



20EEPL601	POWER SYSTEM SIMULATION	L	T	P	C
SDG NO. 4	LABORTARY	0	0	3	1.5

LIST OF EXPERIMENTS:

1. Computation of Transmission Line Parameters
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Power Flow Analysis using Gauss-Seidel Method.
4. Power Flow Analysis using Newton-Raphson Method
5. Symmetric and unsymmetrical fault analysis
6. Transient stability analysis of SMIB System
7. Economic Dispatch in Power Systems
8. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
9. State estimation: Weighted least square estimation
10. Electromagnetic Transients in Power Systems : Transmission Line Energization

TOTAL: 45 PERIODS

CONTENT BEYOND THE SYLLABUS

11. Methods of FACTS device
12. MATLAB Program to Solve Swing Equation using Point-by-Point Method



EXP.NO: 1 COMPUTATION OF TRANSMISSION LINES PARAMETERS

AIM :

- (i) To determine the positive sequence line parameters L and C per phase per kilometre of a three phase single and double circuit transmission lines for different conductor arrangements.
- (ii) To understand modeling and performance of medium lines.

SOFTWARE REQUIRED: MATLAB 8.1 / Mi POWER

THEORY :

Transmission line has four parameters – resistance, inductance, capacitance and conductance. The inductance and capacitance are due to the effect of magnetic and electric fields around the conductor. The resistance of the conductor is best determined from the manufactures data, the inductances and capacitances can be evaluated using the formula.

(A) INDUCTANCE:

The general formula:

$$L = 0.2 \ln (D_m / D_s)$$

where D_m = geometric mean distance (GMD)

D_s = geometric mean radius (GMR)

I) Single phase 2 wire system

$$GMD = D$$

$$GMR = r e^{-1/4} = r'$$

Where, r = radius of conductor

II) Three phase – symmetrical spacing

$$GMD = D$$



$$\text{GMR} = re^{-1/4} = r'$$

Where, r = radius of conductor

III.) THREE PHASE – ASYMMETRICAL TRANSPOSED:

GMD = geometric mean of the three distance of the symmetrically place

$$\text{conductors} = \sqrt[3]{D_{AB} D_{BC} D_{CA}}$$

$$\text{GMR} = re^{-1/4} = r'$$

Where, r = radius of conductors

IV) COMPOSITE CONDUCTOR LINES:

The inductance of composite conductor X_c , is given by

$$L_x = 0.2 \ln \left(\frac{\text{GMD}}{\text{GMR}} \right)$$

$$\text{GMD} = \sqrt[mn]{(D_{aa'} D_{ab'}) \dots (D_{na'} \dots D_{nm'})}$$

$$\text{GMR} = \sqrt[n^2]{(D_{aa} D_{ab} \dots D_{an}) \dots (D_{na} D_{nb} \dots D_{nn})}$$

$$\text{where, } r'_a = r_a e^{(-1/4)}$$

V) BUNDLE CONDUCTORS:

The GMR of bundle conductor is normally calculated

$$\text{GMR for two sub conductor } c = (D_s * d)^{1/2}$$

$$\text{GMR for three sub conductor } D_s^b = (D_s * d^2)^{1/3}$$

$$\text{GMR for four sub conductor } D_s^b = 1.09 (D_s * d^3)^{1/4}$$

where, D_s is the GMR of each sub conductor and d is bundle spacing

Three phase – Double circuit transposed:

The inductance per phase in milli henries per km is

$$L = 0.2 \ln (\text{GMD} / \text{GMR}_L) \text{ mH/km}$$

where



GMRL is equivalent geometric mean radius and is given by

$$GMRL = (D_S D_{SB} D_{SC})^{1/3}$$

$D_S D_{SB}$ and D_{SC} are GMR of each phase group and given by

$$D_S = \sqrt[4]{(D_s^b D_{a1a2})^2} = [D_s^b D_{a1a2}]^{1/2}$$

$$D_{SB} = \sqrt[4]{(D_s^b D_{b1b2})^2} = [D_{sb} D_{b1b2}]^{1/2}$$

$$D_{SC} = \sqrt[4]{(D_s^b D_{c1c2})^2} = [D_{sb} D_{c1c2}]^{1/2}$$

D_s^b = GMR of bundle conductor if conductor a_1, a_2, \dots are bundle conductors

