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Exercise – 4.2

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

i. Solid conductors
ii. Bundled conductors with
    a) 2 sub-conductors
    b) 3 sub-conductors
    c) General case

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M-code:

```
% Ex-4.2 (Transmission System)
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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: ');
```

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```
        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
```

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```
            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
```

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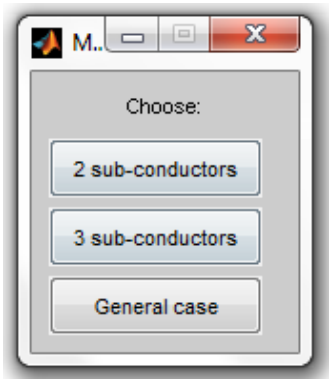
Terminal Display:

Case 1: Bundled conductors – General case




```
Ex-4.2 Inductance of a single-phase transmission line
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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
```

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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
```

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Case 4: Solid conductors

```
Ex-4.2 Inductance of a single-phase transmission line
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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.