Scilab Manual for Electrical Power System II by Prof Mehulsinh Ghanshyamsinh Jadeja Electrical Engineering Vishwakarma Government Engineering College, Chandkheda[1]

Solutions provided by
Prof Mehulsinh Ghanshyamsinh Jadeja
Electrical Engineering
Vishwakarma Government Engineering College, Chandkheda

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Contents

List of Scilab Solutions 4

1 A Scilab Program Obtain Voltage Regulation And Efficiency Of A Short Transmission Line. 6

2 A Scilab Program To Evaluate Performance Of Short Transmission Line Using Graphical Method 9

3 Finding Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal T Method Through Scilab 12

4 Finding Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal Pi Method Through Scilab 15

5 Finding Voltage Regulation And Efficiency Of A Medium Transmission Line Using End Condenser Method Through Scilab 20

6 A Scilab Program To Evaluate Performance Of Medium Transmission Line Using Graphical Method 25

7 Finding voltage regulation and efficiency of a long transmission line using Rigorous solution method through SCILAB 28

8 A Scilab Program To Evaluate Performance Of Long Transmission Line Using Graphical Method 32

9 A Scilab Program To Find Permissible Frequency And Length For Limiting Ferranti Effect In Long Transmission Lines. 35

10 A Scilab Program For Computing The Abcd Parameters Of Short, Medium And Long Transmission Lines 38

11 A Scilab Program For Conversion Of Unsymmetrical Ac Phasors Into Symmetrical Components 46

12 A Scilab Program For Conversion Of Symmetrical Components Into Ac Phasors 51

13 Modification Of Zbus Matrix For Short Circuit Study Using Scilab Programming 54

14 Symmetrical Fault Analysis Using Scilab Programming 64

List of Experiments

Solution 1.1	exp1	6
Solution 2.2	exp2	9
Solution 3.3	exp3	12
Solution 4.4	exp4	15
Solution 5.5	exp5	20
Solution 6.6	exp6	25
Solution 7.7	exp7	28
Solution 8.8	exp8	32
Solution 9.9	exp9	35
Solution 10.10	exp10	38
Solution 11.11	exp11	46
Solution 12.12	exp12	51
Solution 13.13	exp13	54
Solution 14.14	exp14	64

List of Figures

1.1 exp1 8

2.1 exp2 11

3.1 exp3 14

4.1 exp4 19

5.1 exp5 24

6.1 exp6 27

7.1 exp7 31

8.1 exp8 34

9.1 exp9 37

10.1 exp10 44
10.2 exp10 45

11.1 exp11 50
11.2 exp11 50

12.1 exp12 53

13.1 exp13 62
13.2 exp13 63

14.1 exp14 68
14.2 exp14 69

Experiment: 1

A Scilab Program Obtain Voltage Regulation And Efficiency Of A Short Transmission Line.

Scilab code Solution 1.1 exp1

```
1 //Experiment-1
2 // windows Vista - 32-Bit
3 //Scilab - 5.5.2
4
5
6 //Aim : A SCILAB program obtain voltage regulation
     and efficiency of a short transmission line.
7
8 clc;
9 clear all;
10 VRLL=220; VR = VRLL/sqrt(3);
11 Z = (0.15+%i*2*%pi*60*1.3263e-3)*40; //change
     frequency or length
12
13 disp('(a)')
```

```
SR=304.8+%i*228.6; // legging power factor
IR = conj(SR)/(3*conj(VR)) ;
IS = IR;
VS = VR + Z*IR;
VSLL = sqrt(3)*abs(VS)
SS = 3*VS*conj(IS)
REG = (VSLL - VRLL)/VRLL*100
Eff = real(SR)/real(SS)*100
mprintf('Sendingend line voltage = %f kV \n',VSLL)
mprintf('Sending Apprent power = %f MVA \n',SS)
mprintf('Regulation = %f %% \n',REG)
mprintf('Efficiency = %f %% \n',Eff)

disp('(b)')
SR=304.8-%i*228.6; // leading power factor
IR = conj(SR)/(3*conj(VR)); IS = IR;
VS = VR + Z*IR;
VSLL = sqrt(3)*abs(VS)
SS = 3*VS*conj(IS)
REG = (VSLL - VRLL)/VRLL*100
Eff = real(SR)/real(SS)*100
mprintf('Sendingend line voltage = %f kV \n',VSLL)
mprintf('Sending Apprent power = %f MVA \n',SS)
mprintf('Regulation = %f %% \n',REG)
mprintf('Efficiency = %f %% \n',Eff)

//output:-
//(a)
//Sendingend line voltage = 250.018650 kV
//Sending Apprent power = 322.795165 MVA
//Regulation = 13.644841 %
//Efficiency = 94.425206 %
//
// (b)
//Sendingend line voltage = 210.288383 kV
//Sending Apprent power = 322.795165 MVA
//Regulation = -4.414372 %
//Efficiency = 94.425206 %
```

```
 (a)
Sendingend line voltage = 250.018650 kV
Sending Apprent power = 322.795165 MVA
Regulation = 13.644841 %
Efficiency = 94.425206 %

 (b)
Sendingend line voltage = 210.288383 kV
Sending Apprent power = 322.795165 MVA
Regulation = -4.414372 %
Efficiency = 94.425206 %
```

Figure 1.1: exp1

```
52 //
```

Experiment: 2

A Scilab Program To Evaluate Performance Of Short Transmission Line Using Graphical Method

Scilab code Solution 2.2 exp2

```
1 //Experiment-2
2 // windows Vista - 32-Bit
3 //Scilab - 5.5.2
4
5
6 //Aim : A SCILAB program to evaluate performance of
     short transmission line using graphical method
7
8
9 clear all;
10 clc;
11 // This program calculates the percentage regulation
      of a short transmission line
12 // It is assumed that the receiving end voltage Vr
     and magnitude of current Ir are constant
```

```
13 Vr = 220e3; // receiving end voltage
14 R = 33.5;    // input line resistance
15 X = 138;     // line reactance
16 Z = R + X*%i;    // line impedance
17 Irmag = 164.02; // receiving end current magnitude
18 // This Irmag is assumed to be constant. This will
      change the angle of
19 // phasor of Ir in the vector diagram over the range
       of pf set in following line
20              pf = 1:-0.001:0.5;  // power factor

21              Irang = acos(pf);
22              Ir = Irmag * exp(-%i*Irang);     // For
                   lagging power factor
23              Vs = (Vr/sqrt(3))+ Ir*Z;     // sqrt(3)
                   is used here as we need to do a per
                   phase analysis
24              VrNL = abs(Vs);
25 VrFL = abs(Vr/sqrt(3));
26 per_vol_regu= ((VrNL-VrFL)/VrFL)*100;
27 plot(pf,per_vol_regu,'-');
28 xlabel('power factor')
29 ylabel('voltage regulation')
30 title('Graph of power factor v/s voltage regulation'
      )
31
32 // For leading power factor range, angle should be
      positive So,
33
34 Ir = Irmag * exp(%i*Irang);
35
36 Vs = (Vr/sqrt(3))+ Ir*Z;
37
38 VrNL = abs(Vs); // absolute value of Vs
39
40 VrFL = abs(Vr/sqrt(3)); //abs value of Vr per phase
41
42 per_vol_regu= ((VrNL-VrFL)/VrFL)*100;
```

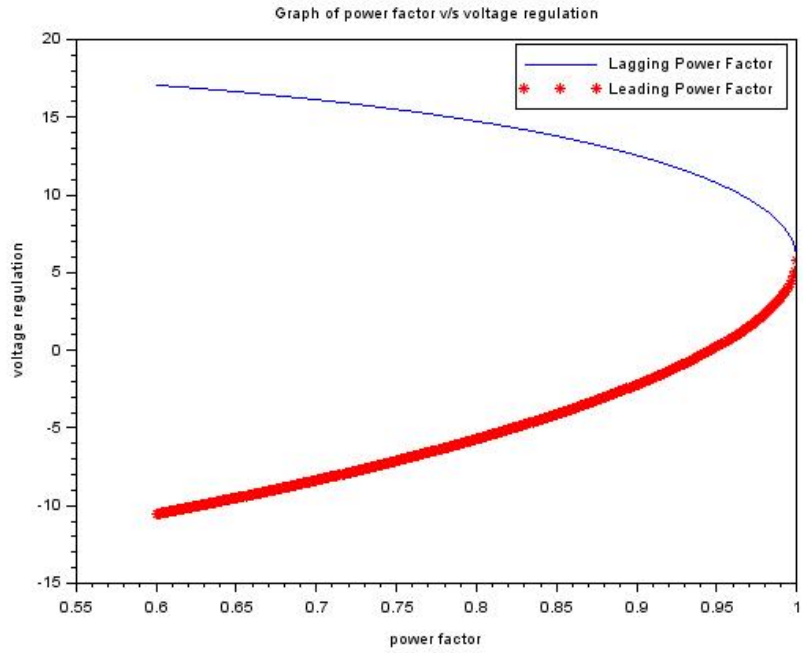


Figure 2.1: exp2

```
43 plot(pf,per_vol_regu,'r*');
44 legend('Lagging Power Factor','Leading Power Factor'
   )
45 //gtext('Vreg vs lagging pf')
46 //gtext('Vreg vs leading pf')
```

