
Rsh=250;                    // Field winding resistance
Ish=V/Rsh;                  // The shunt field current (Ish)
disp('The Shunt field current (Ish) = '+string(Ish)+' Amp');
Il=41;                      // Full-load current
Ia=Il-Ish;                  // Armature current
disp('The Armature current current (Ia) = '+string(Ia)+' Amp');
Ra=0.1;                     // Armature resistance
Eb=V-(Ia*Ra);               // back emf
disp('The back emf (Eb) = '+string(Eb)+' Volt');




              //    p 649        16.11
```

Scilab code Exa 16.12 Speed

```


               // Examle 16.12

V=440;                           // Supply voltage
```

```
Ia=50;                          // Armature currernt
Ra=0.28;                        // Armature resistance
a=2;                            // No.Of paraller path
Q=0.023;                        // Megnetic flux per pole
z=888;                          // Impedence
p=4;                            // No.Of poles
Eb=V-(Ia*Ra);                   // Back emf (Eb)
disp(' Back emf (Eb) = '+string(Eb)+' Volt');

N=(60*a*Eb)/(Q*z*p);           // Speed of the moter
disp(' Speed of the moter = '+string(round(N))+' rms
    ');




           //   p 649          16.12
```

Scilab code Exa 16.13 Speed

```

                    // Examle 16.13

At=900;                        // Speed of motor
V=460;                         // Supply voltage
kQ=V/At;                       // Orignal Flux
disp(' Orignal Flux = '+string(kQ));

V1=200;                        // Chenged Supply voltage
N=V1/(0.7*kQ);                 // Speed of Motor When
    Supply (200 V)
disp(' Speed of Motor When Supply (200 V) = '+string
    (round(N))+' rpm');


```

```
                    //   p 649       16.13
```

Scilab code Exa 16.14 Speed And Torque

```

                     // Examle 16.14

V=480;
Ia=110;                           // Armature currernt
Ra=0.2;                           // Armature resistance
a=6;                              // No.Of paraller path
p=6;                              // No.Of poles
Q=0.05;                           // Megnetic flux per pole
z=864;                            // Impedence
Eb=V-(Ia*Ra);                     // Generated emf (Eb)
disp('Generated emf (Eb) = '+string(Eb)+' Volt');

N=(60*a*Eb)/(Q*z*p);               // Speed of the moter
disp(' Speed of the moter = '+string(round(N))+' rms');

          //  ==> Using Formula { td= Qz/2TT x(p/A) xIa }

x=(Q*z)/(2*%pi);                  // for simlicity
td=(p/a)*Ia*(x);                  // Total Torque (Td)
disp(' Total Torque (Td) = '+string (round(td))+' Nm');




```

```

                 //   p 650         16.14
```

Scilab code Exa 16.15 Power

```


                       // Examle 16.15

t=2000;                     // Torque
N=900;                      // Speed
Ploss=8000;                 // Power loss
Pin=(2*%pi*t*N)/60;         // Input Power (Pin)
disp(' Input Power (Pin) '+string(Pin/1000)+' kW');

Pd=Pin-Ploss;               // Power Generated in
   Armature (Pd)
disp(' Power Generated in Armature (Pd) = '+string(
   Pd/1000)+' kW');



                  //   p 651        16.15
```

Scilab code Exa 16.16 Speed

```

                   // Example 16.16

V=230;                     // Supply voltage
Ia=110;                    // Current
Ra=0.12;                   // Resistance
Rse=0.03;                  // Series field resistance
```

```
E1=V-Ia*(Ra+Rse);       // Emf Generated

                // But for the Given machine  ( E1= QZNP
                   /60A= kQ1N1 )

N1=600;                 // No.Of turns
Q1=0.024;               // Megnetic flux
k=E1/(Q1*N1);           // Constant

Ia1=50;                 // Current of 50A
E2=V-[Ia1*(Ra+Rse)];    // Emf Generated

                // We know that E2=k*Q2*N2

Q2=0.016;               // Megnetic flux
N2=E2/(k*Q2);           // New speed
disp(' The new speed is = '+string(round(N2))+' rpm'
   );




                  //  p 653         16.16
```

Scilab code Exa 16.17 Current

```

                  // Example 16.17

Ra=0.2;                 // Resistance
V=250;                  // Supply voltage
Eb=0;                   // Voltage at rest
Ia=(V-Eb)/Ra;           // Current drawn by the
   machine at Eb=200
disp(' Current drawn by the machine at (Eb=0) = '+
```

```
    string(Ia)+' Amp');

