**Exercise – 4.2**

Write a menu-driven **MATLAB m-code** to compute the inductance of a single-phase transmission line with

1. Solid conductors
2. Bundled conductors with
   1. 2 sub-conductors
   2. 3 sub-conductors
   3. General case

**M-code:**

% Ex-4.2 (Transmission System)

% Sambhav R Jain

% 107108103

clc;

clear all;

close all;

fprintf('Ex-4.2 Inductance of a single-phase transmission line\n');

fprintf(' - Sambhav R Jain (107108103)\n\n');

c = menu('Choose:','Solid conductors','Bundled conductors');

if c==1

D = input('Enter the distance (in metre) between the two solid conductors of a phase: ');

r1 = input('Enter the radius of conductor 1: ');

r2 = input('Enter the radius of conductor 2: ');

GMR1 = 0.7788\*r1;

GMR2 = 0.7788\*r2;

L = 2e-7\*log(D/GMR1) + 2e-7\*log(D/GMR2);

Lnew = L\*1e6;

disp('Loop Inductance (mH/km): '); Lnew

end

if c==2

d = menu('Choose:','2 sub-conductors','3 sub-conductors','General case');

switch d

case 1

fprintf('\*\*\*\* Enter specifics (in metre) of phase A sub-conductors \*\*\*\*\n');

r1 = input('Radius r1: ');

r2 = input('Radius r2: ');

D12 = input('Distance D12: ');

fprintf('\*\*\*\* Enter specifics (in metre) of phase B sub-conductors \*\*\*\*\n');

ra = input('Radius ra: ');

rb = input('Radius rb: ');

Dab = input('Distance Dab: ');

fprintf('\*\*\*\* Enter mutual distances (in metre) \*\*\*\*\n');

D1a = input('M1a: ');

D1b = input('M1b: ');

D2a = input('M2a: ');

D2b = input('M2b: ');

% Calculations

D11 = 0.7788\*r1;

D22 = 0.7788\*r2;

Daa = 0.7788\*ra;

Dbb = 0.7788\*rb;

MGMD = (D1a\*D1b\*D2a\*D2b)^(1/4);

SGMDa = (D11\*D12\*D12\*D22)^(1/4);

SGMDb = (Daa\*Dab\*Dab\*Dbb)^(1/4);

L = 2e-7\*log(MGMD/SGMDa) + 2e-7\*log(MGMD/SGMDb);

Lnew = L\*1e6;

disp('Loop Inductance (mH/km): '); Lnew

case 2

fprintf('\*\*\*\* Enter specifics (in metre) of phase A sub-conductors \*\*\*\*\n');

r1 = input('Radius r1: ');

r2 = input('Radius r2: ');

r3 = input('Radius r3: ');

D12 = input('Distance D12: ');

D23 = input('Distance D23: ');

D13 = input('Distance D13: ');

fprintf('\*\*\*\* Enter specifics (in metre) of phase B sub-conductors \*\*\*\*\n');

ra = input('Radius ra: ');

rb = input('Radius rb: ');

rc = input('Radius rc: ');

Dab = input('Distance Dab: ');

Dbc = input('Distance Dbc: ');

Dac = input('Distance Dac: ');

fprintf('\*\*\*\* Enter mutual distances (in metre) \*\*\*\*\n');

D1a = input('M1a: ');

D1b = input('M1b: ');

D1c = input('M1c: ');

D2a = input('M2a: ');

D2b = input('M2b: ');

D2c = input('M2c: ');

D3a = input('M3a: ');

D3b = input('M3b: ');

D3c = input('M3c: ');

% Calculations

D11 = 0.7788\*r1;

D22 = 0.7788\*r2;

D33 = 0.7788\*r3;

Daa = 0.7788\*ra;

Dbb = 0.7788\*rb;

Dcc = 0.7788\*rc;

MGMD = (D1a\*D1b\*D1c\*D2a\*D2b\*D2c\*D3a\*D3b\*D3c)^(1/9);

SGMDa = (D11\*D12\*D13\*D12\*D22\*D23\*D13\*D23\*D33)^(1/9);

SGMDb = (Daa\*Dab\*Dac\*Dab\*Dbb\*Dbc\*Dac\*Dbc\*Dcc)^(1/9);

L = 2e-7\*log(MGMD/SGMDa) + 2e-7\*log(MGMD/SGMDb);

Lnew = L\*1e6;

disp('Loop Inductance (mH/km): '); Lnew

case 3

m = input('Enter the no of sub-conductors in phase A: ');

n = input('Enter the no of sub-conductors in phase B: ');

fprintf('\*\*\*\* Enter specifics (in metre) of phase A sub-conductors \*\*\*\*\n');

for k = 1:1:m

Da(k,k) = input(sprintf('Radius r%d: ',k))\*0.7788;

end

for k = 1:1:m

for l = k+1:1:m

Da(k,l) = input(sprintf('Phase A --> Distance --> D%d%d: ',k,l));

Da(l,k) = Da(k,l);

end

end

fprintf('\*\*\*\* Enter specifics (in metre) of phase B sub-conductors \*\*\*\*\n');

for k = 1:1:n

Db(k,k) = input(sprintf('Radius r%d: ',k))\*0.7788;

end

for k = 1:1:n

for l = k+1:1:n

Db(k,l) = input(sprintf('Phase B --> Distance --> D%d%d: ',k,l));

