

Scilab Textbook Companion for
Basic Electrical Engineering
by P. S. Dhogal¹

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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.

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Chapter 3

electricity and its fundamental law

Scilab code Exa 3.1 resistance

```
1 //Example 3.1 // resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 V=230; // in volts
7 I=10; // in A
8 R=V/I;
9 disp(R,"resistance of element ,R(ohm)= ")
```

Scilab code Exa 3.2 voltage

```
1 //Example 3.2 // voltage
2 clc;
3 clear;
4 close;
```

```

5 //given data :
6 R1=0.5; // minimum value of resistance in ohm
7 R2=20; // maximum value of resistance in ohm
8 I=1.2; // current in A
9 V1=I*R1;
10 V2=I*R2;
11 disp(V1," voltage drop in Ist case ,V1(V) = ")
12 disp(V2," voltage drop in IInd case ,V2(V) = ")

```

Scilab code Exa 3.3 specific resistance

```

1 //Example 3.3 // resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 L=1000; // length of wire in cm
7 d=0.14; // diameter of wire in cm
8 R1=2.5*10^6; // resistance in micro-ohm
9 a=(%pi*d^2)/4; // cross section area
10 p=(R1*a)/L;
11 disp(p,"the specific resistance ,p(micro-ohm-cm) = ")

```

Scilab code Exa 3.4 resistance

```

1 //Example 3.4 // resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 Rt1=54.3; // resistance in ohm
7 alfa=0.0043; // the resistance temperature of
  coefficient in per degree celcius

```

```

8 t1=20; // temperature in degree celcius
9 t2=40; // temperature in degree celcius
10 Rt2=(Rt1*(1+(alfa*t2)))/(1+(alfa*t1));
11 disp(Rt2,"resistance at 40 degree celsius ,Rt2(ohm) =
    ")

```

Scilab code Exa 3.5.a total resistance

```

1 //Example 3.5.a // resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 r1=30; // resistance in ohm
7 r2=35; // resistance in ohm
8 r3=45; // resistance in ohm
9 R=r1+r2+r3;
10 disp(R,"total resistance ,R(ohm) = ")

```

Scilab code Exa 3.5.b current flowing

```

1 //Example 3.5.b // current
2 clc;
3 clear;
4 close;
5 //given data :
6 r1=30; // resistance in ohm
7 r2=35; // resistance in ohm
8 r3=45; // resistance in ohm
9 R=r1+r2+r3;
10 V=220;
11 I=V/R;
12 disp(I,"current ,I(A) = ")

```

Scilab code Exa 3.6 voltage

```
1 //Example 3.6 // voltage at the generating station
2 clc;
3 clear;
4 close;
5 //given data :
6 I=75; // current in A
7 R=0.15; // resistance in ohm
8 v=220; // voltage in volts
9 V1=I*R; // voltage drop of the feeder in section AB
10 V2=I*R; // voltage drop of the feeder in section CD
11 V_total=V1+V2; // total voltage drop in the lead and
    return feeder
12 V=v+V_total;
13 disp(V,"voltage at the generating station ,V(v) = ")
```

Scilab code Exa 3.7 total resistance

```
1 //Example 3.7 // total resistance
2 clc;
3 clear;
4 close;
5 //given data :
6 r1=6; // resistance in ohm
7 r2=10; // resistance in ohm
8 r3=15; // resistance in ohm
9 r=(1/r1)+(1/r2)+(1/r3);
10 R=1/r;
11 disp(R,"equivalent resistance ,R(ohm) = ")
```

Scilab code Exa 3.8 voltage

```
1 //Example 3.8 // voltage
2 clc;
3 clear;
4 close;
5 //given data :
6 I=5; // current in A
7 n=2; // number of resistance in parallel of section
   BC
8 r1=15; // resistance in ohm
9 r2=20; // resistance in ohm
10 r3=60; // resistance in ohm
11 r4=64; // resistance in ohm
12 r5=64; // resistance in ohm
13 r6=2.5; // resistance in ohm
14 R1=r4/n; // equivalent resistance of section BC
15 R2=(r1*r2*r3)/((r1*r2)+(r2*r3)+(r3*r1)); //
   equivalent resistance of section CD
16 R=R1+R2+r6; // equivalent resistance of section AD
17 V=I*R;
18 disp(V,"voltage ,V(v) = ")
```

Scilab code Exa 3.9 effective resistance and current

```
1 //Example 3.9 // resistance and current
2 clc;
3 clear;
4 close;
5 //given data :
6 V=240; // voltage in volts
7 r1=2; // resistance in ohm
```

```

8 r2=3; // resistance in ohm
9 r3=8.8; // resistance in ohm
10 r4=10; // resistance in ohm
11 r5=3; // resistance in ohm
12 R1=(r1*r2)/(r1+r2); // equivalent resistance of
    parallel branch
13 R2=R1+r3; // equivalent resistance of section ABC
14 R3=(R2*r4)/(R2+r4);
15 R=R3+r5; // total resistance of section AD
16 I=V/R;
17 V1=I*r5; // voltage drop across r5
18 V2=V-V1; // voltage drop across section ABC
19 I1=V2/r4; // current flowing through r4 resistance
20 I2=I-I1; // current in r3 resistance
21 V3=I2*r3; // voltage drop across r3 resistance ,
    section ABC
22 V4=V2-V3; // voltage drop between section AB
23 I3=V4/r1; // current flowing through r1 resistance
24 I4=V4/r2; // current flowing through r2 resistance
25 disp(I3,"current flowing through r1 (2 ohms)
    resistance ,I3(A) = ")
26 disp(I4,"current flowing through r2 (3 ohms)
    resistance ,I4(A) = ")
27 disp(R,"total resistance ,R(ohm) = ")
28 disp(V1,"voltage drop across r5(3 ohms) resistance ,
    V1(V) = ")
29 disp(V2,"voltage drop across section ABC,V2(V) = ")
30 disp(V3,"voltage drop across r3 resistance(8.8 ohms)
    ,V3(V) = ")
31 disp(V4," voltage drop between section AB,V4(V) = ")

```

Scilab code Exa 3.10 current

```

1 //Example 3.10 // current
2 clc;

```

```

3 clear;
4 close;
5 //given data :
6 I=44; // current in A
7 r1=6; // resistance in ohm
8 r2=12; // resistance in ohm
9 r3=18; // resistance in ohm
10 a=(1/r1)+(1/r2)+(1/r3);
11 R=1/a;
12 V=I*R;
13 i1=V/r1;
14 i2=V/r2;
15 i3=V/r3;
16 disp(i1,"current in 6 ohm resistance ,i1(A) = ")
17 disp(i2,"current in 12 ohm resistance ,i2(A) = ")
18 disp(i3,"current in 18 ohm resistance ,i3(A) = ")

```

Scilab code Exa 3.11.a unknow resistance

```

1 //Example 3.11.A // RESISTANCE
2 clc;
3 clear;
4 close;
5 t=15; //TOTAL CURRENT IN AMPERES
6 i1=2; //CURRENT THROUGH UNKNOWN RESISTANCE
7 R1=15; //in ohms
8 R2=50/2; //in ohms
9 x=(t-i1)*((R1*R2)/(R1+2*R2)); //unknown resistance in
    ohms)
10 disp(x,"unknown resistance in ohms")

```

Scilab code Exa 3.11.b potential drop

```

1 //Example 3.11.B // potential drop across the
   circuit
2 clc;
3 clear;
4 close;
5 t=15; //TOTAL CURRENT IN AMPERES
6 i1=2; //CURRENT THROUGH UNKNOWN RESISTANCE
7 R1=15; //in ohms
8 R2=50/2; //in ohms
9 x=(t-i1)*((R1*R2)/(R1+2*R2)); //unknown resistance in
   ohms
10 PD=i1*x; //in volts
11 disp(PD,"potential drop across the circuit in volts
   is")

```

Scilab code Exa 3.11.c current

```

1 //Example 3.11.C // CURRENT IN EACH RESISTANCE
2 clc;
3 clear;
4 close;
5 t=15; //TOTAL CURRENT IN AMPERES
6 i1=2; //CURRENT THROUGH UNKNOWN RESISTANCE
7 R1=15; //in ohms
8 R2=50/2; //in ohms
9 x=(t-i1)*((R1*R2)/(R1+2*R2)); //unknown resistance in
   ohms
10 PD=i1*x; //in volts
11 i5= PD/(2*R2); //current in 5 ohms resistance
12 i15=PD/R1; //current in 15 ohms resistance
13 disp(i5,"current in 5 ohms resistance in ampere")
14 disp(i15,"current in 15 ohms resistance in ampere")

```

Scilab code Exa 3.11.d total resistance

```
1 //Example 3.11.d // total resistance
2 clc;
3 clear;
4 close;
5 t=15; //TOTAL CURRENT IN AMPERES
6 i1=2; //CURRENT THROUGH UNKNOWN RESISTANCE
7 R1=15; //in ohms
8 R2=50/2; //in ohms
9 x=(t-i1)*((R1*R2)/(R1+2*R2)); //unknown resistance in
   ohms
10 PD=i1*x; //in volts
11 RX=((1/R1)+(1/(2*R2))+(1/x)); //
12 R=1/RX; //
13 disp(R,"total resistance of the circuit in ohms")
```

Chapter 4

Work power and energy

Scilab code Exa 4.1.b power lost

```
1 //Example 4.1.b // power lost
2 clc;
3 clear;
4 close;
5 //given data :
6 I=11; // current in A
7 V1=55; // voltage in V
8 V2=220; // voltage in V
9 V=V2-V1;
10 R=V/I;
11 P=I^2*R;
12 disp(P,"power lost ,P(W) = ")
```

Scilab code Exa 4.1 resistance

```
1 //Example 4.1.a // resistance
2 clc;
3 clear;
```

```

4 close;
5 //given data :
6 I=11; // current in A
7 V1=55; // voltage in V
8 V2=220; // voltage in V
9 V=V2-V1;
10 R=V/I;
11 disp(R,"resistance ,R(ohm) = ")

```

Scilab code Exa 4.2 resistance

```

1 //Example 4.2 : resistance of each coil
2 clc;
3 clear;
4 close;
5 //given data :
6 V=300; // voltage in volts
7 W=360; // power lost in one coil in watt
8 I=6; // current in A
9 R1=V/I;
10 R=V^2/W;
11 a=(1/R1)-(1/R);
12 r2=1/a;
13 disp(R,"resistance of 360W coil1 ,R(ohm) = ")
14 disp(r2,"resistance of second coil2 ,r2(ohm) = ")

```

Scilab code Exa 4.3 resistance

```

1 //Example 4.3 : resistance
2 clc;
3 clear;
4 close;
5 //given data :

```

```

6 W1=100; // in watt
7 E=110; // in volts
8 W2=60; // in watt
9 I1=W1/E; // current taken by 100 w lamp
10 I2=W2/E; // current taken by 60W lamp
11 I=I1-I2;
12 R=E/I;
13 disp(R,"resistance ,R(ohm) = ")

```

Scilab code Exa 4.4.a power taken in parallel case

```

1 //Example 4.4.a: power in case of parallel
2 clc;
3 clear;
4 close;
5 //given data :
6 w=100; // in watt
7 V=220; // voltage in volts
8 R1=V^2/w;
9 R=R1/2; // total resistance of the circuit
10 I=V/R;
11 W=I^2*R;
12 disp(W,"power in case of parallel ,W(watt) = ")

```

Scilab code Exa 4.4.b power taken in series case

```

1 //Example 4.4.b: power in case of series
2 clc;
3 clear;
4 close;
5 //given data :
6 w=100; // in watt
7 V=220; // voltage in volts

```

```

8 R1=V^2/w;
9 R2=V^2/w;
10 R=R1+R2; // total resistance of the circuit
11 I=V/R;
12 W=I^2*R;
13 disp(W,"power in case of series ,W(watt) = ")

```

Scilab code Exa 4.5.a total load

```

1 //Example 4.5.a: total load
2 clc;
3 clear;
4 close;
5 //given data :
6 l=300; // number of lamps
7 w1=60; // in watt
8 W1=w1*l; // wattage required for 300 lamps, 60 watt
   each
9 w2=40; // in watt
10 f=100; // number of fan
11 W2=w2*f; // wattage required for 100 fans, 40 watt
   each
12 W=(W1+W2)*10^-3;
13 disp(W,"total load ,W(kilo-watt) = ")