Experiment: 3

Finding Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal T Method Through Scilab

Scilab code Solution 3.3 exp3

```
1  //Experiment-3
2  // windows Vista - 32-Bit
3  //Scilab - 5.5.2
4
5
6  // Aim ; Finding voltage regulation and efficiency
       of a medium  transmission line using nominal T
       method through SCILAB
7
8  clc;
9  clear all;
10 R=10;
11 XL=20;
```

```
Y= 4e-4;
VRLL=66e3;
PR=10000e3;
pf=0.8; // change power factor of load
VR=66e3/sqrt(3);
Z=R+%i*XL;
IR=PR/(sqrt(3)*VRLL*pf);
IR_COMPLEX=IR*(cos(acos(0.8))-%i*sin(acos(0.8)));
VM=VR+IR_COMPLEX*(Z/2);
IC=%i*Y*VM;
IS=IR_COMPLEX+IC;
VS=VM+IS*(Z/2);
[VS_abs,Phase_VS]= polar(VS);
[IS_abs,Phase_IS]= polar(IS);
VS_abs;
IS_abs
VSLL=VS*sqrt(3);
VSLL_abs=abs(VSLL)/1000
PHASE_DIFF=Phase_VS-Phase_IS;
SendingEnd_PF=cos(PHASE_DIFF)
PS=3*abs(VS)*abs(IS)*cos(PHASE_DIFF);
EFF=(abs(PR)/abs(PS))*100
REG = 100*((abs (VSLL) - abs (VRLL)))/ abs (VRLL)
mprintf('Sendingend Current = %f A \n',IS_abs)
mprintf('Sendingend Line Voltage = %f kV \n',
   VSLL_abs)
mprintf('Sendingend Power factor = %f \n',
   SendingEnd_PF)
mprintf('Efficiency = %f %% \n', EFF)
mprintf('Regulation = %f %% \n', REG)


//Output:-
//
//Sendingend Current = 100.533214 A
//Sendingend Line Voltage = 69.543925 kV
//Sendingend Power factor = 0.853122
//Efficiency = 96.796480 %
```

```
 Sendingend Current = 100.533214 A
Sendingend Line Voltage = 69.543925 kV
Sendingend Power factor = 0.853122
Efficiency = 96.796480 %
Regulation = 5.369583 %
```

Figure 3.1: exp3

```
48 //Regulation = 5.369583 %
49 //
```

Experiment: 4

Finding Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal Pi Method Through Scilab

Scilab code Solution 4.4 exp4

```
1 //Experiment-4
2 // windows Vista - 32-Bit
3 //Scilab - 5.5.2
4
5
6 // Aim : Finding voltage regulation and efficiency
    of a medium  transmission line using nominal PI
    method through SCILAB
7
8 mode(0);
9
10 clc
11 clear all
```

```
12 disp('Nominal PI Method for medium transmission line
   ')
13 R = input('Enter the Total line Resistance in Ohms :
    '); // Total Line Resistance in Ohms like 10
   Ohms
14 XL = input('Enter the Total line Inductive Reactance
    in Ohms : '); // Total line Inductive Reactance
   in Ohms like 50 Ohms
15 Y = input('Enter the Total line Suseptance in Seimen
    : '); // Total line Suseptance in Seimen like 10
   e-4 Seimen
16 f = input('Enter the Frequency in Hz: '); //
   Frequency in Hz like 50 Hz
17 PR= input('Enter the Recieving End Power in Watt : '
   ); // Recieving End Power in Volt like 20e6 W
18 VRLL= input('Enter the Recieving End Line Voltage in
    Volt :'); // Recieving End Line Voltage in Volt
   like 66e3 V
19 pf= input('Enter Recievinf End Lagging Power Factor
   : '); // Recievinf End Lagging Power Factor like
   0.9
20 Z=R+%i*XL;
21 VR = VRLL/sqrt(3);
22
23 IR=PR/(sqrt(3)*VRLL*pf);
24 IR_COMPLEX=IR*(cos(acos(pf))-%i*sin(acos(pf)));
25
26 IC1=%i*Y/2*VR;
27
28 IL = IR_COMPLEX + IC1;
29
30 VS = VR + IL*Z;
31
32 IC2 = %i*Y/2*VS;
33
34 IS=IL + IC2
35
36 [VS_abs,Phase_VS]= polar(VS);
```

```
37 [IS_abs,Phase_IS]= polar(IS);
38 VS_abs;
39 IS_abs;
40 VSLL=VS*sqrt(3);
41 VSLL_abs=abs(VSLL)/1000
42 PHASE_DIFF=Phase_VS-Phase_IS;
43 SendingEnd_PF=cos(PHASE_DIFF);
44
45 PS=3*abs(VS)*abs(IS)*cos(PHASE_DIFF)
46 EFF=(abs(PR)/abs(PS))*100
47 REG = 100*((abs (VSLL) - abs (VRLL)))/ abs (VRLL)
48
49 mprintf('Sendingend Current = %f A \n',IS_abs)
50 mprintf('Sendingend Line Voltage = %f kV \n',
     VSLL_abs)
51 mprintf('Sendingend Power factor = %f \n',
     SendingEnd_PF)
52 mprintf('Efficiency = %f %% \n', EFF)
53 mprintf('Regulation = %f %% \n', REG)
54
55
56 //output:-
57 //
58 //Nominal PI Method for medium transmission line
59 //Enter the Total line Resistance in Ohms : 10
60 //Enter the Total line Inductive Reactance in Ohms :
       50
61 //Enter the Total line Suseptance in Seimen : 10e-4
62 //Enter the Frequency in Hz: 50
63 //Enter the Recieving End Power in Watt : 20e6
64 //Enter the Recieving End Line Voltage in Volt :66e3
65 //Enter Recievinf End Lagging Power Factor : 0.9
66 // IS  =
67 //
68 //    170.90917 - 44.112456i
69 // VSLL_abs  =
70 //
71 //    76.021348
```

```
72 // PS  =
73 //
74 //     21047697. + 1.094D-09i
75 // EFF  =
76 //
77 //     95.022274
78 // REG  =
79 //
80 //     15.183861
81 //Sendingend Current = 176.510208 A
82 //Sendingend Line Voltage = 76.021348 kV
83 //Sendingend Power factor = 0.905604
84 //Efficiency = 95.022274 %
85 //Regulation = 15.183861 %
```

```
 Nominal PI Method for medium transmission line
Enter the Total line Resistance in Ohms : 10
Enter the Total line Inductive Reactance in Ohms : 50
Enter the Total line Suseptance in Seimen : 10e-4
Enter the Frequency in Hz: 50
Enter the Recieving End Power in Watt : 20e6
Enter the Recieving End Line Voltage in Volt :66e3
Enter Recievinf End Lagging Power Factor : 0.9
 IS  =

    170.90917 - 44.112456i
 VSLL_abs  =

    76.021348
 PS  =

    21047697. + 1.094D-09i
 EFF  =

    95.022274
 REG  =

    15.183861
Sendingend Current = 176.510208 A
Sendingend Line Voltage = 76.021348 kV
Sendingend Power factor = 0.905604
Efficiency = 95.022274 %
Regulation = 15.183861 %
```

Figure 4.1: exp4

Experiment: 5

Finding Voltage Regulation And Efficiency Of A Medium Transmission Line Using End Condenser Method Through Scilab

