Power Systems Laboratory (EE3P006)

EXPERIMENT-1

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Aim of the Experiment:

To determine the positive sequence line parameters L & C per phase per kilometer of a single phase , three phase circuit transmission lines for differentconductor arrangements

1) **Calculate the loop inductance and capacitance of a 1 phase line with two parallel conductors spaced 3.5 m apart. The diameter of each conductor is 1.5 cm.**

Sol:

CODE

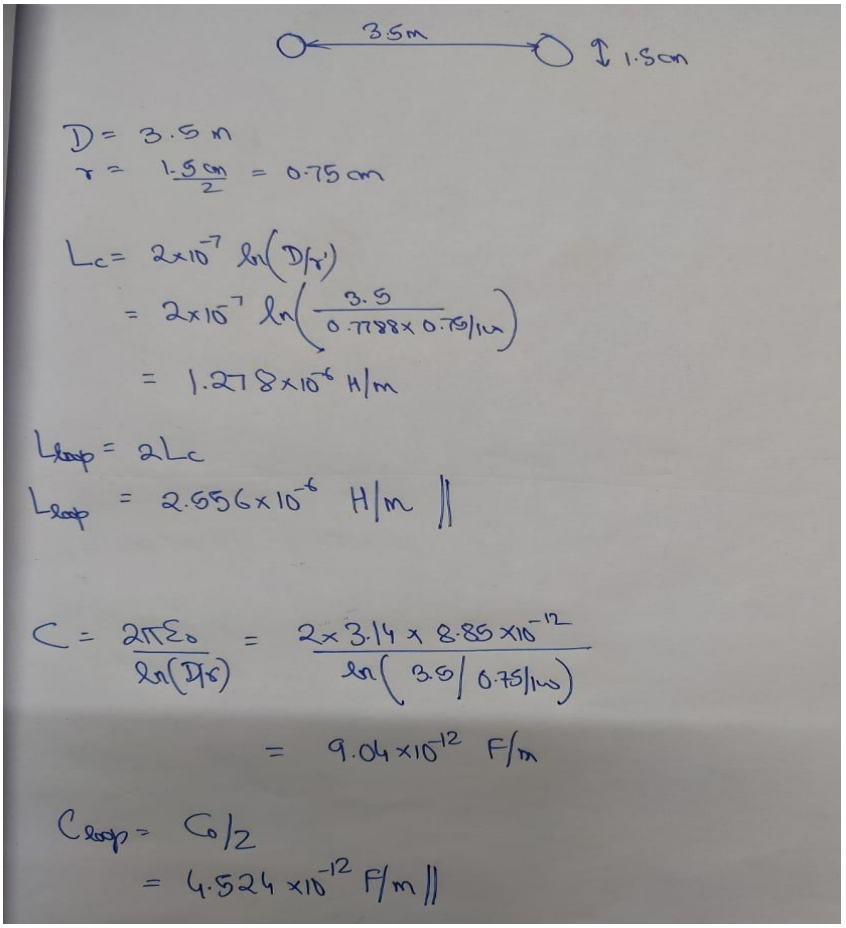
```
d=input('Enter diameter in cm');
r=d/2;
rad=r*10^-2;
D=input('Enter the distance between conductors in m');
r1 = 0.7788*rad;
L = (2e-7)*(log(D/r1)/log(exp(1)));
disp('INDUCTANCE(in H/m):');
disp(L);
C = 2*pi*8.85e-12/((log(D/r)/log(exp(1))));
disp('CAPACITANCE(in F/m):');
disp(C);
```

MATLAB OUTPUT

```
Enter diameter in cm:
1.5
Enter distance between conductors in m:
3.5
INDUCTANCE(in H/m):
   2.5582e-06

CAPACITANCE(in F/m):
   4.5261e-12
```

MANUAL CALCULATIONS



2) Calculate the inductance and capacitance of a conductor of a 3-phase system shown which has 1.2 cm diameter and conductors at the edge of an equilateral triangle of side 1.5 m.

Sol.