Eb1=200;                  // Voltage at Eb=200
Ia1=(V-Eb1)/Ra;           // Current drawn by the
    machine at Eb=200
disp(' Current drawn by the machine at (Eb=200) = '+
    string(Ia1)+' Amp');

Eb2=250;                  // Voltage at Eb=250
Ia2=(V-Eb2)/Ra;           // Current drawn by the
    machine at Eb=250
disp(' Current drawn by the machine at (Eb=250) = '+
    string(Ia2)+' Amp');

Eb3=-250;                  // Voltage at Eb=-250
Ia3=(V-Eb3)/Ra;            // Current drawn by the
    machine at Eb=-250
disp(' Current drawn by the machine at (Eb=-250) = '
    +string(Ia3)+' Amp');





                         //  p 653            16.17
```

Scilab code Exa 16.18 Speed And Torque

```

                         // Examle 16.18

V=480;                            // Supply voltage
Ia=110;                           // Armature currernt
Ra=0.18;                          // Series field
    resistance R1
```

```
Rse=0.02;                          // Series field
   resistance R2
Eb=V-Ia*(Ra+Rse);                  // Generated emf
disp(' Generated emf = '+string(Eb)+' Voltage');

a=6;                               // No.Of paraller path
Q=0.05;                            // Megnetic flux
z=864;                             // Conductor
p=6;                               // No.Of poles
N=(60*a*Eb)/(Q*z*p);               // Speed of a Motor
disp(' Speed of a Motor = '+string(round(N))+' rpm')
   ;

Td=(60*Eb*Ia)/(2*%pi*N);           // The Torque Develop by
    Armeture
disp(' The Torque Develop by Armeture = '+string(
   round(Td))+' Nm');



                        //  p 654   16.18
```

Scilab code Exa 16.19 Resistance

```


                            // Examle 16.19

V=220;                        // Supply voltage
Ia=22;                        // Armature currernt
Ra=0.45;                      // Armature resistance
E1=V-(Ia*Ra);                 // Generated emf
disp(' Generated emf = '+string(E1)+' Voltage');

N1=700;                       // Speed of motor in Shunt
```

```
N2=450;                         // Speed of motor in Series
E2=(N2*E1)/N1;                  // Emf of Shunt motor
disp(' Emf of Shunt motor = '+string(E2)+' voltage ');

Va=Ia*Ra;                       // Armature voltage
R=(V-(E2+Va))/Ia;               // Resistance with Armature
disp(' Resistance with Armature = '+string(R)+' ohms ');



                                // p 654       16.19
```

Scilab code Exa 16.20 Speed

```


                           // Examle 16.20

V=230;                          // Supplt voltage
Ia1=40;                         // Armature currernt Ia1
Ra=0.2;                         // Armature resistance
Rse=0.1;                        // Series field resistance
E1=V-Ia1*(Ra+Rse);              // Back emfat (24 A)
disp(' Back emfat (24 A) = '+string(E1)+' Voltage ');

Ia2=20;                         // Armature currernt Ia2
E2=V-Ia2*(Ra+Rse);              // Back emfat (20 A)
disp(' Back emfat (20 A) = '+string(E2)+' Voltage ');

N1=1000;                        // Speed of a Motor at I=40A
N2=(E2*N1)/(E1*0.6);            // Speed of a Motor
disp(' Speed of a Motor = '+string(round(N2))+' rpm'
```

```
);




            // p 654       16.20
```

Chapter 17

Fractional Horse Power Motors

Scilab code Exa 17.1 Slip And Efficiency

```

                              // Examle 17.1

f=50;                     // Frequency
p=4;                      // No.Of poles
Ns=(120*f)/p;             // Synchronous speed
N=1410;                   // No.Of Revolution in rmp
I=2.9;                    // I/p current
V=230;                    // Supply voltage
CosQ=0.71;                // Power factor
s=(Ns-N)/Ns;              // The Slip
disp('The Slip is = '+string(s*100)+' %');

po=375;                   // O/p power
pin=V*I*CosQ;             // I/p power
eff=po/pin;               // Efficiency
disp('The efficiency is = '+string(eff*100)+' %');




```

```
// p 683          17.1
```

Scilab code Exa 17.2 Current Phase Angle And Power Factor

```

                    // Examle 17.2


zm=(5+%i*12);             // Impedence of main-Winding
za=(12+%i*5);             // Impedence of starting-Winding
V=230+%i*0;               // Supply voltage
Im=V/zm;                  // Current in main-Winding
disp(' The Current in main-Winding = '+string(Im)+' Amp or ('+string(abs(Im))+' <'+string(atand(imag(Im),real(Im)))+' Amp )');