Scilab code Solution 5.5 exp5

```
1  //Experiment-5
2  // windows Vista - 32-Bit
3  //Scilab - 5.5.2
4
5
6  // Aim : Finding voltage regulation and efficiency
       of a medium  transmission line using End
       Condenser method through SCILAB
7
8  mode(0);
9
10 clc
11 clear all
```

```
12 disp('End Condensor Method for medium transmission
     line')
13 R =25 // ('Enter the line Resistance in Ohms : ')
14 X =80 // ('Enter the line Inductive Reactance in
     Ohms : ')
15 Y =14e-4 // ('Enter the line Suseptance in Seimen :
     ')
16 f =50 // ('Enter the frequency : ')
17 PR=15e6 // ('Enter the Recieving End Power in Watt :
     ')
18 VRLine=66e3 // ('Enter the Recieving End Line
     Voltage in Volt :')
19 Pf=0.8 // ('Enter Recievinf End Lagging Power Factor
     : ')
20 // X = 2*%pi*f*L
21 Z = R + X*%i;
22 //Y = %i* 2 *%pi*f*C
23
24 IR = PR/(VRLine*Pf);
25
26 Pfang = acos(Pf);
27
28 IR_Complex= IR*(Pf - %i*sin(Pfang));
29
30 IC_Complex = %i*Y*VRLine;
31
32 IS = IR_Complex + IC_Complex
33
34 Voltage_drop = IS*Z;
35
36 VS = VRLine + IS*Z
37
38 [VS_abs,Phase_VS]= polar(VS);
39
40 [IS_abs,Phase_IS]= polar(IS);
41
42 VS_abs;
43 IS_abs;
```

```
44
45 PHASE_DIFF=Phase_VS-Phase_IS;
46 SendingEnd_PF=cos(PHASE_DIFF);
47 Sending_End_PF = abs(SendingEnd_PF)
48 PS=abs(VS)*abs(IS)*cos(PHASE_DIFF);
49 EFF=(abs(PR)/abs(PS))*100
50 REG = 100*((abs (VS) - abs (VRLine)))/ abs (VRLine)
51
52 //
53 //output:-
54 //
55 //End Condensor Method for medium transmission line
56 // R  =
57 //
58 //     25.
59 // X  =
60 //
61 //     80.
62 // Y  =
63 //
64 //     0.0014
65 // f  =
66 //
67 //     50.
68 // PR  =
69 //
70 //     15000000.
71 // VRLine  =
72 //
73 //     66000.
74 // Pf  =
75 //
76 //     0.8
77 // IS  =
78 //
79 //     227.27273 - 78.054545i
80 // VS  =
81 //
```

```
82 //     77926.182 + 16230.455i
83 // Sending_End_PF  =
84 //
85 //     0.8596751
86 // EFF  =
87 //
88 //     91.220706
89 // REG  =
90 //
91 //     20.603752
```

```
End Condensor Method for medium transmission line
R  =

   25.
X  =

   80.
Y  =

   0.0014
f  =

   50.
PR  =

   15000000.
VRLine  =

   66000.
Pf  =

   0.8
IS  =

   227.27273 - 78.054545i
VS  =

   77926.182 + 16230.455i
Sending_End_PF  =

   0.8596751
EFF  =

   91.220706
REG  =

   20.603752
```


Figure 5.1: exp5

Experiment: 6

A Scilab Program To Evaluate Performance Of Medium Transmission Line Using Graphical Method

Scilab code Solution 6.6 exp6

```
1 //Experiment-6
2 // windows Vista - 32-Bit
3 //Scilab - 5.5.2
4
5
6 // Aim : A SCILAB program to evaluate performance of
      medium transmission line using graphical method
7
8 clear all;
9 clc;
10 // Program to calculate voltage regulation of
     nominal PI method of medium length transmission
     line
11 // Line parameters are taken from Stevenson as
     before. One may use any other data using the
```

```
    %commented input functions
Vr = 220e3;    // input('Enter the value of Vr = ') ;
R =  33.5;    // input('Enter the value of R = ') ;
X = 138;    // input('Enter the value of X = ') ;
pf = 0.9;    // input('Enter the value of pf = ') ;
Pr = 50e6;    // input('Enter the value of pr = ') ;
Y = %i*0.3e-3; // input('Enter the value of Y = ') ;
Z = R + X * %i;
Irmag = Pr/(sqrt(3)*Vr*pf);
pf = 0.5:0.001:1;
Irang = acos (pf);  // Angle in radian
Ir =Irmag * exp (-%i*Irang);
// Irmag is kept constant. Only Ir phasor rotates. -
    ve sign is used because of lagging power factor
    %and to indicate that with Vr as reference phasor
    , angle of Ir should be negative.Irang should be
    %in radian only. It wil give wrong result, if
    Irang is in degrees

Ir1 =Irmag * exp (%i*Irang);    // For leading power
     factor
// Calculations for lagging power factor for medium
    line length
Vs = Vr/ sqrt (3) + (Ir+(Y/2)*Vr/ sqrt (3))*Z; //
    all terms are of voltage and are phase values
VrNLm =abs( Vs / (1+((Y*Z)/2)));
VrFLm= abs (Vr / sqrt (3));
per_vol_regulag = ( (VrNLm -VrFLm) / VrFLm) * 100;
// Calculations for leading power factor for medium
    line length
Vs1m = Vr/ sqrt (3) + (Ir1+(Y/2)*Vr/ sqrt (3))*Z;
// all terms are of voltage and are in phase values
VrNL1m =abs( Vs1m / (1+((Y*Z)/2)));
per_vol_regulead = ( (VrNL1m -VrFLm) / VrFLm) * 100;
// plot the two waveforms on the same graph
plot(pf,per_vol_regulag,'r',pf,per_vol_regulead,'*')
    ;

```

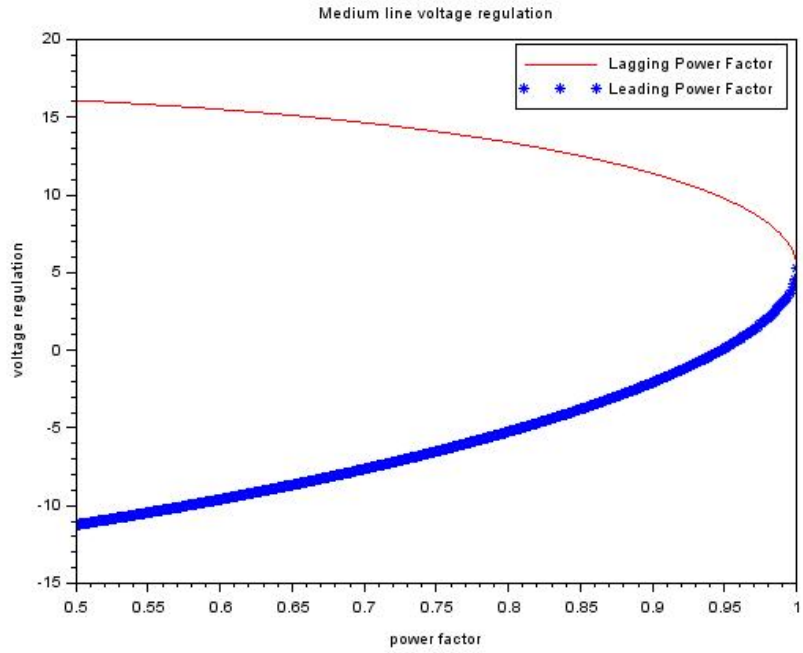


Figure 6.1: exp6

```
39 xlabel('power factor')
40 ylabel('voltage regulation')
41 title('Medium line voltage regulation')
42 legend('Lagging Power Factor','Leading Power Factor'
   )
43 // gtext('Vreg vs lagging pf')
44 // gtext('Vreg vs leading pf')
```

Experiment: 7

Finding voltage regulation and efficiency of a long transmission line using Rigorous solution method through SCILAB

Scilab code Solution 7.7 exp7

```
1  //Experiment-7
2  // windows Vista - 32-Bit
3  //Scilab - 5.5.2
4
5
6  // Aim : Finding voltage regulation and efficiency
       of a long transmission line using Rigorous
       solution method through SCILAB
7
8  mode(0);
9
10 clc
11 clear all
12 disp('Rigorous Method for Long transmission line')
13 R = input('Enter the Total line Resistance in Ohms :
```

```
    ');  // Total line Resistance in Ohms like 32
    Ohms
14  XL = input('Enter the Total line Inductive Reactance
     in Ohms : '); // Total line Inductive Reactance
    in Ohms like 50 Ohms
15  y = input('Enter the Total line Suseptance in Seimen
     : '); // Total line Suseptance in Seimen like
    0.0003
16  f = input('Enter the frequency in Hz : '); //
    frequency in Hz like 50 Hz
17  PR= input('Enter the Recieving End Power in Watt : '
    );// Recieving End Power in Watt like 20e6
18  VRLL= input('Enter the Recieving End Line Voltage in
     Volt :'); // Recieving End Line Voltage in Volt
    like 110e3
19  pf= input('Enter Recievinf End Lagging Power Factor
    : '); // Recievinf End Lagging Power Factor like
    0.8
20  Z=R+%i*XL;
21  Y= %i*y;
22  VR = VRLL/sqrt(3);
23  IR=PR/(sqrt(3)*VRLL*pf);
24
25  A = 1+ (Z*Y)/2 + (Z*Z*Y*Y)/24;     //A= cosh(sqrt(Y*Z
    ))
26
27  B = sqrt(Y*Z) + ((Y*Z)^(3/2))/6;     //B = sinh(sqrt(
    Y*Z))
28
29  VS = VR*A + IR*sqrt(Z/Y)*B;     //VS = VR*cosh(sqrt(Y
    *Z)) + IR*sqrt(Z/Y)*sinh(sqrt(Y*Z))
30
31  IS = VR*sqrt(Y/Z)*B + IR*A;    //IS = VR*sqrt(Y/Z)*
    sinh(sqrt(Y*Z)) + IR*cosh(sqrt(Y*Z))
32
33  [VS_abs,Phase_VS]= polar(VS);
34  [IS_abs,Phase_IS]= polar(IS);
35  VS_abs;
```

```
36 IS_abs;
37 VSLL=VS*sqrt(3);
38 VSLL_abs=abs(VSLL)/1000;
39 Phase_VS;
40 Phase_IS;
41
42 PHASE_DIFF=Phase_VS-Phase_IS;
43
44 SendingEnd_PF=cos(PHASE_DIFF);
45
46 PS=3*VS_abs*IS_abs*cos(PHASE_DIFF);
47 EFF=(abs(PR)/abs(PS))*100;
48 REG = 100*((abs (VSLL) - abs (VRLL)))/ abs (VRLL);
49
50 mprintf('\n\nSendingend Current = %f A \n',IS_abs)
51 mprintf('Sendingend Line Voltage = %f kV \n',
     VSLL_abs)
52 mprintf('Sendingend Power factor = %f \n',
     SendingEnd_PF)
53 mprintf('Efficiency = %f %% \n', EFF)
54 mprintf('Regulation = %f %% \n', REG)
55
56
57 //output:-
58 //
59 // Rigorous Method for Long transmission line
60 //Enter the Total line Resistance in Ohms : 32
61 //Enter the Total line Inductive Reactance in Ohms :
     50
62 //Enter the Total line Suseptance in Seimen : 0.0003
63 //Enter the frequency in Hz : 50
64 //Enter the Recieving End Power in Watt : 20e6
65 //Enter the Recieving End Line Voltage in Volt :110
     e3
66 //Enter Recievinf End Lagging Power Factor : 0.8
67 //
68 //
69 //Sendingend Current = 131.674018 A
```

```
 Rigorous Method for Long transmission line
Enter the Total line Resistance in Ohms : 32
Enter the Total line Inductive Reactance in Ohms : 50
Enter the Total line Suseptance in Seimen : 0.0003
Enter the frequency in Hz : 50
Enter the Recieving End Power in Watt : 20e6
Enter the Recieving End Line Voltage in Volt :110e3
Enter Recievinf End Lagging Power Factor : 0.8


Sendingend Current = 131.674018 A
Sendingend Line Voltage = 117.015932 kV
Sendingend Power factor = 0.998847
Efficiency = 75.028310 %
Regulation = 6.378120 %
```