```

Scilab code Exa 4.5.b current taken

```

1 //Example 4.5.b: current taken by load
2 clc;
3 clear;
4 close;
5 //given data :
6 V=220; // voltage in volts

```

```

7 l=300; // number of lamps
8 w1=60; // in watt
9 W1=w1*l;
10 w2=40; // in watt
11 f=100; // number of fan
12 W2=w2*f;
13 W=(W1+W2)*10^-3;
14 I=(W*1000)/V;
15 disp(I,"current ,I(A) = ")

```

Scilab code Exa 4.6 total cots of electric energy and total charges of bill

```

1 //Example 4.6 // total cost of elecric charge
2 clc;
3 clear;
4 close;
5 nl=12;//no. of lamps
6 wl=100;//wattage of lamps
7 hl=6;//each lamps work 6 hours a days
8 w12=wl*nl*hl;//wattage of 12 lamps in Wh
9 nf=6;//no. of fans
10 wf=60;//wattage of fans
11 hf=5;//each fans work 5 hours a days
12 w6=wf*nf*hf;//wattage of 12 fans in Wh
13 nc=2;//no. of electric cookers
14 wc=1500;//wattage of electric cookers
15 hc=4;//each electric cookers work 4 hours a days
16 w2=wc*nc*hc;//wattage of 2 electric cookers in Wh
17 ng=2;//no. of gysers
18 wg=1000;//wattage of each gyser
19 hg=3;//each gyser works 3 hours a day
20 w21=wg*hg*ng;//total wattage of gysers in Wh
21 tcg=(w12+w6)*10^-3;//TOTAL WATTAGE OF LAMPS AND FANS
22 Ccg=40;//IN PAISA
23 Ecg= (tcg*Ccg*30)/100;//TOTAL ENERGY CHARGES @40

```

```

    PAISA PER UNIT
24 tcg1=(w2+w21)*10^-3; //TOTAL WATTAGE OF COOKERS AND
    GYSERS
25 Ccg1=35; //IN PAISA
26 Ecg1= (tcg1*Ccg1*30)/100; //TOTAL ENERGY CHARGES @35
    PAISA PER UNIT
27 tc=Ecg+Ecg1; // IN RUPPES
28 disp(Ecg,"total cost of electric charge @40 paisa
    per unit in rupees")
29 disp(Ecg1,"total cost of electric charge @35 paisa
    per unit in rupees")
30 disp(tc,"total charge for ligh and power in rupees")

```

Scilab code Exa 4.7 voltage current power and bill amount

```

1 //Example 4.7 // total consumption of factory in
    killo watts
2 clc;
3 clear;
4 close;
5 nl=400; //no. of lamps
6 wl=100; //wattage of lamps
7 w400=wl*nl; //wattage of 400 lamps in W
8 nf=100; //no. of fans
9 wf=40; //wattage of fans
10 w6=wf*nf; //wattage of 100 fans in W
11 nc=200; //no. of wall scokets
12 wc=60; //wattage of wall scckets
13 w2=wc*nc; //wattage of 200 wall sockets in Wh
14 tc= w400+w6+w2; //total consumption in kW
15 tc= w400+w6+w2; //total consumption in kW
16 h=5; // hours
17 ll=tc*10^-3*h; //lightning load in kWh
18 V=250; //in volts
19 I=20; //in amperes

```

```

20 Ml=V*I*10^-3; //miscellaneous loads in kW
21 Ml=V*I*10^-3; //miscellaneous loads in kW
22 hm=2; //hours
23 hl=50; //heating load in kW
24 Mhp=40; //BNHP
25 Mo= ((50*80*746)/(100*1000)); //MOTOR AT 80% LOAD IN
    Kw
26 tl=tc*10^-3+Ml+hl+Mo; //total load in kW
27 disp(tl,"total load is ,(kW)=")
28 It= (tl*10^3)/V; //total current taken buy the
    factory in amperes
29 disp(It,"total current taken by the factory is ,(A)="
    )
30 r=0.03; //IN OHMS
31 Vc=It*r; //voltage drop in the cable
32 Vs=Vc+V; //voltage at the sending end of the feeder
    in volts
33 disp(Vs,"voltage at the sending end of the feeder is
    ,(V)")
34 r=0.03; //IN OHMS
35 Vc=It*r; //voltage drop in the cable
36 Pw=It^2*r; //power wasted in kW
37 disp(Pw*10^-3,"power wasted is ,(kW)")
38 Mlh=Ml*hm; //miscellaneous load in kWh
39 te=Mlh+hl; //TOTAL ENERGY COSNUMED PER DAY
40 Nu=te*6; //NO. OF UNITS
41 Ec=(Nu*30)/100; // ENERGY CHARGE @30 PAISA PER UNIT
42 eCM=Ec+2+34.80; //TOTAL CHARGE AFTER TAX AND RENT IN
    RUPEES
43 hl=50; //heating load in kW
44 hlh=50*4; //heating load in kWh
45 Moh=Mo*8; //MOTOR LOAD IN kWh
46 TEP=hlh+Moh; //total energy per day
47 tep1=TEP*6; //total energy in 6 days
48 tepc=(tep1*35)/100; // energy charges @35 paisa per
    unit in rupees
49 tepcl=tepc+50+78.96; //total charges in rupess
50 disp(eCM,"total lightning charges including meter

```

```

    rent and electricy tax is ,(Rs)=")
51 disp(tepcl,"total power charges including meter rent
    and electricy tax is ,(Rs)=")
52 gt=tepcl+eCM;//
53 disp(gt,"grand total of bills is ,(Rs)=")

```

Scilab code Exa 4.8 current taken

```

1 //Example 4.8: current taken by load
2 clc;
3 clear;
4 close;
5 //given data :
6 V=250; // voltage in volts
7 L=5*746; // 1 hp=746 watt
8 eta=80;// efficiency of motor in %
9 Input=(L*100)/80;
10 I=Input/V;
11 disp(I,"cureent ,I(A) = ")

```

Scilab code Exa 4.9 amount of bills

```

1 //Example 4.9 //total of bills
2 clc;
3 clear;
4 close;
5 p=30;//horse power of motor
6 r=24;// rupees per kWh
7 ec=35;//paisa per unit
8 n=80;//percentage of load
9 t=8;// in hours
10 d=25;// total days
11 ne=96;//efficiency of motor in percentage

```

```

12 mo=(n*p)/100; //output of motor at 80% of load
13 mi=(mo*100*746)/(ne); //input of motor in watts
14 ecm=mi*10-3*t*d; //energy consumed in a month
15 ecu=(ecm*35)/100; //energy charges
16 mid=(30*100*746)/(ne*1000); //input of motor in kW at
    demanded
17 e cud=(mid*24); // demanded connection in rupees
18 ta=ecu+e cud; //total bill in rupees
19 disp(ta,"total bill in rupees is")

```

Scilab code Exa 4.10.a total load of light and fans

```

1
2 //Example 4.10.a//total load of lights and fans
3 clc;
4 clear;
5 close;
6 lp=50; //no. of light points
7 lw=60; //wattage of light points
8 fp=20; //no. of fan points
9 fw=100; //wattage of fan points
10 wpp=10; //no. of wall plug points
11 wppw=60; //wattage of wall plug points
12 bp=5; //no. of bell points
13 bpw=40; //wattage of bell points
14 ppp=8; //power plug points
15 pppw=5000; //wattage of power plug points
16 lpw=lp*lw; //wattage of 50 lamps
17 fpw=fp*fw; //wattage of 20 fans
18 wpppw=wpp*wppw; //wattage of wall plug points
19 bpw=bp*bpw; //wattage of bell points
20 tl=lpw+fpw+wpppw+bpw; //total wattage
21 disp(tl,"total wattage of lightning load is in watts
    ")

```

Scilab code Exa 4.10.b total load current

```
1 //Example 4.10.b//total load of power connection
2 clc;
3 clear;
4 close;
5 V=400; //three phase voltage
6 lp=50; //no. of light points
7 lw=60; //wattage of light points
8 fp=20; //no. of fan points
9 fw=100; //wattage of fan points
10 wpp=10; //no. of wall plug points
11 wppw=60; //wattage of wall plug points
12 bp=5; //no. of bell points
13 bpw=40; //wattage of bell points
14 ppp=8; //power plug points
15 pppw=500; //wattage of power plug points
16 lpw=lp*lw; //wattage of 50 lamps
17 fpw=fp*fw; //wattage of 20 fans
18 wpppw=wpp*wppw; //wattage of wall plug points
19 bpww=bp*bpw; //wattage of bell points
20 tl=lpw+fpw+wpppw+bpww; //total wattage
21 ppppw=ppp*pppw; //wattage of power plug points
22 tw=tl+ppppw; //total wattage
23 I1=(tl/V); // CURRENT THROUGH LIGHTNING LOAD
24 Ip=ppppw/V; // current through power load
25 ttl=I1+Ip; //total load current
26 disp(ttl,"total load current in amperes")
```

Scilab code Exa 4.11 horsepower of the motor

```
1 //Example 4.11: horse power
```

```

2  clc;
3  clear;
4  close;
5  //given data :
6  h=30; // in m
7  F1=10; // friction loss in %
8  H1=(F1/100)*h;
9  total_H=h+H1;
10 eta=90; // efficiency of pump
11 w=1000; // water weight in kg
12 flow_rate=243; // in per hour
13 W_done=(flow_rate*w*total_H)/60; // in kg-m/min
14 output=W_done/4500; //output of pump in hp
15 in=(output*100)/eta;
16 O=in;
17 disp(0,"output of the motor,O(hp) = ")

```

Scilab code Exa 4.12.a Bhp of the motor

```

1
2 //Example 4.12.a: BHP of the motor
3 clc;
4 clear;
5 close;n=80; //efficiency
6 l=7.5; //load in tonnes
7 h=135; //height in meters
8 c=0.5; //cge weight in tonnes
9 b=3; //balance weight in tonnes
10 td=90; //time in seconds
11 onet=1000; // in kg
12 onehp=746; //watt
13 wl=l+c-b; //weight lifted during upward journey in
    tonnes
14 wld=b-c; //weight lifted during downward journey in
    tonnes

```

```

15 wdu=(wl*10^3*h*60)/td; //work done by the lift per
    minute during upward journey
16 wdd=(wld*10^3*h*60)/td; //work done by the lift per
    minute during downward journey
17 mou=wdu/4500; // in hp
18 miu=(mou*100*746)/(n*1000); // input of motor in kW
19 mod=wdd/4500; // in hp
20 mid=(mod*100*746)/(n*1000); // input of motor in kW
21 disp(mou,"BHP of the motor in upward journey in hp")
22 disp(mod,"BHP of the motor in downward journey in hp
    ")

```

Scilab code Exa 4.12.b cost of the energy

```

1 //Example 4.12.b: cost of the energy
2 clc;
3 clear;
4 close;n=80; //efficiency
5 l=7.5; //load in tonnes
6 h=135; //height in meters
7 c=0.5; //cge weight in tonnes
8 b=3; //balance weight in tonnes
9 td=90; //time in seconds
10 onet=1000; // in kg
11 onehp=746; //watt
12 wl=l+c-b; //weight lifted during upward journey in
    tonnes
13 wld=b-c; //weight lifted during downward journey in
    tonnes
14 wdu=(wl*10^3*h*60)/td; //work done by the lift per
    minute during upward journey
15 wdd=(wld*10^3*h*60)/td; //work done by the lift per
    minute during downward journey
16 mou=wdu/4500; // in hp
17 miu=(mou*100*746)/(n*1000); // input of motor in kW

```

```
18 mod=wdd/4500; // in hp
19 mid=(mod*100*746)/(n*1000); // input of motor in kW
20 tc=miu+mid; //total energy consumption in kW
21 Eh=tc*10; //total energy consumption per hour
22 rate=40; //rate in paisa
23 ce=Eh*(rate/100); //cost of energy in rupees
24 disp(ce,"cost of energy in rupees is")
```

Chapter 5

effects of electric current

Scilab code Exa 5.1 ECE of silver

```
1 //Example 5.1: E.C.E
2 clc;
3 clear;
4 close;
5 //given data :
6 t=200; // time in sec
7 M=111.83; // silver in mg
8 I=0.5; // current in A
9 Z=(M/(I*t*1000))*1000; // electro-chemical-equivalent
10 disp(Z,"E.C.E,Z(mg/C) = ")
```