CODE

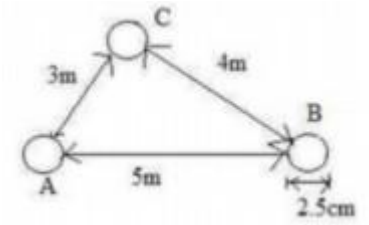
```
d=input('Enter diameter in cm');
r=d/2;
rad=r*10^-2;
D=input('Enter the distance between conductors in m');
r1 = 0.7788*rad;
L = (2e-7)*(log(D/r1)/log(exp(1)));
C = 2*pi*8.85e-12/((log(D/r)/log(exp(1))));
disp('INDUCTANCE(in H/m):');
disp(L);
disp('CAPACITANCE(in F/m):');
disp(C)
```

MATLAB OUTPUT

```
Enter diameter in cm:
1.2
Enter distance between conductors in m:
1.5
INDUCTANCE(in H/m):
   1.1543e-06

CAPACITANCE(in F/m):
   1.0075e-11
```

3) Calculate the inductance, capacitance and reactance of 3 phase 50 Hz over head transmission line which has conductors of 2.5 cm diameter. Distance between conductors are 5 m between A & B 4 m between B & C 3 m between C & A.Assume conductors are transposed regularly



Sol.

CODE

```
d=input('Enter diameter in cm');
r=d/2;
rad=r*10^-2;
Dab=input('Enter distance between conductors A & B in m:');
Dbc=input('Enter distance between conductors B & C in m:');
Dca=input('Enter distance between conductors A & C in m:');
r=input('Enter the radius of conductor');
r1 = 0.7788*rad;
D = (Dab*Dbc*Dca)^0.33;
disp('value of inductance');
L = (2e-7)*(log(D/r1)/log(exp(1)));
disp('INDUCTANCE(in H/m):');
disp(L);
C = 2*pi*8.85e-12/((log(D/r)/log(exp(1))));
disp('CAPACITANCE(in F/m):');
```

```
disp(C);
f=50;
XL=2*pi*f*L;
XC=1/(2*pi*f*C);
disp('INDUCTIVE REACTANCE(in ohm/m):');
disp(XL);
disp('CAPACITIVE REACTANCE(in ohm/m):');
disp(XC);
```

MATLAB OUTPUT

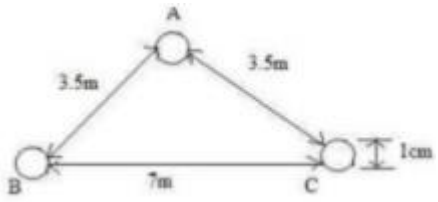
```
Enter diameter in cm:
2.5
Enter distance between conductors A & B in m:
5
Enter distance between conductors B & C in m:
4
Enter distance between conductors C & A in m:
3
Enter Frequency
50
INDUCTANCE(in H/m):
   1.1994e-06

CAPACITANCE(in F/m):
   9.6804e-12

INDUCTIVER REACTANCE(in ohm/m):
   3.7679e-04

CAPACITIVE REACTANCE(in ohm/m):
   3.2882e+08
```

4) Calculate the inductance and capacitance per phase of a 3-phase transmissionline as shown in figure. Radius of conductor is 0.5 cm. Lines are un-transposed.



Sol.

CODE

```
r= input ('enter the radius of the conductor in centimeter');
r=(r*0.7788)/100;
Dab= input('enter the distance between conductors A,B in meters'); Dbc=
input('enter the distance between conductors B,C in meters'); Dca=
input('enter the distance between conductors C,A in meters');
La=(2*10^-7)*(log(((Dab*Dca)^(1/2))/r)+1i*((3^(0.5))*log((Dab/Dca)^(0.5))));
Lb=(2*10^-7)*(log(((Dbc*Dab)^(1/2))/r)+1i*((3^(0.5))*log((Dbc/Dab)^(0.5))));
Lc=(2*10^-7)*(log(((Dca*Dbc)^(1/2))/r)+1i*((3^(0.5))*log((Dca/Dbc)^(0.5))));
disp('Inductance of the line A to ground in H per kilometer is :');
disp(La);
disp('Inductance of the line B to ground in H per kilometer is :');
disp(Lb);
disp('Inductance of the line C to ground in H per kilometer is :');
disp(Lc);
L = (La+Lb+Lc)/3;
disp('Avg Inductance of the line to ground in H per kilometer is :');
disp(L);
```

MATLAB OUTPUT

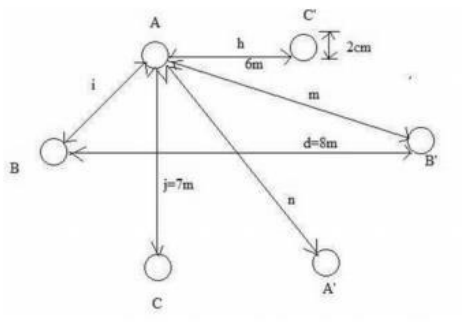
```
Inductance of the line A to ground in H per kilometer is :
   1.3602e-06

Inductance of the line B to ground in H per kilometer is :
   1.4295e-06 + 1.2006e-07i

Inductance of the line C to ground in H per kilometer is :
   1.4295e-06 - 1.2006e-07i


Avg Inductance of the line to ground in H per kilometer is :
   1.4064e-06 + 1.7647e-23i
```

5) Calculate inductance and capacitance per phase of a 3-phase double circuit as shown in the figure. Diameter of each conductor is 2 cm. Line is transposed.