Figure 7.1: exp7

```
70 //Sendingend Line Voltage = 117.015932 kV
71 //Sendingend Power factor = 0.998847
72 //Efficiency = 75.028310 %
73 //Regulation = 6.378120 %
```

Experiment: 8

A Scilab Program To Evaluate Performance Of Long Transmission Line Using Graphical Method

Scilab code Solution 8.8 exp8

```
1 //Experiment-8
2 // windows Vista - 32-Bit
3 //Scilab - 5.5.2
4
5
6 // Aim : A SCILAB program to evaluate performance of
      long transmission line using graphical method
7
8 clc
9 clear all
10 disp('Rigorous Method for Long transmission line
     using graphical method')
11 R =32 // ('Enter the Total line Resistance in Ohms :
      ')
12 XL =50 // ('Enter the Total line Inductive Reactance
```

```
      in Ohms : ')
13 y =0.003 // ('Enter the Total line Suseptance in
     Seimen : ')
14 f =50 // ('Enter the frequency : ')
15 PR= 20e6 //('Enter the Recieving End Power in Watt :
      ')
16 VRLL=110e3 // ('Enter the Recieving End Line Voltage
      in Volt :')
17 pf=0.8,
18 Z=R+%i*XL;
19 Y= %i*y;
20 VR = VRLL/sqrt(3);
21 IR=PR/(sqrt(3)*VRLL*pf);
22 A = 1+ (Z*Y)/2 + (Z*Z*Y*Y)/24;     //A= cosh(sqrt(Y*Z
     ))
23
24 B = sqrt(Y*Z) + ((Y*Z)^(3/2))/6;     //B = sinh(sqrt(
     Y*Z))
25
26 pf = 1:-0.01:0.5
27
28
29 Irang = acos (pf);  // Angle in radian
30
31 Ir =IR * exp (-%i*Irang);
32 Ir1 =IR * exp (%i*Irang);
33
34
35 VS = VR*A + Ir*sqrt(Z/Y)*B;     //VS = VR*cosh(sqrt(Y
     *Z)) + IR*sqrt(Z/Y)*sinh(sqrt(Y*Z))
36
37 VS1 = VR*A + Ir1*sqrt(Z/Y)*B ;    //VS = VR*cosh(sqrt
     (Y*Z)) + IR*sqrt(Z/Y)*sinh(sqrt(Y*Z))
38
39
40 [VS_abs,Phase_VS]= polar(VS);
41 [VS1_abs,Phase_VS1]= polar(VS1);
42
```

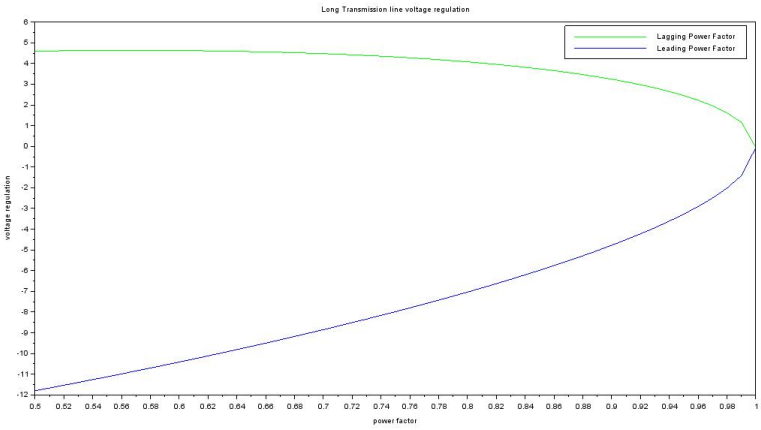


Figure 8.1: exp8

```
43 VSLL=VS;
44 VSLL1=VS1;
45 REGlag = 100*((abs (VSLL) - abs (VR)))/ abs (VR)
46 REGlead = 100*((abs (VSLL1) - abs (VR)))/ abs (VR)
47
48
49 plot(pf,REGlag,'g-');
50 plot(pf,REGlead,'b');
51
52 xlabel('power factor')
53 ylabel('voltage regulation')
54 title('Long Transmission line voltage regulation')
55 legend('Lagging Power Factor','Leading Power Factor'
   )
```

Experiment: 9

A Scilab Program To Find Permissible Frequency And Length For Limiting Ferranti Effect In Long Transmission Lines.

Scilab code Solution 9.9 exp9

```
1  //Experiment-9
2  // windows Vista - 32-Bit
3  //Scilab - 5.5.2
4
5
6  // Aim : A SCILAB Program to find permissible
       frequency and length for limiting Ferranti effect
        in long transmission lines.
7
8
9  clc;
10 clear all; // Clear All Variables & Command Window
11 Standard_f=50;
```

```
12 l=400;
13 VSLL=220e3;     //Defining Given DATA
14 r=0.125; //Defining Given DATA
15 x=0.4;  //Defining Given DATA
16 y=%i*2.8e-6;          //Defining Given DATA
17 R=r*l;
18 X=x*l;
19 Y=y*l;
20 z=r+%i*x;
21 Z=R+%i*X;
22 A=1+Y*Z/2; // Defining ABCD Parameters
23 B=Z*(1+Y*Z/6);             // Defining ABCD
     Parameters
24 C=Y*(1+Y*Z/6);  // Defining ABCD Parameters
25 D=A;                   // Defining ABCD Parameters
26
27 No_load_VRLL=VSLL/A;
28 NoLoad_VRLL=abs(No_load_VRLL)/1000        //Display
     No Load Voltage at Receiving
29 NoLoad_VR=NoLoad_VRLL/sqrt(3);        // Calculate
     Voltage per Phase
30 NoLoad_IS=abs(C*NoLoad_VR)            // Calculate
     Sending end Current
31
32 VRLL_MAX=235e3;                       // Define limit
     , the receiving end Volt
33 new_A=VSLL/VRLL_MAX;                  // Evaluate
     Parameter    A    for VRLL_MAX
34 l=sqrt(real((2*new_A-2)/y/z));        // Equation for
      maximum Length
35 Permisible_Lenth=abs(l)               // Find the
     Magnitude out of Complex
36
37 VRLL_MAX2=250e3;                      //  Similar to
     above
38 new_A2=VSLL/VRLL_MAX2;
39 Max_Permisible_f=abs((2500*sqrt(R^2*Y^2/10000+X*Y*(
     new_A2-1)/1250)-25*R*Y)/X/Y)
```

```
 No Load Voltage at Receiving end = 241.537811 kV

No load Sending end Current = 0.151528 A

Permissible length = 322.243754 Km

Max. Permissible Frequency = 63.678641 Hz
```