Db(l,k) = Db(k,l);

end

end

fprintf('\*\*\*\* Enter mutual distances (in metre) \*\*\*\*\n');

for k = 1:1:m

for l = 1:1:n

M(k,l) = input(sprintf('Mutual: M%d%d: ',k,l));

end

end

MGMD = 1;

for k = 1:1:m

for l = 1:1:n

MGMD = MGMD\*M(k,l);

end

end

MGMD = MGMD^(1/(m\*n));

SGMDa = 1;

for k = 1:1:m

for l = 1:1:m

SGMDa = SGMDa\*Da(k,l);

end

end

SGMDa = SGMDa^(1/(m^2));

SGMDb = 1;

for k = 1:1:n

for l = 1:1:n

SGMDb = SGMDb\*Db(k,l);

end

end

SGMDb = SGMDb^(1/(n^2));

L = 2e-7\*log(MGMD/SGMDa) + 2e-7\*log(MGMD/SGMDb);

Lnew = L\*1e6;

disp('Loop Inductance (mH/km): '); Lnew

end

end

**Terminal Display:**

**Case 1: Bundled conductors – General case**

Ex-4.2 Inductance of a single-phase transmission line

- Sambhav R Jain (107108103)

Enter the no of sub-conductors in phase A: 4

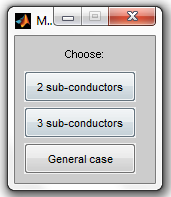
Enter the no of sub-conductors in phase B: 4

\*\*\*\* Enter specifics (in metre) of phase A sub-conductors \*\*\*\*

Radius r1: 4e-3

Radius r2: 4e-3

Radius r3: 4e-3

Radius r4: 4e-3

Phase A --> Distance --> D12: .3

Phase A --> Distance --> D13: .3

Phase A --> Distance --> D14: .4246

Phase A --> Distance --> D23: .4246

Phase A --> Distance --> D24: .3

Phase A --> Distance --> D34: .3

\*\*\*\* Enter specifics (in metre) of phase B sub-conductors \*\*\*\*

Radius r1: 4e-3

Radius r2: 4e-3

Radius r3: 4e-3

Radius r4: 4e-3

Phase B --> Distance --> D12: .3

Phase B --> Distance --> D13: .3

Phase B --> Distance --> D14: .4246

Phase B --> Distance --> D23: .4246

Phase B --> Distance --> D24: .3

Phase B --> Distance --> D34: .3

\*\*\*\* Enter mutual distances (in metre) \*\*\*\*

Mutual: M11: 2.3

Mutual: M12: 2.6

Mutual: M13: 2.31948

Mutual: M14: 2.61725

Mutual: M21: 2

Mutual: M22: 2.3

Mutual: M23: 2.02237

Mutual: M24: 2.31948

Mutual: M31: 2.31948

Mutual: M32: 2.61725

Mutual: M33: 2.3

Mutual: M34: 2.6

Mutual: M41: 2.02237

Mutual: M42: 2.31948

Mutual: M43: 2

Mutual: M44: 2.3

Loop Inductance (mH/km):

Lnew =

1.2368

**Case 2: Bundled conductors – 3 sub-conductors**

Ex-4.2 Inductance of a single-phase transmission line

- Sambhav R Jain (107108103)

\*\*\*\* Enter specifics (in metre) of phase A sub-conductors \*\*\*\*

Radius r1: .5

Radius r2: .5

Radius r3: .5

Distance D12: 2

Distance D23: 2

Distance D13: 2

\*\*\*\* Enter specifics (in metre) of phase B sub-conductors \*\*\*\*

Radius ra: .5

Radius rb: .5

Radius rc: .5

Distance Dab: 2

Distance Dbc: 2

Distance Dac: 2

\*\*\*\* Enter mutual distances (in metre) \*\*\*\*

M1a: 10

M1b: 9.165

M1c: 11.135

M2a: 11.135

M2b: 10

M2c: 12

M3a: 9.165

M3b: 8

M3c: 10

Loop Inductance (mH/km):

Lnew =

0.8619

**Case 3: Bundled conductors – 2 sub-conductors**

Ex-4.2 Inductance of a single-phase transmission line

- Sambhav R Jain (107108103)

\*\*\*\* Enter specifics (in metre) of phase A sub-conductors \*\*\*\*

Radius r1: .5

Radius r2: .5

Distance D12: 2

\*\*\*\* Enter specifics (in metre) of phase B sub-conductors \*\*\*\*

Radius ra: .5

Radius rb: .5

Distance Dab: 2

\*\*\*\* Enter mutual distances (in metre) \*\*\*\*

M1a: 10

M1b: 12

M2a: 8

M2b: 10

Loop Inductance (mH/km):

Lnew =

0.9670

**Case 4: Solid conductors**

Ex-4.2 Inductance of a single-phase transmission line

- Sambhav R Jain (107108103)

Enter the distance (in metre) between the two solid conductors of a phase: 10

Enter the radius of conductor 1: .5

Enter the radius of conductor 2: .5

Loop Inductance (mH/km):

Lnew =

1.2983

**Results:**

Hence a menu driven MATLAB m-code is written to compute the inductance of a single-phase transmission line comprising of both solid and bundled conductors.