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Exercise – 5.2

Assume that you are provided with the bus impedance matrix for the existing power system network with 'N' buses. If a new branch is to be added **between two existing buses**, write a MATLAB m-code to build the Z_{bus} matrix of the modified network.

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M-code:

```
% Ex-5.2 (Power Systems)
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clc;
clear all;
close all;

fprintf('Ex-5.2 Zbus building algorithm\n');
fprintf(' - Sambhav R Jain (107108103)\n\n');

N = input('Enter the number of buses in the existing power system: ');

for m = 1:1:N
    for n = m:1:N
        Z(m,n) = input(sprintf('Enter the z(%d,%d): ',m,n));
        Z(n,m) = Z(m,n);
    end
end

fprintf('\nThe Zbus matrix is: \n');
Zold = 1i*Z

j = input('Enter the bus subscript "j" where the new branch is to be added: ');
k = input('Enter the bus subscript "k" where the new branch is to be added: ');
Zb = input(sprintf('Enter the impedance to be added between bus %d and %d: ',j,k));

for p = 1:1:N
    Z(N+1,p) = Z(k,p) - Z(j,p);
end

for q = 1:1:N
    Z(q,N+1) = Z(q,k) - Z(q,j);
end

Z(N+1,N+1) = Z(k,k) + Z(j,j) -2*Z(k,j) + Zb;
Zeq = Z(N+1,N+1);

% Kron reduction
for m = 1:1:N
    for n = 1:1:N
        Z(m,n) = Z(m,n) - (Z(N+1,n)*Z(m,N+1)/Zeq);
    end
end

% To eliminate the (N+1)th row and column
for m = 1:1:N
    for n = 1:1:N
        Znew(m,n) = Z(m,n);
    end
end

fprintf('\nThe new Zbus matrix is: \n');
Znew = 1i*Znew
```

Terminal Display:

```
Ex-5.2 Zbus building algorithm
 - Sambhav R Jain (107108103)

Enter the number of buses in the existing power system: 3
Enter the z(1,1): 0.42
Enter the z(1,2): 0.28
Enter the z(1,3): 0.38
Enter the z(2,2): 0.52
Enter the z(2,3): 0.26
Enter the z(3,3): 0.53

The Zbus matrix is:

Zold =

        0 + 0.4200i        0 + 0.2800i        0 + 0.3800i
        0 + 0.2800i        0 + 0.5200i        0 + 0.2600i
        0 + 0.3800i        0 + 0.2600i        0 + 0.5300i

Enter the bus subscript "j" where the new branch is to be added: 2
Enter the bus subscript "k" where the new branch is to be added: 3
Enter the impedance to be added between bus 2 and 3: 0.4

The new Zbus matrix is:

Znew =

        0 + 0.4092i        0 + 0.3080i        0 + 0.3510i
        0 + 0.3080i        0 + 0.4473i        0 + 0.3355i
        0 + 0.3510i        0 + 0.3355i        0 + 0.4516i
```

Results:

Hence a MATLAB m-code is written to compute the new Z_{bus} matrix after adding a new branch between two existing buses in a power system network.