Figure 9.1: exp9

```
40
41 mprintf('No Load Voltage at Receiving end = %f kV \n
      \n', NoLoad_VRLL)
42 mprintf('No load Sending end Current = %f A \n\n',
      NoLoad_IS)
43 mprintf('Permissible length = %f Km \n\n',
      Permisible_Lenth)
44 mprintf('Max. Permissible Frequency = %f Hz \n\n',
      Max_Permisible_f)
45
46
47 //output:-
48 //
49 // No Load Voltage at Receiving end = 241.537811 kV
50 //
51 //No load Sending end Current = 0.151528 A
52 //
53 //Permissible length = 322.243754 Km
54 //
55 //Max. Permissible Frequency = 63.678641 Hz
```

Experiment: 10

A Scilab Program For Computing The Abcd Parameters Of Short, Medium And Long Transmission Lines

Scilab code Solution 10.10 exp10

```
1 //Experiment-10
2 // windows Vista - 32-Bit
3 //Scilab - 5.5.2
4
5
6 // Aim : A SCILAB program for computing the ABCD
    parameters of short, medium and long transmission
     lines
7
8 clc
9 clear all
10 disp('Enter your choice:')
11 disp('1 : for short transmission line')
12 disp('2 : for medium transmission line')
13 disp('3 : for long transmission line')
```

```
14 check = input('Enter your choice : ')
15 R = input('Enter the line Resistance in Ohms : ')
16 L = input('Enter the line Inductance in Henry : ')
17 C = input('Enter the line Capacitance in Farad : ')
18 f = input('Enter the frequency : ')
19 X = 2*%pi*f*L
20 Z = R + %i*X;
21 Y = %i*2*%pi*f*C
22 if(check==1)
23 Adata = 1; // ABCD in cartesian form
24 Bdata = Z; // ABCD in cartesian form
25 Cdata = 0; // ABCD in cartesian form
26 Ddata = 1; // ABCD in cartesian form
27 Result = [Adata, Bdata, Cdata, Ddata]
28 mprintf('ABCD constant for Short Transmission line\n
       A constant = %f \n B constant= %f + i %f ohm
      \n C constant=%f mho \n D constant = %f \n',
     Adata,real(Bdata),imag(Bdata),Cdata,Ddata)
29 end
30
31 if(check==2)
32 disp(' Enter 1 for Nominal T-method')
33 disp('Enter 2 for Nominal PI-method')
34 s = input('Enter your choice : ')
35 if(s==1)
36 Adata = 1 + (Y*Z)/2;
37 Bdata = Z*(1 + (Y*Z)/4);
38 Cdata = Y;
39 Ddata = (1 + (Y*Z)/2);
40
41 Result = [Adata, Bdata, Cdata, Ddata]
42 mprintf('ABCD constant for Medium Transmission line
     Nominal T-method \n A constant = %f + i %f \n
     B constant= %f + i%f ohm \n C constant=%f + i %f
      mho \n D constant = %f + i%f \n',real(Adata),
     imag(Adata),real(Bdata),imag(Bdata),real(Cdata),
     imag(Cdata),real(Ddata),imag(Ddata))
43 else
```

```
44 Adata = 1 + (Y*Z)/2;
45 Bdata = Z
46 Cdata = Y * (1 + (Y*Z)/4);
47 Ddata = (1 + (Y*Z)/2);
48 Result = [Adata, Bdata, Cdata, Ddata]
49 mprintf('ABCD constant for Medium Transmission line
     Nominal PI-method\n A constant = %f + i %f \n
     B constant= %f + i%f ohm \n C constant=%f + i %f
      mho \n D constant = %f + i%f \n',real(Adata),
     imag(Adata),real(Bdata),imag(Bdata),real(Cdata),
     imag(Cdata),real(Ddata),imag(Ddata))
50 end end
51
52 if(check==3)
53 Adata = cosh(sqrt(Y*Z));
54 Bdata = (sqrt(Z/Y) * sinh(sqrt(Y*Z)));
55 Cdata = (1/sqrt(Z/Y) * sinh(sqrt(Y*Z)));
56 Ddata = cosh(sqrt(Y*Z));
57 Result = [Adata,Bdata,Cdata,Ddata];
58 mprintf('ABCD constant for Long Transmission line \n
      A constant = %f + i %f \n B constant= %f + i%f
      ohm \n C constant=%f + i %f mho \n D constant =
      %f + i%f \n',real(Adata),imag(Adata),real(Bdata
     ),imag(Bdata),real(Cdata),imag(Cdata),real(Ddata)
     ,imag(Ddata))
59 end
60
61 //
62 //output:-
63 //
64 //For Short Transmission line
65 //
66 //Enter your choice:
67 //
68 // 1 : for short transmission line
69 //
70 // 2 : for medium transmission line
71 //
```

```
72 // 3 : for long transmission line
73 //Enter your choice : 1
74 //Enter the line Resistance in Ohms : 20
75 //Enter the line Inductance in Henry : 50
76 //Enter the line Capacitance in Farad : 0.0003
77 //Enter the frequency : 50
78 //ABCD constant for Short Transmission line
79 //  A constant  = 1.000000
80 //  B constant= 20.000000 + i 15707.963268  ohm
81 // C constant=0.000000  mho
82 // D constant = 1.000000
83 //
84 //
85 //For Nominal T method of medium Transmission line
86 //
87 //Enter your choice:
88 //
89 // 1 : for short transmission line
90 //
91 // 2 : for medium transmission line
92 //
93 // 3 : for long transmission line
94 //Enter your choice : 2
95 //Enter the line Resistance in Ohms : 20
96 //Enter the line Inductance in Henry : 50
97 //Enter the line Capacitance in Farad : 0.0003
98 //Enter the frequency : 50
99 //
100 //  Enter 1 for Nominal T-method
101 //
102 // Enter 2 for Nominal PI-method
103 //Enter your choice : 1
104 //ABCD constant for Medium Transmission line Nominal
        T-method
105 //  A constant  = -739.220330 + i 0.942478
106 //  B constant= -14784.406602 + i-5797959.489510 ohm
107 // C constant=0.000000 + i 0.094248  mho
108 // D constant = -739.220330  + i0.942478
```

```
109 //
110 //For Nominal PI method of medium Transmission line
111 //
112 //Enter your choice:
113 //
114 // 1 : for short transmission line
115 //
116 // 2 : for medium transmission line
117 //
118 // 3 : for long transmission line
119 //Enter your choice : 2
120 //Enter the line Resistance in Ohms : 20
121 //Enter the line Inductance in Henry : 50
122 //Enter the line Capacitance in Farad : 0.0003
123 //Enter the frequency : 50
124 //
125 //  Enter 1 for Nominal T-method
126 //
127 // Enter 2 for Nominal PI-method
128 //Enter your choice : 2
129 //ABCD constant for Medium Transmission line Nominal
        PI-method
130 //  A constant  = -739.220330 + i 0.942478
131 //  B constant= 20.000000 + i15707.963268 ohm
132 // C constant=-0.044413 + i -34.787813  mho
133 // D constant = -739.220330  + i0.942478
134 //
135 //
136 //For long Transmission line
137 //
138 //Enter your choice:
139 //
140 // 1 : for short transmission line
141 //
142 // 2 : for medium transmission line
143 //
144 // 3 : for long transmission line
145 //Enter your choice : 3
```

```
146 //Enter the line Resistance in Ohms : 20
147 //Enter the line Inductance in Henry : 50
148 //Enter the line Capacitance in Farad : 0.0003
149 //Enter the frequency : 50
150 //ABCD constant for Long Transmission line
151 // A constant  = 0.712960 + i 0.017183
152 //  B constant= 7.310527 + i286.435826 ohm
153 // C constant=0.000042 + i 0.001719  mho
154 // D constant = 0.712960  + i0.017183
```

```
 Enter your choice:

 1 : for short transmission line

 2 : for medium transmission line

 3 : for long transmission line
Enter your choice : 1
Enter the line Resistance in Ohms : 20
Enter the line Inductance in Henry : 50
Enter the line Capacitance in Farad : 0.0003
Enter the frequency : 50
ABCD constant for Short Transmission line
  A constant  = 1.000000
  B constant= 20.000000 + i 15707.963268  ohm
 C constant=0.000000  mho
 D constant = 1.000000



 Enter your choice:

 1 : for short transmission line

 2 : for medium transmission line

 3 : for long transmission line
Enter your choice : 2
Enter the line Resistance in Ohms : 20
Enter the line Inductance in Henry : 50
Enter the line Capacitance in Farad : 0.0003
Enter the frequency : 50

  Enter 1 for Nominal T-method

 Enter 2 for Nominal PI-method
Enter your choice : 1
ABCD constant for Medium Transmission line Nominal T-method
  A constant  = -739.220330 + i 0.942478
  B constant= -14784.406602 + i-5797959.489510 ohm
 C constant=0.000000 + i 0.094248  mho
 D constant = -739.220330  + i0.942478
```