Scilab code Exa 5.2 thickness of coper

```
1 //Example 5.2: thickness
2 clc;
3 clear;
4 close;
5 //given data :
```

```

6 Z=0.329*10^-3; // IN g/C
7 I=1; // in amperes
8 t=90*60; // in seconds
9 M=Z*I*t; // in grams
10 A=200; //area in centimete square
11 S=8.9; //density in g/cc
12 T=(M)/(2*A*S); //thickness in cm
13 disp(T,"thickness of copper in cm is")

```

Scilab code Exa 5.3 resistance

```

1 //Example 5.3 // resistance of the heater element
2 clc;
3 clear;
4 close;
5 w=15; // in kg
6 t1=15; // in degree celsius
7 t2=100; //in degree celsius
8 t=25; // time in minutes
9 I=10; // in ampere
10 n=85; //efficiency of conversion in percentage
11 ho=w*(t2-t1); //output heat required in kcal
12 R=((ho*4187*100)/(I^2*t*60*n)); // resistance in ohms
13 disp(R,"resistance in ohms")

```

Scilab code Exa 5.4 potential difference

```

1 //Example 5.4 // potential difference across the
  heater element
2 clc;
3 clear;
4 close;
5 w=20; // in kg

```

```
6 t1=10; // in degree celsius
7 t2=90; //in degree celsius
8 t=2*3600+19*60+34; // time in seconds
9 I=4; // in ampere
10 n=80; //efficiency of conversion in percentage
11 ho=w*(t2-t1); //output heat required in kcal
12 V=((ho*4187*100)/(I*t*n)); // POTENTIAL DROP IN VOLTS
13 disp(V,"potential drop across heater element in
      volts is")
```

Chapter 6

magnetism and electromagnetism

Scilab code Exa 6.1 field strength

```
1 //Example 6.1 // field strength
2 clc;
3 clear;
4 close;
5 I=1.5; // in amperes
6 n=50; //turns
7 l=0.25; //length of coil in meter
8 H=(I*n)/l; //field strength in ampere-turns/m
9 disp(H,"field strength in ampere-turns/m")
```

Scilab code Exa 6.2 force

```
1 //Example 6.2 // force
2 clc;
3 clear;
4 close;
```

```
5 I=70; // in amperes
6 B=0.4; // flux density in Wb/m^2
7 n=1; // turns
8 F=B*n*I; // in newton
9 disp(F, "force in newtons is")
```

Scilab code Exa 6.3 emf induced

```
1
2 //Example 6.3 // emf induced
3 clc;
4 clear;
5 close;
6 b=2; //in Wb/m^2
7 l=6; //in cm
8 s=0.75; //in m's
9 alpha=90; //
10 emf=b*l*s*(sind(alpha)); //
11 disp(emf, "emf induced in volts is")
```

Chapter 7

DC generators

Scilab code Exa 7.1.a emf induced

```
1 //Example 7.1.a: e.m.f
2 clc;
3 clear;
4 close;
5 // given data:
6 p=8; // number of poles
7 a=p; // in lap winding
8 fi=15*10^-3; // in wb
9 N=500; // rev/min
10 Z=800; // number of conductors on armature
11 emf=(fi*Z*N*p)/(60*a); // when the armature is lap
    wound
12 disp(emf, "emf(V) = ")
```

Scilab code Exa 7.1.b emf generated

```
1 //Example 7.1.b: e.m.f if the armature is wave wound
2 clc;
```

```

3 clear;
4 close;
5 // given data:
6 p=8; // number of poles
7 a=2; // in wave winding
8 fi=15*10^-3; // in wb
9 N=500; // rev/min
10 Z=800; // number of conductors on armature
11 emf=(fi*Z*N*p)/(60*a); // when the armature is wave
    wound
12 disp(emf, "emf(V) = ")

```

Scilab code Exa 7.2.a total armature current

```

1 //Example 7.2.a: total armature current
2 clc;
3 clear;
4 close;
5 // given data:
6 Vt=200; // terminal voltage in volts
7 Rsh=100; //shunt fieldresistance in ohm
8 Ra=0.1; // armature resistance in ohm
9 l=60; // number of lamps
10 w=40; // in watt
11 total_l=l*w; // in watt
12 Il=total_l/Vt; // load current
13 Ish=Vt/Rsh; // shunt field current
14 Ia=Il+Ish;
15 disp(Ia, "armature current ,Ia(A) = ")

```

Scilab code Exa 7.2.b current per armature path

```

1 //Example 7.2.b: current per armature path

```

```

2  clc;
3  clear;
4  close;
5  // given data:
6  Vt=200; // terminal voltage in volts
7  Rsh=100; //shunt fieldresistance in ohm
8  Ra=0.1; // armature resistance in ohm
9  l=60; // number of lamps
10 w=40; // in watt
11 total_l=l*w; // in watt
12 I1=total_l/Vt; // load current
13 Ish=Vt/Rsh; // shunt field current
14 Ia=I1+Ish;
15 N=4; // number of poles
16 I=Ia/N;
17 disp(I,"current per path in a armature ,I(A) = ")

```

Scilab code Exa 7.2.c emf generated

```

1 //Example 7.2.c: emf
2 clc;
3 clear;
4 close;
5 // given data:
6 Vt=200; // terminal voltage in volts
7 Rsh=100; //shunt fieldresistance in ohm
8 Ra=0.1; // armature resistance in ohm
9 l=60; // number of lamps
10 w=40; // in watt
11 total_l=l*w; // in watt
12 I1=total_l/Vt; // load current
13 Ish=Vt/Rsh; // shunt field current
14 Ia=I1+Ish;
15 N=4; // number of poles
16 I=Ia/N;

```

```

17 Va=Ia*Ra; //armature voltage drop
18 Vb=1+1; // brush contact drop for 2 pair of poles
19 E=Vt+Va+Vb;
20 disp(E,"emf ,E(v) = ")

```

Scilab code Exa 7.3.a terminal voltage

```

1 //Example 7.3.a: terminal voltage
2 clc;
3 clear;
4 close;
5 // given data:
6 W=10; // output of the generator in k-w
7 V=250; // voltage in volts
8 R=0.07; // in ohm
9 I1=(W*1000)/V; // load current in A
10 Vf=I1*R; // voltage drop in feeder
11 Vt=V+Vf;
12 disp(Vt,"terminal voltage ,Vt(V) = ")

```

Scilab code Exa 7.3.b emf generated

```

1 //Example 7.3.b: emf
2 clc;
3 clear;
4 close;
5 // given data:
6 W=10; // output of the generator in k-w
7 V=250; // voltage in volts
8 R=0.07; // in ohm
9 I1=(W*1000)/V; // load current in A
10 Vf=I1*R; // voltage drop in feeder
11 Vt=V+Vf; // terminal voltage

```

```

12 Rsh=63.2; // shunt resistance in ohm
13 Ra=0.05; // armature resistance in ohm
14 Vb=2; // brush contact drop
15 Ish=Vt/Rsh;
16 Ia=I1+Ish;
17 Vd=Ia*Ra; // voltage drop in the armature
18 E=Vt+Vd+Vb;
19 disp(E,"emf,E(V) = ")

```

Scilab code Exa 7.4.a terminal voltage

```

1 //Example 7.4.a: terminal voltage
2 clc;
3 clear;
4 close;
5 // given data:
6 W=20000; // in watt
7 V=200; // in volts
8 R=0.08; // in ohm
9 Rs=0.02; // series field resistance in ohm
10 I=W/V; // in A
11 Vf=I*R;
12 Vs=I*Rs;
13 V1=Vf+Vs; // voltage drop of feeder and series field
14 Vg=V+V1;
15 disp(Vg,"terminal voltage ,Vg(V) = ")

```

Scilab code Exa 7.4.b emf generated

```

1 //Example 7.4.b: emf generated
2 clc;
3 clear;
4 close;

```

```

5 // given data:
6 W=20000; // in watt
7 V=200; // in volts
8 R=0.08; // in ohm
9 Rs=0.02; // series field resistance in ohm
10 I=W/V; // in A
11 Rsh=42; // shunt ield resistance in ohm
12 Ra=0.04; // armature resistance in ohm
13 Vf=I*R;
14 Vs=I*Rs;
15 V1=Vf+Vs; // voltage drop of feeder and series field
16 Vg=V+V1; // terminal voltage
17 Ish=Vg/Rsh; // shunt field current
18 Ia=I+Ish;
19 Vd=Ia*Ra;
20 emf=Vg+Vd;
21 disp(emf, "emf(V) = ")

```

Scilab code Exa 7.4.c copper losses

```

1 //Example 7.4.c: copper losses
2 clc;
3 clear;
4 close;
5 // given data:
6 W=20000; // electrical output in watt
7 V=200; // in volts
8 R=0.08; // in ohm
9 Rs=0.02; // series field resistance in ohm
10 I=W/V; // in A
11 Rsh=42; // shunt ield resistance in ohm
12 Ra=0.04; // armature resistance in ohm
13 Vf=I*R;
14 Vs=I*Rs;
15 V1=Vf+Vs; // voltage drop of feeder and series field

```

```

16 Vg=V+V1; // terminal voltage
17 Ish=Vg/Rsh; // shunt field current
18 Ia=I+Ish;
19 Vd=Ia*Ra;
20 emf=Vg+Vd;
21 Ed=emf*Ia; // in watt
22 copper_losses=Ed-W;
23 disp(copper_losses, "copper losses (Watt) = ")

```

Scilab code Exa 7.4.d Bhp metric of the primemover

```

1 //Example 7.4.d: bhp metric of the primemover
2 clc;
3 clear;
4 close;
5 // given data:
6 W=20000; // electrical output in watt
7 V=200; // in volts
8 R=0.08; // in ohm
9 Rs=0.02; // series field resistance in ohm
10 I=W/V; // in A
11 Rsh=42; // shunt field resistance in ohm
12 Ra=0.04; // armature resistance in ohm
13 iron_losses=309.5; // iron and friction losses
14 Vf=I*R;
15 Vs=I*Rs;
16 V1=Vf+Vs; // voltage drop of feeder and series field
17 Vg=V+V1; // terminal voltage
18 Ish=Vg/Rsh; // shunt field current
19 Ia=I+Ish;
20 Vd=Ia*Ra;
21 emf=Vg+Vd;
22 Ed=emf*Ia; // in watt
23 copper_losses=Ed-W;
24 mech_in=W+copper_losses+iron_losses;

```

```
25 Bhp=mech_in/735.5;
26 disp(Bhp,"bhp metric of the primemover ,Bhp = ")
```

Scilab code Exa 7.4.e commercial efficiency

```
1
2 //Example 7.4.d: bhp metric of the primemover
3 clc;
4 clear;
5 close;
6 // given data:
7 W=20000; // electrical output in watt
8 V=200; // in volts
9 R=0.08; // in ohm
10 Rs=0.02; // series field resistance in ohm
11 I=W/V; // in A
12 Rsh=42; // shunt field resistance in ohm
13 Ra=0.04; // armature resistance in ohm
14 iron_losses=309.5; // iron and friction losses
15 Vf=I*R;
16 Vs=I*Rs;
17 V1=Vf+Vs; // voltage drop of feeder and series field
18 Vg=V+V1; // terminal voltage
19 Ish=Vg/Rsh; // shunt field current
20 Ia=I+Ish;
21 Vd=Ia*Ra;
22 emf=Vg+Vd;
23 Ed=emf*Ia; // in watt
24 copper_losses=Ed-W;
25 mech_in=W+copper_losses+iron_losses; // mechanical
    power inoutput
26 Bhp=mech_in/735.5;
27 efficiency=(W/mech_in)*100;
28 disp(percentage," efficiency (%) = ")
```

Scilab code Exa 7.5.a total armature current

```
1 //Example 7.5.a: total armature current
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3; // number of motors
7 i=30; //current in A
8 I=i*n; // current taken by three motors
9 Rsh=44; // shunt field resistance
10 V=440; // voltage in V
11 Ish=V/Rsh; // shunt field current
12 Ia=I+Ish;
13 disp(Ia, "total armature current ,Ia(A) = ")
```