Sol.

CODE

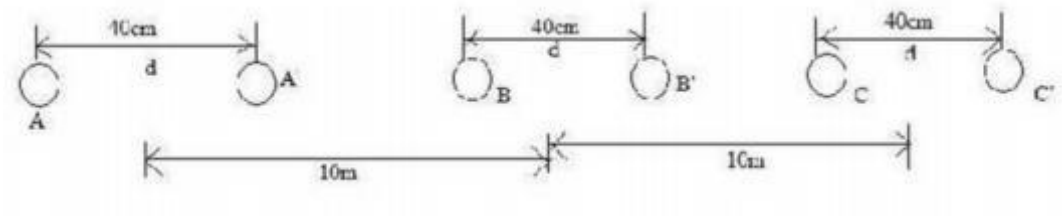
```
r= input ('enter the radius of the conductor in centimeter');
r = r/100;
Daa_ = input('Daa_');
Dbb_ = input('Dbb_');
Dcc_ = input('Dcc_');
Dab = input('Dab');
Dab_ = input('Dab_');
Da_b = input('Da_b');
Da_b_ = input('Da_b_');
Dbc = input('Dbc');
Dbc_ = input('Dbc_');
Db_c = input('Db_c');
Db_c_ = input('Db_c_');
Dca = input('Dca');
Dca_ = input('Dca_');
Dc_a = input('Dc_a');
Dc_a_ = input('Dc_a_');
r_ = 0.7788*r;
GMR_L= ((Daa_*Dbb_*Dcc_)^(1/6)*(r_^(1/2)));
GMR_C= ((Daa_*Dbb_*Dcc_)^(1/6)*(r^(1/2)));
GMD =(Dab*Dab_*Da_b*Da_b_*Dbc*Dbc_*Db_c*Db_c_*Dca*Dca_*Dc_a*Dc_a_)^(1/12);
L_double = 2*(10^(-7))*(log(GMD/GMR_L));
C_double = (2*pi*e0)/log(GMD/GMR_C);
L=L_double/2;
C=C_double*2;
disp('Inductance of the line to ground in H per kilometer is :');
disp(L);
disp('Capacitance of the line in F in per kilometer :');
disp(C);
```

MATLAB OUTPUT

```
Inductance of the line to ground in H per kilometer is :
   3.0800e-07

Capacitance of the line in F in per kilometer :
   3.7653e-11
```

6) **A 300 KV, 3 phase bundled conductor with sub-conductors per phase has a horizontal configuration as in the figure. Find inductance per phase and capacitance if the radius of each sub-conductor is 1.2 cm.**



Sol.

CODE

```
r=input ('enter the radius of the conductor in centimeter');
r=r/100;
d = input('distance between two conductors in each strand in meter');
% in general, in bundle conductors D+d= D-d = D;
% Because D>>d;
% D-> Dsistance each phase; d -> distance between conductors; D =
input('Distance between each phase in meter');
r_ = 0.7788*r;
GMR_L= ((d*r_*d*r_)^(1/4));
GMR_C= ((d*r*d*r)^(1/4));% 2-strand bundled circuit GMD =
((D*2*D*D*2*D)*(D*D*D*D)*(D*2*D*D*2*D))^(1/12);
% GMD =
(Dab*Dab_*Da_b*Da_b_*Dbc*Dbc_*Db_c*Db_c_*Dca*Dca_*Dc_a*Dc_a_)^(1/12); L =
(2*10^(-7))*(log(GMD/GMR_L));
C = (2*pi*e0)/log(GMD/GMR_C); Lloop = L/2;
Cloop = C*2;
disp('Inductance of the line to ground in H per kilometer is :');
disp(Lloop);
disp('Capacitance of the line in F in per kilometer :');
disp(Cloop);
```

MATLAB OUTPUT

```
Inductance of the line to ground in H per kilometer is :
   5.6748e-07

Capacitance of the line in F in per kilometer :
   2.0049e-11
```

CONCLUSION

We have determined the positive sequence line parameters L & C per phase perkilometer of a single phase , three phase circuit transmission lines for different conductor arrangements.