Figure 10.1: exp10

```
 Enter your choice:

 1 : for short transmission line

 2 : for medium transmission line

 3 : for long transmission line
Enter your choice : 2
Enter the line Resistance in Ohms : 20
Enter the line Inductance in Henry : 50
Enter the line Capacitance in Farad : 0.0003
Enter the frequency : 50

  Enter 1 for Nominal T-method

 Enter 2 for Nominal PI-method
Enter your choice : 2
ABCD constant for Medium Transmission line Nominal PI-method
  A constant  = -739.220330 + i 0.942478
  B constant= 20.000000 + i15707.963268 ohm
 C constant=-0.044413 + i -34.787813  mho
 D constant = -739.220330  + i0.942478
```

```
 Enter your choice:

 1 : for short transmission line

 2 : for medium transmission line

 3 : for long transmission line
Enter your choice : 3
Enter the line Resistance in Ohms : 20
Enter the line Inductance in Henry : 50
Enter the line Capacitance in Farad : 0.0003
Enter the frequency : 50
ABCD constant for Long Transmission line
 A constant  = 0.712960 + i 0.017183
  B constant= 7.310527 + i286.435826 ohm
 C constant=0.000042 + i 0.001719  mho
 D constant = 0.712960  + i0.017183
```


Figure 10.2: exp10

Experiment: 11

A Scilab Program For Conversion Of Unsymmetrical Ac Phasors Into Symmetrical Components

Scilab code Solution 11.11 exp11

```
1  //Experiment-11
2  // windows Vista - 32-Bit
3  //Scilab - 5.5.2
4
5
6  // Aim : A SCILAB program for conversion of
       unsymmetrical AC phasors into symmetrical
       components
7
8
9
10 clc
11
12 disp('Enter your choice:');
13
```

```
14 disp('1 for phasor to symmetrical;  2 for
      symmetrical to phasor');
15 choice=input('Enter your transformation type=');
16
17 alpha = -0.5+%i*0.866;
18 if(choice==1)
19
20 Va=input('Enter the value of complex phase voltage
      VA=') //complex phase voltage VA=200 - %i*100
21 Vb=input('Enter the value of complex phase voltage
      VB=') //complex phase voltage VB=-36.59 - %i
      *209.804
22 Vc=input('Enter the value of complex phase voltage
      VC=') //Enter the value of complex phase voltage
      VC=136.59 +%i*309.80
23 disp('Positive sequence component =');
24 Va1=(Va+(alpha*Vb)+(alpha)^2*Vc)/3
25 mprintf('Va1 = %f + i%f \n',real(Va1),imag(Va1))
26
27 disp('Negative sequence component =');
28 Va2=[Va+(alpha^2)*Vb+(alpha*Vc)]/3
29 mprintf('Va2 = %f + i%f \n',real(Va2),imag(Va2))
30
31 disp('Zero sequence component =');
32 Va0=[Va+Vb+Vc]/3
33 mprintf('Va0 = %f + i%f \n',real(Va0),imag(Va0))
34 end
35
36 if(choice==2)
37
38 Va1=input('Enter the value of positive sequence
      voltage Va1='); // positive sequence voltage Va1
      =200 - %i*100
39 Va2=input('Enter the value of negative sequence
      voltage Va2='); //negative sequence voltage Va2
      =-100
40 Va0=input('Enter the value of zero sequence voltage
      Va0='); //zero sequence voltage Va0=100
```

```
41 disp('Complex voltage Va =');
42
43 Va=[Va1+Va2+Va0]
44 mprintf('Va = %f + i%f \n',real(Va),imag(Va))
45
46 disp('Complex Voltage Vb=');
47 Vb=[(alpha^2*Va1)+(alpha*Va2)+Va0]
48 mprintf('Vb = %f + i%f \n',real(Vb),imag(Vb))
49
50 disp('Complex Voltage Vc=');
51 Vc=[(alpha*Va1)+(alpha^2*Va2)+Va0]
52 mprintf('Vc = %f + i%f \n',real(Vc),imag(Vc))
53 end
54
55 //
56 //output:-
57 //
58 //for phasor to symmetrical :
59 //
60 //Enter your choice:
61 //
62 // 1 for phasor to symmetrical;  2 for symmetrical
      to phasor
63 //Enter your transformation type=1
64 //Enter the value of complex phase voltage VA=200 -
      %i*100
65 //Enter the value of complex phase voltage VB=-36.59
       - %i*209.804
66 //Enter the value of complex phase voltage VC=136.59
       +%i*309.80
67 //
68 // Positive sequence component =
69 //Va1 = 199.994358 + i-99.986083
70 //
71 // Negative sequence component =
72 //Va2 = -99.992891 + i-0.011117
73 //
74 // Zero sequence component =
```

```
75 //Va0 = 100.000000 + i -0.001333
76 //
77 //
78 //
79 //for symmetrical to phasor :
80 //
81 //Enter your choice:
82 //
83 // 1 for phasor to symmetrical;  2 for symmetrical
     to phasor
84 //Enter your transformation type=2
85 //Enter the value of positive sequence voltage Va1
     =200 - %i*100
86 //Enter the value of negative sequence voltage Va2
     =-100
87 //Enter the value of zero sequence voltage Va0=100
88 //
89 // Complex voltage Va =
90 //Va = 200.000000 + i -100.000000
91 //
92 // Complex Voltage Vb=
93 //Vb = -36.591200 + i -209.804400
94 //
95 // Complex Voltage Vc=
96 //Vc = 136.595600 + i309.800000
```

```
 Enter your choice:

 1 for phasor to symmetrical;  2 for symmetrical to phasor
Enter your transformation type=1
Enter the value of complex phase voltage VA=200 - %i*100
Enter the value of complex phase voltage VB=-36.59 - %i*209.804
Enter the value of complex phase voltage VC=136.59 +%i*309.80

 Positive sequence component =
Va1 = 199.994358 + i-99.986083

 Negative sequence component =
Va2 = -99.992891 + i-0.011117

 Zero sequence component =
Va0 = 100.000000 + i-0.001333
```

Figure 11.1: exp11

```
 Enter your choice:

 1 for phasor to symmetrical;  2 for symmetrical to phasor
Enter your transformation type=2
Enter the value of positive sequence voltage Va1=200 - %i*100
Enter the value of negative sequence voltage Va2=-100
Enter the value of zero sequence voltage Va0=100

 Complex voltage Va =
Va = 200.000000 + i-100.000000

 Complex Voltage Vb=
Vb = -36.591200 + i-209.804400

 Complex Voltage Vc=
Vc = 136.595600 + i309.800000
```

Figure 11.2: exp11

Experiment: 12

A Scilab Program For Conversion Of Symmetrical Components Into Ac Phasors

Scilab code Solution 12.12 exp12

```
1  //Experiment-12
2  // windows Vista - 32-Bit
3  //Scilab - 5.5.2
4
5
6  // Aim : A SCILAB program for conversion of
       symmetrical components into AC phasors
7
8
9  // To find Symmetrical Components for 3-phase
       Unbalanced System
10
11
12 clc;
13 clear all;
14
15 Q=[3 310
```

```
16     5 105
17     4 12
18           ]
19 i=sqrt(-1);
20 n=3; // Number of Phases
21 a=1.0*(cos((360/n)*%pi/180)+%i*sin((360/n)*%pi/180))
      ;
22 a2=a^2;
23 // Conversion from Polar to Cartesian Form of Matrix
       I
24 Ia=Q(1)*(cos(Q(4)*%pi/180)+%i*sin(Q(4)*%pi/180));
25 Ib=Q(2)*(cos(Q(5)*%pi/180)+%i*sin(Q(5)*%pi/180));
26 Ic=Q(3)*(cos(Q(6)*%pi/180)+%i*sin(Q(6)*%pi/180));
27 // Define symmetrical components transformation
      matrix
28 A=   [1     1      1
29       1     a2     a
30       1     a      a2];
31 A012=inv(A)*[Ia;Ib;Ic];
32 // To check the results
33 Add0=A012(1)+A012(2)+A012(3); //This is Ia
34 Add1=A012(1)+a2*A012(2)+a*A012(3); //This is Ib
35 Add2=A012(1)+a*A012(2)+a2*A012(3); // This is Ic
36 // Symmetrical Components in Cartesian Form
37 Symm3= [A012(1) A012(2) A012(3)
38          A012(1) a2*A012(2) a*A012(3)
39          A012(1) a*A012(2) a2*A012(3)];
40 // Symmetrical Components in Polar Form
41 // Sym3Abs=abs(Symm3)
42 [sym3abs,Sym3Angle]=polar(Symm3)
43 sym3angle= Sym3Angle*180/%pi
44 disp('[Magnitude,Angle]')
45 mprintf('\n')
46 for i=1:3
47     for j=1:3
48        mprintf('[%.3f,%.3f]     ',sym3abs(i,j),
             sym3angle(i,j))
49     end
```

```
 [Magnitude,Angle]

[3.817,35.558]    [-0.276,-19.726]    [-0.276,13.835]
[-0.276,-19.726]    [3.817,60.635]    [-0.276,53.517]
[-0.276,13.835]    [-0.276,53.517]    [3.817,-84.773]
```