Scilab code Exa 7.5.b current

```
1 //Example 7.5.b: current in each path
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3; // number of motors
7 n1=4; // number of parallel path in winding
8 i=30; //current in A
9 I=i*n; // current taken by three motors
10 Rsh=44; // shunt field resistance
11 Ra=0.08; // armature resistance in ohm
12 V=440; // voltage in V
13 Ish=V/Rsh; // shunt field current
14 Ia=I+Ish;
```

```
15 I1=Ia/n1; // current in each path
16 disp(I1,"current in each path,I1(A) = ")
```

Scilab code Exa 7.5.c emf generated

```
1 //Example 7.5.c: e.m.f
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3; // number of motors
7 n1=4; // number of parallel path in winding
8 i=30; //current in A
9 I=i*n; // current taken by three motors
10 Rsh=44; // shunt field resistance
11 Ra=0.08; // armature resistance in ohm
12 V=440; // voltage in V
13 Ish=V/Rsh; // shunt field current
14 Ia=I+Ish;
15 I1=Ia/n1; // current in each path
16 Va=Ia*Ra; // armature drop
17 Vb=2; // we know , brush contact drops
18 E=V+Va+Vb;
19 disp(E,"emf,E(V) = ")
20 // answer is wrong in a book
```

Scilab code Exa 7.5.d power developed

```
1 //Example 7.5.d: electrical power developed in the
  armature
2 clc;
3 clear;
4 close;
```

```

5 // given data:
6 n=3; // number of motors
7 n1=4; // number of parallel path in winding
8 i=30; //current in A
9 Bhp=65; // in hp
10 I=i*n; // current taken by three motors
11 Rsh=44; // shunt field resistance
12 Ra=0.08; // armature resistance in ohm
13 V=440; // voltage in V
14 Ish=V/Rsh; // shunt field current
15 Ia=I+Ish;
16 I1=Ia/n1; // current in each path
17 Va=Ia*Ra; // armature drop
18 Vb=2; // we know , brush contact drops
19 E=V+Va+Vb;
20 E_power=E*Ia;
21 W=V*I; // in watt
22 M_power=Bhp*746; // assume Bhp=746 W
23 disp(E_power,"electrical power developed in watt = "
24 )
24 // answer is wrong in a book

```

Scilab code Exa 7.5.e copper losses

```

1 //Example 7.5.e: copper losses
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3; // number of motors
7 n1=4; // number of parallel path in winding
8 i=30; //current in A
9 Bhp=65; // in hp
10 I=i*n; // current taken by three motors
11 Rsh=44; // shunt field resistance

```

```

12 Ra=0.08; // armature resistance in ohm
13 V=440; // voltage in V
14 Ish=V/Rsh; // shunt field current
15 Ia=I+Ish;
16 I1=Ia/n1; // current in each path
17 Va=Ia*Ra; // armature drop
18 Vb=2; // we know , brush contact drops
19 E=V+Va+Vb;
20 E_power=E*Ia;
21 W=V*I; // in watt
22 M_power=Bhp*746; // assume Bhp=746 W
23 Copper_losses=E_power-W;
24 disp(Copper_losses,"copper losses (W) = ")

```

Scilab code Exa 7.5.f stray losses

```

1 //Example 7.5.f: stray losses
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3; // number of motors
7 n1=4; // number of parallel path in winding
8 i=30; //current in A
9 Bhp=65; // in hp
10 I=i*n; // current taken by three motors
11 Rsh=44; // shunt field resistance
12 Ra=0.08; // armature resistance in ohm
13 V=440; // voltage in V
14 Ish=V/Rsh; // shunt field current
15 Ia=I+Ish;
16 I1=Ia/n1; // current in each path
17 Va=Ia*Ra; // armature drop
18 Vb=2; // we know , brush contact drops
19 E=V+Va+Vb;

```

```

20 E_power=E*Ia;
21 W=V*I;// in watt
22 M_power=Bhp*746;// assume Bhp=746 W
23 Copper_losses=E_power-W;
24 S_loses=M_power-E_power;
25 disp(S_loses,"stray losses (W) = ")

```

Scilab code Exa 7.5.g.1 electrical efficiency

```

1 //Example 7.5.g.i: electrical efficiency
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3;// number of motors
7 n1=4;// number of parallel path in winding
8 i=30; //current in A
9 Bhp=65;// in hp
10 I=i*n;// current taken by three motors
11 Rsh=44; // shunt field resistance
12 Ra=0.08; // armature resistance in ohm
13 V=440; // voltage in V
14 Ish=V/Rsh;// shunt field current
15 Ia=I+Ish;
16 I1=Ia/n1;// current in each path
17 Va=Ia*Ra; // armature drop
18 Vb=2;// we know , brush contact drops
19 E=V+Va+Vb;
20 E_power=E*Ia;
21 W=V*I;// in watt
22 M_power=Bhp*746;// assume Bhp=746 W
23 Copper_losses=E_power-W;
24 S_loses=M_power-E_power;
25 eta_e=(W/E_power)*100;
26 disp(eta_e,"electrical efficiency ,eta_e (%) = ")

```

Scilab code Exa 7.5.g.2 commercial efficiency

```
1 //Example 7.5.g.i: commercial efficiency
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3; // number of motors
7 n1=4; // number of parallel path in winding
8 i=30; //current in A
9 Bhp=65; // in hp
10 I=i*n; // current taken by three motors
11 Rsh=44; // shunt field resistance
12 Ra=0.08; // armature resistance in ohm
13 V=440; // voltage in V
14 Ish=V/Rsh; // shunt field current
15 Ia=I+Ish;
16 I1=Ia/n1; // current in each path
17 Va=Ia*Ra; // armature drop
18 Vb=2; // we know , brush contact drops
19 E=V+Va+Vb;
20 E_power=E*Ia;
21 W=V*I; // in watt
22 M_power=Bhp*746; // assume Bhp=746 W
23 Copper_losses=E_power-W;
24 S_loses=M_power-E_power;
25 eta_c=(W/M_power)*100;
26 disp(eta_c,"commercial efficiency ,eta_c (%) = ")
```

Scilab code Exa 7.5.g.3 mechanical efficiency

```

1 //Example 7.5.g.i: electrical efficiency
2 clc;
3 clear;
4 close;
5 // given data:
6 n=3; // number of motors
7 n1=4; // number of parallel path in winding
8 i=30; //current in A
9 Bhp=65; // in hp
10 I=i*n; // current taken by three motors
11 Rsh=44; // shunt field resistance
12 Ra=0.08; // armature resistance in ohm
13 V=440; // voltage in V
14 Ish=V/Rsh; // shunt field current
15 Ia=I+Ish;
16 I1=Ia/n1; // current in each path
17 Va=Ia*Ra; // armature drop
18 Vb=2; // we know , brush contact drops
19 E=V+Va+Vb;
20 E_power=E*Ia;
21 W=V*I; // in watt
22 M_power=Bhp*746; // assume Bhp=746 W
23 Copper_losses=E_power-W;
24 S_loses=M_power-E_power;
25 eta_m=(E_power/M_power)*100;
26 disp(eta_m,"mechanical efficiency ,eta_m(%) = ")

```

Chapter 8

DC motors

Scilab code Exa 8.1 speed

```
1 //Example 8.1 // speed
2 clc;
3 clear;
4 close;
5 //given data :
6 pi=22/7;
7 s=22; // shaft of the motor in hp
8 Tsh=210; // torue in hp
9 N=(s*60*746)/(2*pi*Tsh);
10 disp(N,"speed ,N(rpm) = ")
```

Scilab code Exa 8.2.a Bhp

```
1 //Example 8.2.a: bhp
2 clc;
3 clear;
4 close;
5 //given data :
```

```

6 V=230; // voltage in volts
7 I=72; // current in A
8 W=V*I;
9 s=968; // stray losses
10 Rsh=115; // shunt field resistance in ohm
11 Ra=0.5; // armature resistance in ohm
12 Ish=V/Rsh; // shunt field resistance
13 Ia=I-Ish;
14 Eb=V-(Ia*Ra); // back emf in volts
15 Dpd=Eb*Ia; // driving power developed
16 Mpo=Dpd-s;
17 bhp=Mpo/746;
18 disp(bhp, " bhp = ")

```

Scilab code Exa 8.2.b copper losses

```

1 //Example 8.2.b: copper losses
2 clc;
3 clear;
4 close;
5 //given data :
6 V=230; // voltage in volts
7 I=72; // current in A
8 W=V*I;
9 s=968; // stray losses
10 Rsh=115; // shunt field resistance in ohm
11 Ra=0.5; // armature resistance in ohm
12 Ish=V/Rsh; // shunt field resistance
13 Ia=I-Ish;
14 Eb=V-(Ia*Ra); // back emf in volts
15 Dpd=Eb*Ia; // driving power developed
16 Mpo=Dpd-s;
17 bhp=Mpo/746;
18 c_losses=W-Dpd;
19 disp(c_losses, " copper losses (W) = ")

```

Scilab code Exa 8.2.c armature torque

```
1 //Example 8.2.c: armature torque
2 clc;
3 clear;
4 close;
5 //given data :
6 N=955; // in r.p.m
7 V=230; // voltage in volts
8 I=72; // current in A
9 W=V*I;
10 s=968; // stray losses
11 Rsh=115; // shunt field resistance in ohm
12 Ra=0.5; // armature resistance in ohm
13 Ish=V/Rsh; // shunt field resistance
14 Ia=I-Ish;
15 Eb=V-(Ia*Ra); // back emf in volts
16 Dpd=Eb*Ia; // driving power developed
17 Mpo=Dpd-s;
18 bhp=Mpo/746;
19 c_losses=W-Dpd;
20 Ta=(9.55*Eb*Ia)/N;
21 disp(Ta,"torque armature ,Ta(N-m) = ")
```

Scilab code Exa 8.2.d shaft torque

```
1 //Example 8.2.d: shaft torque
2 clc;
3 clear;
4 close;
5 //given data :
```

```

6 pi=22/7;
7 N=955; // in r.p.m
8 V=230; // voltage in volts
9 I=72; // current in A
10 W=V*I;
11 s=968; // stray losses
12 Rsh=115; // shunt field resistance in ohm
13 Ra=0.5; // armature resistance in ohm
14 Ish=V/Rsh; // shunt field resistance
15 Ia=I-Ish;
16 Eb=V-(Ia*Ra); // back emf in volts
17 Dpd=Eb*Ia; // driving power developed
18 Mpo=Dpd-s;
19 bhp=Mpo/746;
20 c_losses=W-Dpd;
21 Ta=(9.55*Eb*Ia)/N;
22 Tsh=(bhp*60*746)/(2*pi*N);
23 disp(Tsh," shaft torque ,Tsh(N-m) = ")

```

Scilab code Exa 8.2.e lost torque

```

1 //Example 8.2.e: lost torque
2 clc;
3 clear;
4 close;
5 //given data :
6 pi=22/7;
7 N=955; // in r.p.m
8 V=230; // voltage in volts
9 I=72; // current in A
10 W=V*I;
11 s=968; // stray losses
12 Rsh=115; // shunt field resistance in ohm
13 Ra=0.5; // armature resistance in ohm
14 Ish=V/Rsh; // shunt field resistance

```

```

15 Ia=I-Ish;
16 Eb=V-(Ia*Ra); // back emf in volts
17 Dpd=Eb*Ia; // driving power developed
18 Mpo=Dpd-s;
19 bhp=Mpo/746;
20 c_losses=W-Dpd;
21 Ta=(9.55*Eb*Ia)/N;
22 Tsh=(bhp*60*746)/(2*pi*N);
23 Tl=Ta-Tsh;
24 disp(Tl,"lost torque ,Tl(N-m) = ")

```

Scilab code Exa 8.2.f commercial efficiency

```

1 //Example 8.2.f: commercial efficiency
2 clc;
3 clear;
4 close;
5 //given data :
6 pi=22/7;
7 N=955; // in r.p.m
8 V=230; // voltage in volts
9 I=72; // current in A
10 W=V*I;
11 s=968; // stray losses
12 Rsh=115; // shunt field resistance in ohm
13 Ra=0.5; // armature resistance in ohm
14 Ish=V/Rsh; // shunt field resistance
15 Ia=I-Ish;
16 Eb=V-(Ia*Ra); // back emf in volts
17 Dpd=Eb*Ia; // driving power developed
18 Mpo=Dpd-s;
19 bhp=Mpo/746;
20 c_losses=W-Dpd;
21 Ta=(9.55*Eb*Ia)/N;
22 Tsh=(bhp*60*746)/(2*pi*N);