$D_s^b = r_{a1}' = r_{b1} = r_{a2}' = r_{b2}' = r_{c2}'$ if a_1, a_2, \dots are bundle conductor

GMD is the equivalent GMD per phase" & is given by

$$GMD = [D_{AB} * D_{BC} * D_{CA}]^{1/3}$$

D_{AB}, D_{BC} & D_{CA} are GMD between each phase group A-B, B-C, C-A

Which are given by

$$D_{AB} = [D_{a1b1} * D_{a1b2} * D_{a2b1} * D_{a2b2}]^{1/4}$$

$$D_{BC} = [D_{b1c1} * D_{b1c2} * D_{b2c1} * D_{b2c2}]^{1/4}$$

$$D_{CA} = [D_{c1a1} * D_{c2a1} * D_{c2a1} * D_{c2a2}]^{1/4}$$

(B)CAPACITANCE

A general formula for evaluating capacitance per phase in micro farad per km of a transmission line is given by

$$C = 0.0556 / \ln (GMD/GMR) \text{ } \mu\text{F/km}$$

GMD is the "Geometric mean distance" which is same as that defined for inductance under various cases

PROCEDURE :

1. Enter the command window of the MATLAB.



2. Create a new M – file by selecting File - New – M – File
3. Type and save the program.
4. Execute the program by either pressing Tools – Run.
5. View the results.

Exercise:

1. A three phase overhead line 200km long $R = 0.16 \text{ ohm/km}$ and Conductor diameter of 2cm with spacing 4,5,6m transposed. Find A,B,C,D constants ,sending end voltage,current ,power factor and power when the line is delivering full load of 50MW at 132kV ,0.8 pf lagging , transmission efficiency , receiving end voltage and regulation.

PROGRAM :

```
ab=input('value of ab');
bc=input('value of bc');
ca=input('value of ca');
pr=input('receiving end power in mw');
vr=input('receiving end voltage in kv');
pfr=input('receiving end powerfactor');
l=input('length of the line in km');
r=input('resistance/ph/km');
f=input('frequency');
D=input('diameter in m');
rad=D/2;
newrad=(0.7788*rad);
deq=(ab*bc*ca)^(1/3);
L=2*10^(-7)*log(deq/newrad);
c=(2*pi*8.854*10^-12)/log(deq/rad);
XL=2*pi*f*L*l*1000;
rnew=r*l;
Z=rnew+i*(XL);
Y=i*(2*pi*f*C*l*1000);
A=1+((Y*Z)/2);
D=A;
```



```

B=Z;
C=Y*(1+(Y*Z)/4);
vrph=(vr*10^3)/1.732;
irol=(pr*10^6)/(1.732*vr*10^3*.8);
k=sin(acos(pfr));
ir=irol*(pfr-j*k);
vs=((A*vrph)+(B*ir));
is=((C*vrph)+(D*ir)); angle(vs);
angle(is);
f=angle(vs);
u=angle(is);
PFS=cos(f-u);
eff=((pr*10^6)/(3*abs(vs)*abs(is)*PFS))*100;
reg=((abs(vs)/abs(A))-abs(vrph))/abs(vrph))*100;
L
c
rnew
A
B
C
abs(vs)
abs(is)
angle(vs)*180/pi
angle(is)*180/pi
PFS
eff
reg

```

RESULT :

Thus the positive sequence line parameters L and C per phase per km, of a transmission line for different conductor arrangement was determined. Thus the modeling and performance of transmission line was understood.