Ia=V/za;                  // Current in starting-Winding
disp(' The Current in starting-Winding = '+string(Ia)+' Amp or ('+string(abs(Ia))+' <'+string(atand(imag(Ia),real(Ia)))+' Amp )');

Il=Im+Ia;                 // The line Current
disp(' The line Current = '+string(Il)+' Amp or ('+string(abs(Il))+' <'+string(atand(imag(Il),real(Il)))+' Amp )');

Qa=-22.62;                // Phase angle of starting-winding
Qm=-67.38;                // Phase angle of main-winding
```

```
Q=Qa-Qm;                    // The phase displacement (Q)
disp(' The phase displacement (Q) = '+string(Q)+'  i.e = '+string(round(Q))+' Digree');

pf=cosd(round(Q));          // The Power factor
disp(' The Power factor is = '+string(pf)+' lagging');



                    // p 683         17.2
```

Scilab code Exa 17.3 Capacitor

```

                    // Examle 17.3

Xm=20;                      // Inductive reactance of Main-winding
Rm=2;                       // Main-winding resistance
Ra=25;                      // Auxilliary-winding resistance
f=50;                       // Frequency
Xa=5;                       // Inductive reactance of Auxilliary-winding
Qm=atand(Xm/Rm);            // Angle of Main-winding
Qa=Qm-90;                   // Angle of Auxilliary-winding
Xc=Xa-(tand(Qa)*Ra);        // Capacitive reactance
C=1/(2*%pi*f*7.495);        //Capacitor (C)   ==> { Xc = 7.5 ,but taking Xc= 7.495 }
disp('The value of Capacitor (C) = '+string(C)+' F');

```

```
// p 684      17.3
```

Scilab code Exa 17.4 Revolution Steps And Speed

```

                    // Examle 17.4

b=2.5;                   // Step Angle
r=360/b;                 // Resolution (r)
disp('Resolution (r) = '+string(r)+' steps per
   revolution');

n=r*25;                  // No.Of step Required for (25
   Rev)
disp('No.Of step Required for (25 Rev) = '+string(n)
   );

s=(b*n)/360;             // Shaft Speed (s)
disp('Shaft Speed (s) = '+string(s)+' rps');




          //  p 689       17.4
```

Scilab code Exa 17.5 No of Rotors And Stators

```

                    // Examle 17.5

```

```
b=15;                              // Step Angle
m=3;                               // No.Oh phase
Nr=360/(m*b);                      // Number of rotors
disp('No.Of Rotors = '+string(abs(Nr)));

Ns1=(Nr*360)/((b*Nr)-360);         // No.Of Stator When (Ns > Nr)
disp('No.Of Stator When (Ns > Nr) = '+string(abs(Ns1)));

Ns2=(Nr*360)/((b*Nr)+360);         // No.Of Stator When (Ns < Nr)
disp('No.Of Stator When (Ns < Nr) = '+string(Ns2));



              // p 690       17.5
```

Scilab code Exa 17.6 No of Rotors And Stators Theeth

```


                // Examle 17.6

         //  ==> Given 4 Stack VR stepper motor

m=4;                   // No.Oh phase
b=1.8;                 // Step Angle
Nr=360/(b*m);          // Number of rotors
disp('Number of rotors = '+string(Nr));



            //  p 692       17.6
```

Chapter 18

Electrical Measuring Instruments

Scilab code Exa 18.1 Torque

```

                    // Examle 18.1

I=0.015;                     // Current in a coil
B=0.2;                       // Megnetic flux density
l=0.02;                      // Length of megnetic field
n1=42;                       // No.Of turns N1
r=0.0125;                    // radius of coil
n2=43;                       // No.Of turns N2
F1=I*B*l*n1;                 // The force on(42-
   Conductors)
disp('The force on(42-Conductors) = '+string(F1)+' N
   ');

F2=I*B*l*n2;                 // The force on(43-
   Conductors)
disp('The force on(43-Conductors) = '+string(F2)+' N
   ');

```

```
Tr=(F1+F2)*r;                //  Total  Torque  (Td)
disp ('Total  Torque  (Td)  =  '+string(Tr)+' Nm');
              //   p  756            18.1
```

Scilab code Exa 18.2 Resistance

```
                   //  Examle  18.2
Ifs=10*10^-3;                //  Maximum  current
Im=100*10^-6;                //  Full-scale  diflection  current
Rm=100;                      //  Internal  resistance
Ish=Ifs-Im;                  //  Shunt  Current  (Ish)
disp('Shunt  Current  (Ish)  =  '+ string(Ish)+' Amp');
Rsh=(Im*Rm)/Ish;             //  Shunt  Current  (Rsh)
disp('Shunt  Current  (Rsh)  =  '+ string(Rsh)+' ohms');
              //   p  762      18.2
```

Scilab code Exa 18.4 Resistance