```

```

23 Tl=Ta-Tsh;
24 eta=(Mpo/W)*100;
25 disp(eta,"commercial efficioency ,eta(%) = ")

```

Scilab code Exa 8.3 speed

```

1 //Example 8.3 // speed
2 clc;
3 clear;
4 close;
5 V=230;// in volts
6 I=5;// in amperes
7 rpm=914;//turns
8 ra=0.5;//resistance of armature in ihms
9 rsh=115;//shunt field in ohms
10 I1=30;// in amperes
11 ar=10;// in percent
12 Ish=V/rsh;// in amperes
13 anl=I-Ish;//armature current in amperes at no load
14 al=I1-Ish;//armature current in amperes at load
15 Eb1=(V-anl*ra);//back emf at no load
16 Eb2=(V-al*ra);//back emf at load
17 ph1=100;//
18 ph2=90;//
19 Ns=(rpm*Eb2*ph1)/(Eb1*ph2);//speed when loaded in
rpm
20 disp(Ns,"speed when loaded in rpm")

```

Scilab code Exa 8.4.a stray losses

```

1 //Example 8.4.a // stray losses
2 clc;
3 clear;

```

```

4  close;
5  I1=83; // WHEN LOADED IN AMPERES
6  V=110; // in volts
7  I=5; // in amperes without load
8  ra=0.5; //armature resistance in ohms
9  rsh=110; //shunt field in ohms
10 Ish=V/rsh; // in ampere
11  anl=I-Ish; //armature current in amperes at no load
12  al=I1-Ish; //armature current in amperes at load
13  Eb1=(V-anl*ra); //back emf at no load
14  Eb2=(V-al*ra); //back emf at load
15  Dp=Eb1*anl; //driving power at no load in watt
16  Dpl=Eb2*al; //driving power at load in watt
17  mo=Dpl-Dp; //out of motor in watt
18 disp(Dp,"stray losses in watt")

```

Scilab code Exa 8.4.b horsepower of the motor

```

1 //Example 8.4.b // horse power
2 clc;
3 clear;
4 close;
5 I1=83; // WHEN LOADED IN AMPERES
6 V=110; // in volts
7 I=5; // in amperes without load
8 ra=0.5; //armature resistance in ohms
9 rsh=110; //shunt field in ohms
10 Ish=V/rsh; // in ampere
11  anl=I-Ish; //armature current in amperes at no load
12  al=I1-Ish; //armature current in amperes at load
13  Eb1=(V-anl*ra); //back emf at no load
14  Eb2=(V-al*ra); //back emf at load
15  Dp=Eb1*anl; //driving power at no load in watt
16  Dpl=Eb2*al; //driving power at load in watt
17  mo=Dpl-Dp; //out of motor in watt

```

```
18 bhp=mo/746;//horse power
19 disp(bhp,"horse power in ampere is")
```

Scilab code Exa 8.4.c efficiency

```
1 //Example 8.4.c // efficiency
2 clc;
3 clear;
4 close;
5 I1=83;// WHEN LOADED IN AMPERES
6 V=110;// in volts
7 I=5;// in amperes without load
8 ra=0.5;//armature resistance in ohms
9 rsh=110;//shunt field in ohms
10 Ish=V/rsh;// in ampere
11 anl=I-Ish;//armature current in amperes at no load
12 al=I1-Ish;//armature current in amperes at load
13 Eb1=(V-anl*ra);//back emf at no load
14 Eb2=(V-al*ra);//back emf at load
15 Dp=Eb1*anl;//driving power at no load in watt
16 Dpl=Eb2*al;//driving power at load in watt
17 mo=Dpl-Dp;//out of motor in watt
18 bhp=mo/746;//horse power
19 mi=V*al;//input power in watt
20 n=(mo/mi)*100;//efficiency in percentage
21 disp(n,"efficiency of motor when it is work on full
    ,load in percentage is")
22 //answer is wrong in the textbook
```

Scilab code Exa 8.5.a back emf

```
1 //Example 8.5.a // back emf
2 clc;
```

```

3 clear;
4 close;
5 V=230; // in volts
6 I=60; // in amperes
7 rpm=955; //turns
8 ra=0.2; //resistance of armature in ihms
9 rsh=0.15; //shunt field in ohms
10 sl=604; //stray losses in watts
11 Rm=ra+rsh; // in ohms
12 Eb=(V-I*Rm); // back emf in volts
13 disp(Eb,"back emf in volts")

```

Scilab code Exa 8.5.b copper losses

```

1 //Example 8.5.b // copper losses
2 clc;
3 clear;
4 close;
5 V=230; // in volts
6 I=60; // in amperes
7 rpm=955; //turns
8 ra=0.2; //resistance of armature in ihms
9 rsh=0.15; //shunt field in ohms
10 sl=604; //stray losses in watts
11 Rm=ra+rsh; // in ohms
12 Eb=(V-I*Rm); // back emf in volts
13 Dp=Eb*I; //driving power in watts
14 mi=V*I; //input power in watts
15 Cl=mi-Dp; // copper losses in watts
16 disp(Cl,"copper losses in watts")

```

Scilab code Exa 8.5.c Bhp

```

1 //Example 8.5.c //horse power
2 clc;
3 clear;
4 close;
5 V=230; // in volts
6 I=60; // in amperes
7 rpm=955; //turns
8 ra=0.2; //resistance of armature in ihms
9 rsh=0.15; //shunt field in ohms
10 sl=604; //stray losses in watts
11 Rm=ra+rsh; // in ohms
12 Eb=(V-I*Rm); // back emf in volts
13 Dp=Eb*I; //driving power in watts
14 mi=V*I; //input power in watts
15 Cl=mi-Dp; // copper losses in watts
16 mo=Dp-sl; //output of motor
17 bhp=mo/746; // horse power in bhp
18 disp(bhp,"horse power is")

```

Scilab code Exa 8.5.d total torque

```

1 //Example 8.5.d //total torque
2 clc;
3 clear;
4 close;
5 V=230; // in volts
6 I=60; // in amperes
7 rpm=955; //turns
8 ra=0.2; //resistance of armature in ihms
9 rsh=0.15; //shunt field in ohms
10 sl=604; //stray losses in watts
11 Rm=ra+rsh; // in ohms
12 Eb=(V-I*Rm); // back emf in volts
13 Dp=Eb*I; //driving power in watts
14 mi=V*I; //input power in watts

```

```

15  Cl=mi-Dp;// copper losses in watts
16  mo=Dp-s1;//output of motor
17  bhp=mo/746;// horse power in bhp
18  Ta=(9.55*Eb*I)/rpm;//total torque in N-m
19  disp(Ta,"total torque in N-m")

```

Scilab code Exa 8.5.e shaft torque

```

1  //Example 8.5.e //shaft torque
2  clc;
3  clear;
4  close;
5  V=230;// in volts
6  I=60;// in amperes
7  rpm=955;//turns
8  ra=0.2;//resistance of armature in ihms
9  rsh=0.15;//shunt field in ohms
10 s1=604;//stray losses in watts
11 Rm=ra+rsh;// in ohms
12 Eb=(V-I*Rm);// back emf in volts
13 Dp=Eb*I;//driving power in watts
14 mi=V*I;//input power in watts
15 Cl=mi-Dp;// copper losses in watts
16 mo=Dp-s1;//output of motor
17 bhp=mo/746;// horse power in bhp
18 Ta=(9.55*Eb*I)/rpm;//total torque in N-m
19 Ts=(bhp*60*746)/(2*%pi*rpm);//shaft torque in N-m
20 disp(Ts,"shaft torque in N-m")

```

Scilab code Exa 8.5.f lost torque

```

1  //Example 8.5.f //lost torque
2  clc;

```

```

3 clear;
4 close;
5 V=230; // in volts
6 I=60; // in amperes
7 rpm=955; //turns
8 ra=0.2; //resistance of armature in ihms
9 rsh=0.15; //shunt field in ohms
10 sl=604; //stray losses in watts
11 Rm=ra+rsh; // in ohms
12 Eb=(V-I*Rm); // back emf in volts
13 Dp=Eb*I; //driving power in watts
14 mi=V*I; //input power in watts
15 Cl=mi-Dp; // copper losses in watts
16 mo=Dp-sl; //output of motor
17 bhp=mo/746; // horse power in bhp
18 Ta=(9.55*Eb*I)/rpm; //total torque in N-m
19 Ts=(bhp*60*746)/(2*%pi*rpm); //shaft torque in N-m
20 Tl=Ta-Ts; //lost torque in N-m
21 disp(Tl,"lost torque in N-m")

```

Scilab code Exa 8.5.g commercial efficiency

```

1 //Example 8.5.g //commercial efficiency
2 clc;
3 clear;
4 close;
5 V=230; // in volts
6 I=60; // in amperes
7 rpm=955; //turns
8 ra=0.2; //resistance of armature in ihms
9 rsh=0.15; //shunt field in ohms
10 sl=604; //stray losses in watts
11 Rm=ra+rsh; // in ohms
12 Eb=(V-I*Rm); // back emf in volts
13 Dp=Eb*I; //driving power in watts

```

```

14  mi=V*I; //input power in watts
15  Cl=mi-Dp; // copper losses in watts
16  mo=Dp-sl; //output of motor
17  bhp=mo/746; // horse power in bhp
18  Ta=(9.55*Eb*I)/rpm; //total torque in N-m
19  Ts=(bhp*60*746)/(2*pi*rpm); //shaft torque in N-m
20  Tl=Ta-Ts; //lost torque in N-m
21  nc=(mo/mi)*100; //commercial efficiency in percentge
22  disp(nc,"commercial efficiency in percentge")

```

Scilab code Exa 8.6 current taken

```

1  //Example 8.6 //current
2  clc;
3  clear;
4  close;
5  V=220; // in volts
6  I=60; // in amperes
7  rpm=728; //turns
8  Ts=150; //shaft torque in N-m
9  nc=80; //commercial efficiency in percentge
10 I=((Ts*2*pi*rpm*746)/(60*746*(nc/100)*V)); //
    CURRENT TAKEN IN AMPERES
11 disp(round(I),"current taken in amperes is")

```

Scilab code Exa 8.7 speed

```

1  //Example 8.7 //SPEED
2  clc;
3  clear;
4  close;
5  V=220; // in volts
6  rpm=2100; //turns

```

```
7  ra=0.5;//resistance of armature in ihms
8  rsh=220;//shunt field in ohms
9  I1=21;// in amperes
10 R1=220;// in ohms
11 Ish=V/rsh;// in amperes
12 Ifs=V/(rsh+R1);//shunt field current in second case
    in ampere
13 ph1=50;//
14 ph2=100;//
15 n2=(rpm*ph2)/ph1;//speed in rpm
16 disp(n2,"speed in rpm is")
```

Chapter 9

cells and batteries

Scilab code Exa 9.1 value of current flowing

```
1 //Example 9.1 // current
2 clc;
3 clear;
4 close;
5 //given data :
6 n=20; // dry cells of emf
7 E=1.5; // emf in volts
8 R=5; // external resistance in ohm
9 r=0.5; // internal resistance in ohm
10 I=(n*E)/(R+(n*r));
11 disp(I,"current flowing ,I(A) = ")
```

Scilab code Exa 9.2 value of current flowing

```
1 //Example 9.2 // current
2 clc;
3 clear;
4 close;
```

```

5 //given data :
6 n=10; // dry cells of emf
7 E=1.5; // emf in volts
8 R=4.9; // resistance in ohm
9 r=1; // internal resistance in ohm
10 I=(n*E)/((n*R)+(r));
11 disp(I,"current flowing ,I(A) = ")

```

Scilab code Exa 9.3 value of current flowing

```

1 //Example 9.3 // current
2 clc;
3 clear;
4 close;
5 //given data :
6 m=3;
7 n=10; // dry cells of emf
8 E=1.5; // emf in volts
9 R=2.5; // resistance in ohm
10 r=0.5; // internal resistance in ohm
11 I=(m*n*E)/((m*R)+(n*r));
12 disp(I,"current flowing ,I(A) = ")

```

Scilab code Exa 9.4.a internal resistance

```

1 //Example 9.4.a // internal resistance of each cell
2 clc;
3 clear;
4 close;
5 n=10; // no. of cells
6 Rl=4; // LOAD RESISTANCE
7 V=12; // in volts
8 Va=18; // IN VOLTS