Figure 12.1: exp12

```
50      mprintf('\n')
51  end
52
53  // End of the Program
54
55
56  //output:-
57  //
58  //[Magnitude,Angle]
59  //
60  //[3.817,35.558]      [-0.276,-19.726]
        [-0.276,13.835]
61  //[-0.276,-19.726]      [3.817,60.635]
        [-0.276,53.517]
62  //[-0.276,13.835]      [-0.276,53.517]
        [3.817,-84.773]
63  //
```

Experiment: 13

Modification Of Zbus Matrix For Short Circuit Study Using Scilab Programming

Scilab code Solution 13.13 exp13

```
1 //Experiment-13
2 // windows Vista - 32-Bit
3 //Scilab - 5.5.2
4
5
6 // Aim : Modification of Zbus matrix for short
     circuit study using SCILAB Programming
7
8
9 // Display mode
10 mode(0);
11
12 clc;
13 clear;
14 s=input('Enter Size of Z bus Matrix :')// Size of Z
     bus Matrix like 3 or 4
15 mprintf('Enter %g X %g Matrix',s,s)
```

```
16
17 Zorg = input('')// Zorg like [1 2 3;4 5 6;7 8 9]
18 disp('Enter 1 for Type 1  2 for Type 2 3 for Type 3
      and 4 for Type 4 Zbus modification')
19 check = input('Enter Your Choice :')
20
21 if check==1 then
22
23 Zb = input ('Enter value of Impidance between New
      Bus and Reference:')// value of Impidance between
       New Bus and Reference like 10 or 20 etc.
24 l = max(size(Zorg));
25 Znew= zeros(l+1,l+1);
26 for i = 1:l+1
27   for j = 1:l+1
28     if i<=(l) & j<=(l) then
29       Znew(i,j)=Zorg(i,j);
30     elseif i==l+1 & j==l+1 then
31       Znew(i,j) = Zb;
32     else
33       Znew(i,j) = Znew(i,j);
34     end;
35   end;
36 end;
37 Znew
38 end;
39
40
41
42 if check==2 then
43 bc=input('Enter the Bus number where Impedance is
      Connected : ')// Bus number where Impedance is
      Connected in between define matrix like 1 or 2 or
       3
44 Zb = input ('Enter value of Impidance between New
      Bus and existing Bus: ')//Impidance between New
      Bus and existing Bus like 10 or 20
45 l=max(size(Zorg));
```

```
46 row =Zorg(bc,:);
47 column =Zorg(:,bc);
48 for i = 1:l + 1
49     for j = 1:l + 1
50         if i<=l & j<=l
51             Znew(i,j)=Zorg(i,j);
52         elseif i==l+1
53 for p=1:l
54 Znew(i,p)=row(p);
55 end
56 elseif j ==l + 1
57 for q=1:l
58 Znew(q,j)=column(q);
59 end
60 end
61 if i ==l + 1 & j ==l + 1
62 Znew(i,j)=Zb+Zorg(bc,bc);
63 end
64 end
65 end
66 Znew
67 end
68
69 if check==4 then
70     aa = input('Enter the From Bus number where
          Impedance is Connected :')//From Bus number
          where Impedance is Connected in between
          define matrix like 2
71      bb = input('Enter the To Bus number where
          Impedance is Connected :')//  To Bus number
          where Impedance is Connected in between
          define matrix like 3
72 Zb = input ('Enter value of Impidance between
    existing Buses : ')// Impidance between existing
    Buses like 10 or 20
73      l = max(size(Zorg));
74
75              Zb_row = Zorg(aa,:)-Zorg(bb,:);
```

```
76                Zb_col = Zorg(:,aa)-Zorg(:,bb);
77      xy=((Zb_col*Zb_row)/(Zorg(aa,aa)+Zorg(bb,bb)+Zb
          -2*Zorg(aa,bb)));
78
79       Znew = Zorg-xy
80
81
82  end
83       if check==3 then
84            aa = input('Enter the Bus number where
                 Impedance is Connected to Reference :')
                  // Bus number where Impedance is
                 Connected to Reference like 1 or 2 or 3
85            Zb = input ('Enter value of Impidance
                 between Existing Bus and Reference: ')
                 // value of Impidance between Existing
                 Bus and Reference like 10 or 20
86       l = max(size(Zorg));
87
88                Zb_row = Zorg(aa,:);
89                Zb_col = Zorg(:,aa);
90      xy=((Zb_col*Zb_row)/(Zorg(aa,aa)+Zb));
91
92       Znew = Zorg-xy
93      end
94
95  //
96  //output:-
97  //
98  //For Type-1 Zbus Modification
99  //
100 //
101 //Enter Size of Z bus Matrix :3
102 // s  =
103 //
104 //     3.
105 //Enter 3 X 3 Matrix
106 //[1 2 3;4 5 6;7 8 9]
```

```
107 // Zorg  =
108 //
109 //     1.     2.     3.
110 //     4.     5.     6.
111 //     7.     8.     9.
112 //
113 // Enter 1 for Type 1  2 for Type 2 3 for Type 3 and
        4 for Type 4 Zbus m
114 //       odification
115 //Enter Your Choice :1
116 // check  =
117 //
118 //     1.
119 //Enter value of Impidance between New Bus and
       Reference:10
120 // Zb  =
121 //
122 //     10.
123 // Znew  =
124 //
125 //     1.     2.     3.     0.
126 //     4.     5.     6.     0.
127 //     7.     8.     9.     0.
128 //     0.     0.     0.     10.
129 //
130 //
131 //
132 //For Type-2 Zbus Modification
133 //
134 //
135 //Enter Size of Z bus Matrix :3
136 // s  =
137 //
138 //     3.
139 //Enter 3 X 3 Matrix
140 //[1 2 3;4 5 6;7 8 9]
141 // Zorg  =
142 //
```

```
143 //     1.     2.     3.
144 //     4.     5.     6.
145 //     7.     8.     9.
146 //
147 // Enter 1 for Type 1  2 for Type 2 3 for Type 3 and
        4 for Type 4 Zbus m
148 //       odification
149 //Enter Your Choice :2
150 // check  =
151 //
152 //     2.
153 //Enter the Bus number where Impedance is Connected
       : 2
154 // bc  =
155 //
156 //     2.
157 //Enter value of Impidance between New Bus and
       existing Bus: 15
158 // Zb  =
159 //
160 //     15.
161 // Znew  =
162 //
163 //     1.     2.     3.     2.
164 //     4.     5.     6.     5.
165 //     7.     8.     9.     8.
166 //     4.     5.     6.     20.
167 //
168 //For Type-3 Zbus Modification
169 //
170 //
171 //Enter Size of Z bus Matrix :3
172 // s  =
173 //
174 //     3.
175 //Enter 3 X 3 Matrix
176 //[1 2 3;4 5 6;7 8 9]
177 // Zorg  =
```

```
178 //
179 //     1.     2.     3.
180 //     4.     5.     6.
181 //     7.     8.     9.
182 //
183 // Enter 1 for Type 1  2 for Type 2 3 for Type 3 and
       4 for Type 4 Zbus m
184 //       odification
185 //Enter Your Choice :3
186 // check  =
187 //
188 //     3.
189 //Enter the Bus number where Impedance is Connected
      to Reference :3
190 // aa  =
191 //
192 //     3.
193 //Enter value of Impidance between Existing Bus and
      Reference: 20
194 // Zb  =
195 //
196 //     20.
197 // Znew  =
198 //
199 //     0.2758621     1.1724138     2.0689655
200 //     2.5517241     3.3448276     4.137931
201 //     4.8275862     5.5172414     6.2068966
202 //
203 //For Type-4 Zbus Modification
204 //
205 //
206 //Enter Size of Z bus Matrix :3
207 // s  =
208 //
209 //     3.
210 //Enter 3 X 3 Matrix
211 //[1 2 3;4 5 6;7 8 9]
212 // Zorg  =
```

```
213 //
214 //     1.     2.     3.
215 //     4.     5.     6.
216 //     7.     8.     9.
217 //
218 // Enter 1 for Type 1  2 for Type 2 3 for Type 3 and
        4 for Type 4 Zbus m
219 //       odification
220 //Enter Your Choice :4
221 // check  =
222 //
223 //     4.
224 //Enter the From Bus number where Impedance is
       Connected :2
225 // aa  =
226 //
227 //     2.
228 //Enter the To Bus number where Impedance is
       Connected :3
229 // bb  =
230 //
231 //     3.
232 //Enter value of Impidance between existing Buses :
       30
233 // Zb  =
234 //
235 //     30.
236 // Znew  =
237 //
238 //     0.90625     1.90625     2.90625
239 //     3.90625     4.90625     5.90625
240 //     6.90625     7.90625     8.90625
```

```
Enter Size of Z bus Matrix :3
 s  =

    3.
Enter 3 X 3 Matrix
[1 2 3;4 5 6;7 8 9]
 Zorg  =

    1.    2.    3.
    4.    5.    6.
    7.    8.    9.

 Enter 1 for Type 1  2 for Type 2 3 for Type 3 and 4 for Type 4 Zbus m
       odification
Enter Your Choice :1
 check  =

    1.
Enter value of Impidance between New Bus and Reference:10
 Zb  =

    10.
 Znew  =

    1.    2.    3.    0.
    4.    5.    6.    0.
    7.    8.    9.    0.
    0.    0.    0.    10.
```

```
Enter Size of Z bus Matrix :3
 s  =

    3.
Enter 3 X 3 Matrix
[1 2 3;4 5 6;7 8 9]
 Zorg  =

    1.    2.    3.
    4.    5.    6.
    7.    8.    9.

 Enter 1 for Type 1  2 for Type 2 3 for Type 3 and 4 for Type 4 Zbus m
       odification
Enter Your Choice :2
 check  =

    2.
Enter the Bus number where Impedance is Connected : 2
 bc  =

    2.
Enter value of Impidance between New Bus and existing Bus: 15
 Zb  =

    15.
 Znew  =

    1.    2.    3.    2.
    4.    5.    6.    5.
    7.    8.    9.    8.
    4.    5.    6.    20.
```