```
                   //  Examle  18.4
Im=50*10^-6;                    //  Current  sensitivity
```

```
Rm=100;                          // Internal resistance
Vf=50;                           // volt-meter range
Rs=(Vf/Im)-Rm;                   // The Value of Resister (Rs)
disp ('The Value of Resister (Rs) = '+string(Rs/1000)+' kilo-ohms');




                 //   p 767     18.4
```

Scilab code Exa 18.5 Resistance And Multiplying Factor

```

                   // Examle 18.5

Im=50*10^-6;                   // Current sensitivity
Rm=1000;                       // Internal resistance
Vf=50;                         // volt-meter range
Rs=(Vf/Im)-Rm;                 // The Value of Resister (Rs)
disp ('The Value of Resister (Rs) = '+string(Rs/1000)+' kilo-ohms');

n=Vf/(Im*Rm);                 // The Voltage Multiplying Factor (N)
disp('The Voltage Multiplying Factor (N) = '+string(n));




                 // p 767     18.5
```

Scilab code Exa 18.6 Voltage And Error

```

                        // Examle 18.6

s=1000;                         // Sensitivity of Volt-meter A
r=50;                           // Load resistance
Vt=50;                          // Range of volt-meter
Ri1=s*r;                        // Internal resistance of Volt-meter A
V1=150*{25000/(100000+25000)};  // Voltage in Ist Meter
disp('Voltage in Ist Meter (V) = '+string(V1)+' Volt');

s1=20000;                       // Sensitivity of Volt-meter B
Ri2=s1*r;                       // Internal resistance of Volt-meter B
V2=150*{47600/(100000+47600)};  // Voltage in 2nd Meter
disp('Voltage in 2nd Meter (V) = '+string(V2)+' Volt');

Er1=(Vt-V1)*100/Vt;             // % Error in Ist meter
disp('% Error in Ist meter = '+string(Er1)+' %');

Er2=(Vt-48.36)*100/Vt;           // % Error in 2nd meter ==> { V2=48.3739, but taking V2= 48.36 }
disp('% Error in 2nd meter = '+string(Er2)+' %');

```

```
                // p 770              18.6
```

Scilab code Exa 18.7 Angle of Deflection

```

                            // Examle 18.7

k=60/20;                     // Derived from  { Q= k x I }
i=12;                        // Current
Q1=k*i;                      // Diflection for Spring-Control Current
disp('Diflection for Spring-Control Current = '+string(Q1)+' Digree');

k1=sind(60)/20;              // Derived from { SinQ= k x I }
Q2=asind(k1*12);             // Diflection for Gravity-Control Current
disp('Diflection for Gravity-Control Current = '+string(Q2)+' Digree');



                 // 775       18.7
```

Scilab code Exa 18.8 Deflection in the Torque

```
                      // Examle 18.8

w=0.005;                    // Controling weigth
l=0.024;                    // Distance
td=1.05*10^-4;              // Deflecting torque
k=asind(td/(w*l));          // Diflection  in Digree (@)
disp('Diflection  in Digree (@) = '+string(round(k))+' Digree');



       //  p 776         18.8
```

Scilab code Exa 18.9 Angle of Deflection

```

                      // Examle 18.9

i1=10;                            // Current I1
i2=5;                             // Current I2
Q=90;                             // Deflection due to 10 Amp
Q1=(i2/i1)^2*Q;                   // Diflection for Spring-Control Current
disp('Diflection for Spring-Control Current = '+string(Q1)+' Digree');

        // Using formula ==> {  Q2= Sin[(i2/i1)^2*sin(Q)]  }

Q2=asind((i2/i1)^2*sind(Q));      // Diflection for Gravity-Control Current
disp('Diflection for Gravity-Control Current = '+string(Q2)+' Digree');
```

Scilab code Exa 18.10 Current

```
                      // Examle 18.10

w=0.004;               // width of the coil
l=0.005;               // Length of the coil
A=w*l;                 // Area of the coil
B=0.1;                 // Megnetic flux density
n=80;                  // No.Of turns
tc=0.5*60*10^-6;       // Controling torque
td=3*10^-3;            // Deflecting torque
I=tc/(B*n*A);          // Current
disp('Current (I) = '+string(I)+' Amp');



     //   p 777         18.10
```