```

```
9 r=((Va-V)*R1)/(n*V); // internal resistance in ohms
10 disp(r,"internal resistance in ohms is")
```

Scilab code Exa 9.4.b value of current flowing

```
1 //Example 9.4.b // current
2 clc;
3 clear;
4 close;
5 n=10; // no. of cells
6 R1=4; // LOAD RESISTANCE
7 V=12; // in volts
8 Va=18; // IN VOLTS
9 r=((Va-V)*R1)/(n*V); // internal resistance in ohms
10 I1=V/R1; // IN AMPERES
11 disp(I1,"load current in amperes is")
```

Scilab code Exa 9.5 emf of each cell and its internal resistance

```
1 //Example 9.5 // emf and internal resistance of each
  cell
2 clc;
3 clear;
4 close;
5 n=6; // no. of cells
6 R1=3; // LOAD RESISTANCE
7 I=2.5; // IN AMPERES
8 r1=9; // in ohms
9 I2=1.25; // om amperes
10 r=((r1*I2)-(R1*I))/(n*(I-I2)); // internal resistance
  in ohms
11 E=((I*(R1+n*r))/n); // emf of each cell in volts
12 disp(E,"emf of each cell in volts is")
```

```
13 disp(r,"internal resistance of each cell in ohms")
```

Scilab code Exa 9.6 ampere hour capacity

```
1 //Example 9.6 //find ampere-hour capacity of a
  battery
2 clc;
3 clear;
4 close;
5 I=20; // in amperes
6 t=15; // in hours
7 Ah=I*t; // ampere hour capacity of the battery
8 disp(Ah,"ampere hour capacity of the battery in A-h"
  )
```

Scilab code Exa 9.7.a ampere hour efficiency

```
1 //Example 9.7.a //find ampere-hour efficiency
2 clc;
3 clear;
4 close;
5 I=30; // in amperes
6 t=6; // in hours
7 Vt=2; // terminal voltage
8 Ic=40; // in amperes
9 tc=5; // in hours
10 Vc=2.5; // in volts
11 Aho=I*t; // ampere hour output of the battery
12 Ahi=Ic*tc; // ampere hour input of the battery
13 nAh=(Aho/Ahi)*100; // ampere hour efficiency
14 disp(nAh,"ampere hour efficiency of the battery in
  percentage is")
```

Scilab code Exa 9.7.b watt hour efficiency

```
1 //Example 9.7.b //find watt-hour efficiency
2 clc;
3 clear;
4 close;
5 I=30; // in amperes
6 t=6; // in hours
7 Vt=2; // terminal voltage
8 Ic=40; // in amperes
9 tc=5; // in hours
10 Vc=2.5; // in volts
11 Who=I*t*Vt; // watt hour output of the battery
12 Whi=Ic*tc*Vc; // watt hour input of the battery
13 nWh=(Who/Whi)*100; // ampere hour efficiency
14 disp(nWh,"watt hour efficiency of the battery in
    percentage is")
```

Scilab code Exa 9.8.a initial charging current

```
1 //Example 9.8.a //initial charging current
2 clc;
3 clear;
4 close;
5 n=50; // no. of cells
6 Vc=250; // in volts
7 Vd=1.8; //in volts
8 Vcs=2.2; //in volts
9 r=0.01; //internal resistance of each cell in ohms
10 rl=0.1; //lead resistance in ohms
11 Re=19.4; //external resistance in ohms
12 Ib=n*r; // internal resistance of battery
```

```

13 Tb=r1+Ib; //total resistance of battery
14 Eb=Vd*n; //total rmf of battery
15 I=(Vc-Eb)/(Re+Tb); // initial charging current in
    amperes
16 disp(I,"initial charging current in amperes is")

```

Scilab code Exa 9.8.b final charging current

```

1 //Example 9.8.b //final charging current
2 clc;
3 clear;
4 close
5 n=50; // no. of cells
6 Vc=250; // in volts
7 Vd=1.8; //in volts
8 Vcs=2.2; //in volts
9 r=0.01; //internal resistance of each cell in ohms
10 r1=0.1; //lead resistance in ohms
11 Re=19.4; //external resistance in ohms
12 Ib=n*r; // internal resistance of battery
13 Tb=r1+Ib; //total resistance of battery
14 Eb=Vd*n; //total rmf of battery
15 Ebf=Vcs*n; //emf of the battery at the end of
    charging
16 I=(Vc-Ebf)/(Re+Tb); // initial charging current in
    amperes
17 disp(I,"final charging current in amperes is")

```

Scilab code Exa 9.9.a value and direction of current

```

1 //Example 9.9.a //value and direction of the current
2 clc;
3 clear;

```

```

4  close
5  V=230; // in volts
6  emf1=122; //in volts
7  r=0.4; //internal resistance in ohms
8  emf2=130; //in volts
9  r1=0.5; //in ohms
10 //apllying kirchoff's low
11 // x ampere is the total current taken by battery
12 // x1 ampere is the total current taken by battery A
13 // x-x1 ampere is the total current taken by battery
   B
14 // 5*x+0.4*y=180 is the equation in mesh ABEF
15 // 5.5*x+0.5*y=100 equation in the mesh CDEF
16 // equation 1 is 25*x+2*y=540 and equation 2 is 22*x
   -2*y=400
17 A=[25 2 ;22 -2]; // EQUATIONS
18 B=[540;400]; // VALUES
19 X=A\B; // UNKNOW VALUES
20 x=X(1,1); //TOTAL CURRENT IN AMPERES
21 x1=X(2,1); //current taken by battery A
22 x2=20-x1; //
23 disp(x1,"current in battery A in amperes (
   discharging)")
24 disp(x2,"current in bettery B in amperes")

```

Scilab code Exa 9.9.b total current

```

1 //Example 9.9.b //total current
2 clc;
3 clear;
4 close
5 V=230; // in volts
6 emf1=122; //in volts
7 r=0.4; //internal resistance in ohms
8 emf2=130; //in volts

```

```

 9 r1=0.5; //in ohms
10 //apllying kirchoff's low
11 // x ampere is the total current taken by battery
12 // x1 ampere is the total current taken by battery A
13 // x-x1 ampere is the total current taken by battery
   B
14 // 5*x+0.4*y=180 is the equation in mesh ABEF
15 // 5.5*x+0.5*y=100 equation in the mesh CDEF
16 // equation 1 is 25*x+2*y=540 and equation 2 is 22*x
   -2*y=400
17 A=[25 2 ;22 -2]; // EQUATIONS
18 B=[540;400]; // VALUES
19 X=A\B; // UNKNOWN VALUES
20 x=X(1,1); //TOTAL CURRENT IN AMPERES
21 x1=X(2,1); //current taken by battery A
22 x2=20-20; //
23 disp(x,"total current in battery A and B in amperes
   (charging)")

```

Scilab code Exa 9.9.c power dissipated

```

1 //Example 9.9.c //tpower dissipated
2 clc;
3 clear;
4 close
5 R=5; // in ohms
6 V=230; // in volts
7 emf1=122; //in volts
8 r=0.4; //internal resistance in ohms
9 emf2=130; //in volts
10 r1=0.5; //in ohms
11 //apllying kirchoff's low
12 // x ampere is the total current taken by battery
13 // x1 ampere is the total current taken by battery A
14 // x-x1 ampere is the total current taken by battery

```

```

      B
15 // 5*x+0.4*y=180 is the equation in mesh ABEF
16 // 5.5*x+0.5*y=100 equation in the mesh CDEF
17 // equation 1 is 25*x+2*y=540 and equation 2 is 22*x
    -2*y=400
18 A=[25 2 ;22 -2];// EQUATIONS
19 B=[540;400];// VALUES
20 X=A\B;// UNKNOW VALUES
21 x=X(1,1);//TOTAL CURRENT IN AMPERES
22 x1=X(2,1);//current taken by battery A
23 x2=20-20;//
24 p=x^2*R;// in watt
25 disp(p,"power dissipated in watts is")

```

Scilab code Exa 9.10 direction of current and total resistance

```

1 //Example 9.10 //value and direction of the current
2 clc;
3 clear;
4 close
5 V=34;// in volts
6 emf1=2;//in volts
7 r1=6;//in ohms
8 r2=1;//in ohms
9 r3=2;//in ohms
10 r4=4;// in ohms
11 //apllying kirchoff's low
12 // x ampere is the current in branch AB
13 // x1 ampere is the current in branch AC
14 //x2 ampere is the current in the Branch BD
15 // x-x2 ampere is the current in the branch BC
16 // x1+x2 ampere is the current in the branch DC
17 // x-6*x1+8*x2=2 in mesh ABD
18 // 2*x-4*x1-14*x2=-2 in mesh BCD
19 // 10*x1+4*x2=34;//in mesh ADCEF

```

```

20 A=[1 -6 8;2 -4 -14;0 10 4]; // EQUATIONS
21 B=[2;-2;34]; // VALUES
22 X=A\B; // UNKNOWN VALUES
23 x=X(1,1); //TOTAL CURRENT IN AMPERES
24 x1=X(2,1); //current taken by battery A
25 x2=X(3,1); //
26 b1=x-x2; // in amperes
27 b2=x1+x2; //in amperes
28 R=((r1*x1+r4*(x2+x1))/(x+x1)); //total resistance in
    ohms
29 disp(x," current in 1 ohms resistance from A to B in
    amperes ")
30 disp(x1," current in 6 ohms resistance from A to D
    in amperes ")
31 disp(x2," current in 8 ohms resistance from B to D
    in amperes ")
32 disp(b1," current in 2 ohm resistance from B to C in
    amperes")
33 disp(b2," current in 4 ohm resistance from D to C in
    amperes")
34 disp(R," total resistance in ohms is")

```

Chapter 11

single phase AC circuits

Scilab code Exa 11.1 instantaneous emf

```
1 //Example 11.1 // instantaneous value
2 clc;
3 clear;
4 close;
5 //given data :
6 E_max=500; // emf in volts
7 thita=30; // in degree
8 e=E_max*sind(thita);
9 disp(e,"instantaneous value ,e(v) = ")
```

Scilab code Exa 11.2 rms value of alternating current

```
1 //Example 11.2 // rms value
2 clc;
3 clear;
4 close;
5 //given data :
6 I_max=1.414; // maximum value of current in A
```

```
7 I_rms=I_max*0.707;
8 disp(round(I_rms),"rms value of current ,I_rms(A) ")
```

Scilab code Exa 11.3 current drawn

```
1 //Example 11.3 // current drawn
2 clc;
3 clear;
4 close;
5 //given data :
6 f=50; // frequency in Hz
7 L=0.2; // inductance in H
8 V=220; // voltage in volts
9 pi=22/7;
10 XL=2*pi*f*L;// in ohm
11 Z=XL;
12 I=V/Z;
13 disp(I,"current drawn ,I(A) = ")
```

Scilab code Exa 11.4 current

```
1 //Example 11.4 // current flowing
2 clc;
3 clear;
4 close;
5 //given data :
6 f=50; // frequency in Hz
7 C=100*10^-6;// capacitor in Farad
8 V=210; // voltage in volts
9 pi=22/7;
10 XC=(1/(2*pi*f*C));
11 Z=XC;
12 I=V/Z;
```

```
13 disp(I,"current flowing ,I(A) = ")
```

Scilab code Exa 11.5.a value of current flowing

```
1
2 //Example 11.5.a // current
3 clc;
4 clear;
5 close;
6 //given data :
7 f=50; // frequency in Hz
8 L=0.4; // inductance in H
9 V=220; // voltage in volts
10 pi=22/7;
11 XL=2*pi*f*L;
12 I=V/XL;
13 f1=25; // when frequency is halved
14 pi=22/7;
15 XL1=2*pi*f1*L;
16 I1=V/XL1;
17
18 disp(I,"current flowing ,I(A) = ")
19 disp(I1,"current when frequency is halved ,I(A) = ")
```

Scilab code Exa 11.5.b value of current flowing

```
1 //Example 11.5.b // current if frequency is halved
2 clc;
3 clear;
4 close;
5 //given data :
6 //given data :
7 f=50; // frequency in Hz
```

```

8 L=0.4; // inductance in H
9 V=220; // voltage in volts
10 f2=100; // when frequency is doubled
11 pi=22/7;
12 XL=2*pi*f2*L;
13 I=V/XL;
14 disp(I,"current when frequency is halved ,I(A) = ")