Figure 13.1: exp13

```
Enter Size of Z bus Matrix :3
 s  =

     3.
Enter 3 X 3 Matrix
[1 2 3;4 5 6;7 8 9]
 Zorg  =

     1.     2.     3.
     4.     5.     6.
     7.     8.     9.

 Enter 1 for Type 1  2 for Type 2 3 for Type 3 and 4 for Type 4 Zbus m
       odification
Enter Your Choice :3
 check  =

     3.
Enter the Bus number where Impedance is Connected to Reference :3
 aa  =

     3.
Enter value of Impidance between Existing Bus and Reference: 20
 Zb  =

     20.
 Znew  =

    0.2758621     1.1724138     2.0689655
    2.5517241     3.3448276     4.137931
    4.8275862     5.5172414     6.2068966
```

```
Enter Size of Z bus Matrix :3
 s  =

     3.
Enter 3 X 3 Matrix
[1 2 3;4 5 6;7 8 9]
 Zorg  =

     1.     2.     3.
     4.     5.     6.
     7.     8.     9.

 Enter 1 for Type 1  2 for Type 2 3 for Type 3 and 4 for Type 4 Zbus m
       odification
Enter Your Choice :4
 check  =

     4.
Enter the From Bus number where Impedance is Connected :2
 aa  =

     2.
Enter the To Bus number where Impedance is Connected :3
 bb  =

     3.
Enter value of Impidance between existing Buses : 30
 Zb  =

     30.
 Znew  =

    0.90625     1.90625     2.90625
    3.90625     4.90625     5.90625
    6.90625     7.90625     8.90625
```

Figure 13.2: exp13

Experiment: 14

Symmetrical Fault Analysis Using Scilab Programming

Scilab code Solution 14.14 exp14

```
1  //Experiment-14
2  // windows Vista - 32-Bit
3  //Scilab - 5.5.2
4
5
6  // Aim : Symmetrical Fault analysis using SCILAB
       programming
7
8  mode (0);
9
10 clc;
11 clear all;
12
13 SA = input('Enter Alternator Rating in kVA :');//
       Alternator Rating in kVA=10e3
14 XA = input('Enter Alternator % Reactance :');//
       Alternator % Reactance = 10%
15 ST = input ('Enter Transformer Rating in kVA :');//
       Transformer Rating in kVA =5e3
```

```
16 XT = input ('Enter Transformer % Reactance :');//
   Transformer % Reactance=5%
17 VL = input('Enter Transmission line Voltage in kV :'
   );// Transmission line Voltage in kV=10
18 XL = input('Enter Transmissin Line Reactance in Ohm
   :');// Transmissin Line Reactance in Ohm=4
19 RL = input ('enter Transmission Line Resistance in
   Ohm : '); // Transmission Line Resistance in Ohm
   =1
20
21 Base_kVA = max(SA,ST);
22
23 PXA = (Base_kVA/SA)*XA; // Percentage Reactance of
   Alternator
24
25 PXT = (Base_kVA/ST)*XT; // Percentage Reactance of
   Transformer
26
27 PXL = (Base_kVA*XL)/(10*VL*VL); // Percentage
   Reactance of Transmission line
28
29 PRL = (Base_kVA*RL)/(10*VL*VL); // Percentage
   Resistance of Transmission line
30 disp('Fault at F1 means at source side and Fault at
   F2 means at load side')
31 disp('Enter 1 for Fault at F1 or 2 for Fault at F2')
32
33 check = input('Enter Your Choice for Symatrical
   Fault in Transmission line : ')
34
35 if check==2 then
36
37 TX = PXA+PXT+PXL; // Total Percentage Reactance
38
39 TR = PRL; // Total Percentage Resistance
40
41 PZ = sqrt(TX*TX + TR*TR); // Total Percentage
   Impidance
```

```
42
43 Short_Circuit_kVA = Base_kVA*(100/PZ);
44 Short_Circuit_Current= Short_Circuit_kVA/(sqrt(3)*VL
   );
45 mprintf('Short Circuit kVA for Fault at F2 : %f kVA
   \n',Short_Circuit_kVA)
46 mprintf('Short Circuit Current for Fault at F2 : %f
   A \n',Short_Circuit_Current)
47 end
48
49 if check==1 then
50     TX = PXA+PXT; // Total Percentage Reactance
51
52 Short_Circuit_kVA1 = Base_kVA*(100/TX);
53 Short_Circuit_Current1= Short_Circuit_kVA1/(sqrt(3)*
   VL);
54 mprintf('Short Circuit kVA for Fault at F1 : %f kVA
   \n',Short_Circuit_kVA1)
55 mprintf('Short Circuit Current for Fault at F1 : %f
   A \n',Short_Circuit_Current1)
56 end
57
58
59 //output:-
60 //
61 //Symatrical Fault F1 at source side:
62 //
63 //Enter Alternator Rating in kVA :10e3
64 //Enter Alternator % Reactance :10
65 //Enter Transformer Rating in kVA :5e3
66 //Enter Transformer % Reactance :5
67 //Enter Transmission line Voltage in kV :10
68 //Enter Transmissin Line Reactance in Ohm :4
69 //enter Transmission Line Resistance in Ohm : 1
70 //
71 // Fault at F1 means at source side and Fault at F2
   means at load side
72 //
```

```
73 // Enter 1 for Fault at F1 or 2 for Fault at F2
74 //Enter Your Choice for Symatrical Fault in
      Transmission line : 1
75 // check =
76 //
77 //    1.
78 //Short Circuit kVA for Fault at F1 : 50000.000000
      kVA
79 //Short Circuit Current for Fault at F1 :
      2886.751346 A
80 //
81 //Symatrical Fault F2 at laod side:
82 //
83 //Enter Alternator Rating in kVA :10e3
84 //Enter Alternator % Reactance :10
85 //Enter Transformer Rating in kVA :5e3
86 //Enter Transformer % Reactance :5
87 //Enter Transmission line Voltage in kV :10
88 //Enter Transmissin Line Reactance in Ohm :4
89 //enter Transmission Line Resistance in Ohm : 1
90 //
91 // Fault at F1 means at source side and Fault at F2
      means at load side
92 //
93 // Enter 1 for Fault at F1 or 2 for Fault at F2
94 //Enter Your Choice for Symatrical Fault in
      Transmission line : 2
95 // check =
96 //
97 //    2.
98 //Short Circuit kVA for Fault at F2 : 16439.898731
      kVA
99 //Short Circuit Current for Fault at F2 : 949.157996
      A
```

```
Enter Alternator Rating in kVA :10e3
Enter Alternator % Reactance :10
Enter Transformer Rating in kVA :5e3
Enter Transformer % Reactance :5
Enter Transmission line Voltage in kV :10
Enter Transmissin Line Reactance in Ohm :4
enter Transmission Line Resistance in Ohm : 1

 Fault at F1 means at source side and Fault at F2 means at load side

 Enter 1 for Fault at F1 or 2 for Fault at F2
Enter Your Choice for Symatrical Fault in Transmission line : 1
 check  =

    1.
Short Circuit kVA for Fault at F1 : 50000.000000 kVA
Short Circuit Current for Fault at F1 : 2886.751346 A
```

Figure 14.1: exp14

```
Enter Alternator Rating in kVA :10e3
Enter Alternator % Reactance :10
Enter Transformer Rating in kVA :5e3
Enter Transformer % Reactance :5
Enter Transmission line Voltage in kV :10
Enter Transmissin Line Reactance in Ohm :4
enter Transmission Line Resistance in Ohm : 1

 Fault at F1 means at source side and Fault at F2 means at load side

 Enter 1 for Fault at F1 or 2 for Fault at F2
Enter Your Choice for Symatrical Fault in Transmission line : 2
 check  =

    2.
Short Circuit kVA for Fault at F2 : 16439.898731 kVA
Short Circuit Current for Fault at F2 : 949.157996 A
```

Figure 14.2: exp14