```

Scilab code Exa 11.6.a value of current flowing

```

1 //Example 11.6.a // current
2 clc;
3 clear;
4 close;
5 //given data :
6 f=50; // frequency in Hz
7 C=28*10^-6; // capacitor in Farad
8 V=250; // voltage in volts
9 pi=22/7;
10 XC=1/(2*pi*f*C);
11 I1=V/XC;
12 f=50; // frequency in Hz
13 C=28*10^-6; // capacitor in Farad
14 V=250; // voltage in volts
15 pi=22/7;
16 f1=25; // when frequency is halved
17 XC=1/(2*pi*f1*C);
18 I2=V/XC;
19 disp(I1,"current flowing ,I(A) = ")
20 disp(I2,"current flowing when frequency is halved ,I(
    A) = ")

```

Scilab code Exa 11.6.b value of current flowing

```

1 //Example 11.6.b // current if frequency is halved
2 clc;
3 clear;
4 close;
5 //given data :
6 f=50; // frequency in Hz
7 C=28*10^-6; // capacitor in Farad
8 V=250; // voltage in volts
9 pi=22/7;
10 f2=100; // when frequency is doubled
11 XC=1/(2*pi*f2*C);
12 I=V/XC;
13 disp(I,"current flowing when frequency is doubled ,I
    (A) = ")

```

Scilab code Exa 11.7.a inductive reactance

```

1 //Example 11.7.a // inductive reactance
2 clc;
3 clear;
4 close;
5 R=40; //in ohms
6 L=0.07; //IN HENRY
7 v=223; //IN VOLTS
8 F=50; // IN HERTS
9 Xl=2*%pi*F*L; // inductive reactance in ohms
10 disp(round(Xl),"inductive reactance in ohms is")

```

Scilab code Exa 11.7.b impedance

```

1 //Example 11.7.b // impedance
2 clc;
3 clear;

```

```

4 close;
5 R=40; //in ohms
6 L=0.07; //IN HENRY
7 v=223; //IN VOLTS
8 F=50; // IN HERTS
9 Xl=2*%pi*F*L; // inductive reactance in ohms
10 Z=sqrt(R^2+Xl^2); //IMPEDENCE IN OHMS
11 disp(Z,"impedence in ohms is")

```

Scilab code Exa 11.7.c current

```

1 //Example 11.7.c // current
2 clc;
3 clear;
4 close;
5 R=40; //in ohms
6 L=0.07; //IN HENRY
7 V=223; //IN VOLTS
8 F=50; // IN HERTS
9 Xl=2*%pi*F*L; // inductive reactance in ohms
10 Z=sqrt(R^2+Xl^2); //IMPEDENCE IN OHMS
11 I=V/Z; //in amperes
12 disp(I,"current in amperes is")

```

Scilab code Exa 11.7.d angle of phase difference

```

1 //Example 11.7.d // angle of phase differnce
2 clc;
3 clear;
4 close;
5 R=40; //in ohms
6 L=0.07; //IN HENRY
7 V=223; //IN VOLTS

```

```

8 F=50; // IN HERTS
9 Xl=2*%pi*F*L; // inductive reactance in ohms
10 Z=sqrt(R^2+Xl^2); //IMPEDENCE IN OHMS
11 I=V/Z; //in amperes
12 csp=R/Z; //pf
13 phi=acosd(csp); //angle of phase differnce in degree
14 x=floor(phi); //
15 y=phi-x; //
16 disp(" angle of phase difference is "+string(x)+"
      degree and "+string(y*60)+" minutes ")

```

Scilab code Exa 11.8 inductance and phase angle

```

1 //Example 11.8 // inductance and phase angle between
  voltage and current
2 clc;
3 clear;
4 close;
5 V=200; //in volts
6 I=2.5; // in amperes
7 Vo=250; // in volts
8 f=50; // in hertz
9 R=V/I; // in ohms
10 Z=Vo/I; // in ohms
11 Xl=sqrt(Z^2-R^2); //inductive reactance in ohms
12 L=(Xl/(2*%pi*f)); //inductance in henry
13 pf=R/Z; //power factor
14 phi=acosd(pf); //angle of phase differnce in degree
15 x=floor(phi); //
16 y=phi-x; //
17 disp(L,"inductance in henry is")
18 disp(" angle of phase difference is "+string(x)+"
      degree and "+string(round(y*60))+ " minutes ")

```

Scilab code Exa 11.9 capacitance

```
1 //Example 11.9 // capacitance
2 clc;
3 clear;
4 close;
5 W=100; //in watts
6 V=110; //in volts
7 Vc=220; //in volts
8 f=50; //in hertz
9 I=W/V; // in amperes
10 R=V/I; //in ohms
11 Z=Vc/I; // in ohms
12 Xc=sqrt(Z^2-R^2); // IN OHMS
13 C=(1/(2*pi*f*Xc)); // in farads
14 disp(C*10^6, "capacitance in micro farads is")
```

Scilab code Exa 11.10.a impedance

```
1 //Example 11.10.a // impedance
2 clc;
3 clear;
4 close;
5 R=5.94; //in ohms
6 L=0.35; //IN HENRY
7 C=35; // in micro farads
8 V=220; //IN VOLTS
9 F=50; // IN HERTS
10 Xc=(1/(2*pi*F*C*10^-6)); // capacitive reactance in
    ohms
11 Xl=2*pi*F*L; // inductive reactance in ohms
12 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
```

```
13 disp(round(Z),"impedence in ohms is")
```

Scilab code Exa 11.10.b current

```
1 //Example 11.10.B // CURRENT
2 clc;
3 clear;
4 close;
5 R=5.94; //in ohms
6 L=0.35; //IN HENRY
7 C=35; // in micro farads
8 V=200; //IN VOLTS it is given wrong in the book
9 F=50; // IN HERTS
10 Xc=(1/(2*pi*F*C*10^-6)); // capacitive reactance in
    ohms
11 Xl=2*pi*F*L; // inductive reactance in ohms
12 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
13 I=V/round(Z); // in amperes
14 disp(I,"current in amperes is")
```

Scilab code Exa 11.10.c phase angles

```
1 //Example 11.10.c // angle of phase differnce
2 clc;
3 clear;
4 close;
5 R=5.94; //in ohms
6 L=0.35; //IN HENRY
7 C=35; // in micro farads
8 V=200; //IN VOLTS it is given wrong in the book
9 F=50; // IN HERTS
10 Xc=(1/(2*pi*F*C*10^-6)); // capacitive reactance in
    ohms
```

```

11 Xl=2*%pi*F*L; // inductive reactance in ohms
12 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
13 I=V/round(Z); // in amperes
14 pf=R/round(Z); // power factor
15 disp(pf,"angle of phase diffence between voltage and
      current is")

```

Scilab code Exa 11.10.d voltage

```

1 //Example 11.10.d // voltage across te coil
2 clc;
3 clear;
4 close;
5 R=5.94; //in ohms
6 L=0.35; //IN HENRY
7 C=35; // in micro farads
8 V=200; //IN VOLTS it is given wrong in the book
9 F=50; // IN HERTS
10 Xc=(1/(2*%pi*F*C*10^-6)); // capacitive reactance in
      ohms
11 Xl=2*%pi*F*L; // inductive reactance in ohms
12 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
13 I=V/round(Z); // in amperes
14 pf=R/round(Z); // power factor
15 Zc=sqrt(R^2+Xl^2); //impedence of the coil
16 Vl=I*Zc; //voltage drop across the coil
17 disp(Vl,"voltage across the coil in volts is")

```

Scilab code Exa 11.10.e voltage across the coil

```

1 //Example 11.10.e // voltage across the capacitor
2 clear;
3 close;

```

```

4  clc;
5  R=5.94; //in ohms
6  L=0.35; //IN HENRY
7  C=35; // in micro farads
8  V=200; //IN VOLTS it is given wrong in the book
9  F=50; // IN HERTS
10 Xc=(1/(2*%pi*F*C*10^-6)); // capacitive reactance in
    ohms
11 Xl=2*%pi*F*L; // inductive reactance in ohms
12 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
13 I=V/round(Z); // in amperes
14 pf=R/round(Z); // power factor
15 Vc=I*Xc; //voltage drop across the capacitor
16 disp(Vc," voltage across capacitor in volts is")

```

Scilab code Exa 11.10.f total power taken

```

1
2 //Example 11.10.f // total power taken
3 clear;
4 close;
5 clc;
6 R=5.94; //in ohms
7 L=0.35; //IN HENRY
8 C=35; // in micro farads
9 V=200; //IN VOLTS it is given wrong in the book
10 F=50; // IN HERTS
11 Xc=(1/(2*%pi*F*C*10^-6)); // capacitive reactance in
    ohms
12 Xl=2*%pi*F*L; // inductive reactance in ohms
13 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
14 I=V/round(Z); // in amperes
15 W=I^2*R; //total power taken in watts
16 disp(W," total power taken in watts is")

```

Scilab code Exa 11.11.a total impedance

```
1 //Example 11.11.a // impedance
2 clc;
3 clear;
4 close;
5 r1=6; //in ohms
6 r2=3.95; //in ohms
7 R=r1+r2; //in ohms
8 L1=0.21; //IN HENRY
9 L2=0.14; //in henry
10 C1=30; // in micro farads
11 C2=60; //in micro farads
12 V=220; //IN VOLTS
13 F=50; // IN HERTS
14 Xc1=(1/(2*%pi*F*C1*10^-6)); // capacitive reactance
    in ohms
15 Xc2=(1/(2*%pi*F*C2*10^-6)); // capacitive reactance
    in ohms
16 Xc=Xc1+Xc2; //IN OHMS
17 Xl1=2*%pi*F*L1; // inductive reactance in ohms
18 Xl2=2*%pi*F*L2; // inductive reactance in ohms
19 Xl=Xl1+Xl2; //in ohms
20 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
21 disp(round(Z), "impedance in ohms is")
```

Scilab code Exa 11.11.b current taken

```
1 //Example 11.11.b // current taken
2 clc;
3 clear;
4 close;
```

```

5 r1=6; //in ohms
6 r2=3.95; //in ohms
7 R=r1+r2; //in ohms
8 L1=0.21; //IN HENRY
9 L2=0.14; //in henry
10 C1=30; // in micro farads
11 C2=60; //in micro farads
12 V=200; //IN VOLTS
13 F=50; // IN HERTS
14 Xc1=(1/(2*%pi*F*C1*10^-6)); // capacitive reactance
    in ohms
15 Xc2=(1/(2*%pi*F*C2*10^-6)); // capacitive reactance
    in ohms
16 Xc=Xc1+Xc2; //IN OHMS
17 Xl1=2*%pi*F*L1; // inductive reactance in ohms
18 Xl2=2*%pi*F*L2; // inductive reactance in ohms
19 Xl=Xl1+Xl2; //in ohms
20 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
21 I=V/Z; //
22 disp(round(I), "current in amperes is")

```

Scilab code Exa 11.11.c power factor

```

1 //Example 11.11.c // power factor
2 clc;
3 clear;
4 close;
5 r1=6; //in ohms
6 r2=3.95; //in ohms
7 R=r1+r2; //in ohms
8 L1=0.21; //IN HENRY
9 L2=0.14; //in henry
10 C1=30; // in micro farads
11 C2=60; //in micro farads
12 V=200; //IN VOLTS

```

```

13 F=50; // IN HERTS
14 Xc1=(1/(2*%pi*F*C1*10^-6)); // capacitive reactance
    in ohms
15 Xc2=(1/(2*%pi*F*C2*10^-6)); // capacitive reactance
    in ohms
16 Xc=Xc1+Xc2; //IN OHMS
17 Xl1=2*%pi*F*L1; // inductive reactance in ohms
18 Xl2=2*%pi*F*L2; // inductive reactance in ohms
19 Xl=Xl1+Xl2; //in ohms
20 Z=sqrt(R^2+(Xl-Xc)^2); // impedance in ohms
21 I=V/Z; //
22 pf=R/Z; // leading power factor
23 disp(pf, "power factor (leading) is")

```

Scilab code Exa 11.12.a current taken

```

1
2 //Example 11.12.a // current
3 clc;
4 clear;
5 close;
6 V=200; // in volts
7 L=0.04; // in henry
8 C=100; //in micro fards
9 f=50; // hertz
10 Xl=2*%pi*f*L; //inductive reactance in ohms
11 Xc=(1/(2*%pi*f*C*10^-6)); //CAPACITIVE REACTANCE IN
    OHMS
12 Z1=10; //ohms
13 R1=10; // in ohms
14 X1=0; // in ohms
15 R2=5; // in ohms
16 Z2=sqrt(R2^2+X1^2); //in ohms
17 X2=X1; //
18 R3=15; // in ohms

```

```

19 Z3=sqrt(R3^2+Xc^2); // IN OHMS
20 X3=Xc; //
21 g1=R1/(Z1)^2; // conductance of branch 1 in mho
22 b1=X1/(Z1)^2; //susceptance in mho in branch 1
23 g2=R2/(Z2)^2; // conductance of branch 2 in mho
24 b2=X2/(Z2)^2; //susceptance in mho in branch 2
25 g3=R3/(Z3)^2; // conductance of branch 3 in mho
26 b3=X3/(Z3)^2; //susceptance in mho in branch 3
27 G=g1+g2+g3; // total conductance in mho
28 B=b1+b2-b3; // total susceptance in mho
29 Y=sqrt(G^2+B^2); //in ohms
30 I=V*Y; //curent in ampere
31 disp(I,"current in amperes is")

```

Scilab code Exa 11.12.b phase angle

```

1
2 //Example 11.12.b // PHASE ANGLE OF CURRENT AND
  VOLTAGE
3 clc;
4 clear;
5 close;
6 V=200; // in volts
7 L=0.04; // in henry
8 C=100; //in micro fards
9 f=50; // hertz
10 Xl=2*pi*f*L; //inductive reactance in ohms
11 Xc=(1/(2*pi*f*C*10^-6)); //CAPACITIVE REACTANCE IN
  OHMS
12 Z1=10; //ohms
13 R1=10; // in ohms
14 X1=0; // in ohms
15 R2=5; // in ohms
16 Z2=sqrt(R2^2+X1^2); //in ohms
17 X2=X1; //

```

```

18 R3=15; // in ohms
19 Z3=sqrt(R3^2+Xc^2); // IN OHMS
20 X3=Xc; //
21 g1=R1/(Z1)^2; // conductance of branch 1 in mho
22 b1=X1/(Z1)^2; //susceptance in mho in branch 1
23 g2=R2/(Z2)^2; // conductance of branch 2 in mho
24 b2=X2/(Z2)^2; //susceptance in mho in branch 2
25 g3=R3/(Z3)^2; // conductance of branch 3 in mho
26 b3=X3/(Z3)^2; //susceptance in mho in branch 3
27 G=g1+g2+g3; // total conductance in mho
28 B=b1+b2-b3; // total susceptance in mho
29 Y=sqrt(G^2+B^2); //in ohms
30 I=V*Y; //curent in ampere
31 theta=acosd(G/Y); //
32 x=round(theta); //
33 y=theta-x; //
34 disp("phase angle is "+string(x)+" degree and "+
      string(60*y)+" munutes ")
35 //answer is wrong in the textbook

```

Scilab code Exa 11.12.c series equivalent arrangement of resistance and reactance

```

1 //Example 11.12.c // series equivalent arrangement
  of resistance and reactance
2 clc;
3 clear;
4 close;
5 V=200; // in volts
6 L=0.04; // in henry
7 C=100; //in micro fards
8 f=50; // hertz
9 Xl=2*pi*f*L; //inductive reactance in ohms
10 Xc=(1/(2*pi*f*C*10^-6)); //CAPACITIVE REACTANCE IN
  OHMS
11 Z1=10; //ohms

```

```

12 R1=10; // in ohms
13 X1=0; // in ohms
14 R2=5; // in ohms
15 Z2=sqrt(R2^2+X1^2); //in ohms
16 X2=X1; //
17 R3=15; // in ohms
18 Z3=sqrt(R3^2+Xc^2); // IN OHMS
19 X3=Xc; //
20 g1=R1/(Z1)^2; // conductance of branch 1 in mho
21 b1=X1/(Z1)^2; //susceptance in mho in branch 1
22 g2=R2/(Z2)^2; // conductance of branch 2 in mho
23 b2=X2/(Z2)^2; //susceptance in mho in branch 2
24 g3=R3/(Z3)^2; // conductance of branch 3 in mho
25 b3=X3/(Z3)^2; //susceptance in mho in branch 3
26 G=g1+g2+g3; // total conductance in mho
27 B=b1+b2-b3; // total susceptance in mho
28 I=V/Z3; //curent in amperes
29 pf3=R3/Z3; //power factor
30 phi=acosd(pf3); //angle of phase differnce in degree
31 x=floor(phi); //
32 y=phi-x; //
33 tc3=pf3; //
34 ts3=sind(phi)
35 pf1=R1/R1; //
36 tc1=pf1; //
37 ts1=sind(acosd(pf1)); //
38 I1=V/Z1; //
39 E1=I1*tc1; // energy component in branch 1
40 EL1=I1*ts1; // idel current component in branch 1
41 I2=V/Z2; //
42 pf2=R2/Z2; //
43 tc2=pf2; //
44 ts2=sind(acosd(pf2)); //
45 E2=I2*tc2; //ENERGY COMPONENT IN BRANCH2
46 EL2=I2*ts2; //idele current component in branch 2
47 E3=I*tc3; //energy component in branch3
48 EL3=I*ts3; //idle component of current in branch 3
49 E=E1+E2+E3; //sum of energy component of current

```

```
50 EL=EL1+EL2-EL3;//sum of idel component of current
51 It=sqrt(E^2+EL^2);// total current
52 pft=E/It;//power factor of the complete circuit
53 phi=acosd(0.95);//angle of phase differnce in degree
54 x=round(phi);//
55 y=phi-x;//
56 Zt=V/It;//in ohms
57 R=Zt*pft;//equivalent series resistance
58 X=Zt*(sind(phi));//equivalent series reactance
59 disp(R,"equivalent series resistance in ohms is")
60 disp(X,"euivalent series reactance in ohms is")
```

Chapter 12

polyphase system

Scilab code Exa 12.1.a line current and phase current

```
1 //Example 12.1.a // line current
2 clc;
3 clear;
4 close;
5 L=30;//load in kW
6 pf=0.8;//power factor
7 V1=250;//line voltage in volts
8 I=((L*10^3)/(V1*pf*sqrt(3)));//line current in
   ampers
9 Ip=I;// in star connection
10 disp(I,"line current (star connection) in ampere is"
   )
11 disp(Ip,"pahse current (start connection) in ampere
   is")
```

Scilab code Exa 12.1.b line current and phase current

```
1 //Example 12.1.b // phase current
```

```

2  clc;
3  clear;
4  close;
5  L=30; //load in kW
6  pf=0.8; //power factor
7  V1=250; //line voltage in volts
8  I=((L*10^3)/(V1*pf*sqrt(3))); //line current in
    ampers
9  Ip=I/(sqrt(3)); //phase current
10 I1=sqrt(3)*Ip; //line current in amperes
11 disp(Ip,"phase current in ampere is")
12 disp(I1,"line current (delta connection ) in amperes
    is")

```

Scilab code Exa 12.2.a line current and total power

```

1  //Example 12.2.a // line current and power abosrbed
2  clc;
3  clear;
4  close;
5  R=11.88; //coil resistance in ohms
6  L=0.07; //inductance in henry
7  f=50; // in hertz
8  pf=0.48; //power factor
9  V1=433; //line voltage in volts
10 Vp= V1/(sqrt(3)); //phase voltage
11 Xl=(2*%pi*f*L); //in ohms
12 Zb=sqrt(R^2+Xl^2); // in ohms
13 Ie=Vp/Zb; //current in each winding in amperes
14 I1=Ie; //line current in amperes
15 W=sqrt(3)*V1*I1*pf; //power in watts
16 disp(I1,"line current in ampere is")
17 disp(W*10^-3,"power taken in connection in kW")

```

Scilab code Exa 12.2.b line current and total power

```
1 //Example 12.2.b // line current and power abosrbed
2 clc;
3 clear;
4 close;
5 R=11.88;//coil resistance in ohms
6 L=0.07;//inductance in henry
7 f=50;// in hertz
8 pf=0.48;//power factor
9 V1=433;//line voltage in volts
10 Vp= V1;//phase voltage
11 Xl=(2*%pi*f*L);//in ohms
12 Zb=sqrt(R^2+Xl^2);// in ohms
13 Ie=Vp/Zb;//current in each winding in amperes
14 Il=sqrt(3)*Ie;//line current in amperes
15 W=sqrt(3)*V1*Il*pf;//power in watts
16 disp(Il,"line current in ampere is")
17 disp(W*10^-3,"power taken in connection in kW")
```

Scilab code Exa 12.3.a current in each phase of the motor

```
1
2 //Example 12.3.a // motor current in each phase
3 clc;
4 clear;
5 close;
6 V1=1100;//line voltage in volts
7 n=99;//motor efficiency in percentage
8 Mo=n*735.5;//output of the motor
9 Mi=(Mo*100)/75;// INPUT OF THE MOTOR IN WATTS
10 pf= 0.8;//power factor
```

```

11 I1=(Mi)/(sqrt(3)*V1*pf); //line current in amperes
12 Ip=I1/(sqrt(3)); //phase current in amperes
13 Ipm=I1; //phase current of the motor
14 Ac=Ip*pf; //active component of phase current in the
    motor
15 Rc=Ip*(sqrt(1-pf^2)); //reactive component of phase
    current of motor
16 disp(Ip,"phase current of motor in amperes is")
17 disp(Ac,"active component of phase current in the
    motor in amperes")
18 disp(Rc,"reactive component of phase current in the
    motor in amperes")

```

Scilab code Exa 12.3.b current in each phase of the generator

```

1
2 //Example 12.3.b // motor generator in each phase
3 clc;
4 clear;
5 close;
6 V1=1100; //line voltage in volts
7 n=99; //motor efficiency in percentage
8 Mo=n*735.5; //output of the motor
9 Mi=(Mo*100)/75; // INPUT OF THE MOTOR IN WATTS
10 pf= 0.8; //power factor
11 I1=(Mi)/(sqrt(3)*V1*pf); //line current in amperes
12 Ip=I1/(sqrt(3)); //phase current in amperes
13 Ipm=I1; //phase current of the motor
14 Ac=Ipm*pf; //active component of phase current in the
    generator
15 Rc=Ipm*(sqrt(1-pf^2)); //reactive component of phase
    current of generator
16 disp(Ipm,"phase current of the generator in ampere is
    ")
17 disp(Ac,"active component of phase current in the

```

```
generator in amperes")
18 disp(Rc,"reactive component of phase current in the
generator in amperes")
```

Scilab code Exa 12.4 reading

```
1 //Example 12.4 // reading
2 clc;
3 clear;
4 close;
5 ni=74.6;//efficiency
6 Mo=40;//HP OF MOTOR
7 mo=Mo*ni;//output of motor in watts
8 mi=(mo*100)/(ni*1000);//input of motor in kW
9 tw=40;//total in kW
10 pf=0.8;//power factor
11 theta=acosd(pf);//in degree
12 v=tand(theta);//
13 dw=(v*tw)/(sqrt(3));//
14 w1=(tw+dw)/2;//FIRST READING IN kW
15 w2=tw-w1;//second reading in kW
16 disp(w1,"first reading in kW")
17 disp(w2,"second reading in kW")
```

Scilab code Exa 12.5.a power factor when both readings are positive

```
1 //Example 12.5.a // power factor
2 clc;
3 clear;
4 close;
5 w1=4.5;//first reading in kW
6 w2=3;//second reading in kW , this value is given
wrong in question
```

```

7 tw=w1+w2; //in kW
8 dw=w1-w2; //in kW
9 pfa=atand(sqrt(3)*(dw/tw));
10 pf=cosd(pfa); //power factor when both the readings
    are positive
11 disp(pf,"power factor when both the readings are
    positive")

```

Scilab code Exa 12.5.b power factor

```

1 //Example 12.5.b // power factor
2 clc;
3 clear;
4 close;
5 w1=4.5; //first reading in kW
6 w2=-3; //second reading in kW , this value is given
    wrong in question
7 tw=w1+w2; //in kW
8 dw=w1-w2; //in kW
9 pfa=atand(sqrt(3)*(dw/tw));
10 pf=cosd(pfa); //power factor when second reading is
    obtained by reversing the connection
11 disp(pf,"power factor when second reading is
    obtained by reversing the connections ")

```
