DELHI TECHNOLOGICAL UNIVERSITY

SCIENTIFIC COMPUTING (MC-204)

PRACTICAL FILE

SUBMITTED TO:
PROF. DINESH UDAR
MR. ANKIT SHARMA

SUBMITTED BY:
NITYA MITTAL
(2K19/MC/089)

EXPERIMENT 3

AIM

Write the MATLAB program of Gauss Seidel method for solving the system of linear equations.

THEORY

The Gauss-Seidel method (called Seidel's method by Jeffreys and Jeffreys 1988, p. 305) is a technique for solving the n equations of the linear system of equations $\mathbf{A}\,\mathbf{x} = \mathbf{b}$ one at a time in sequence, and uses previously computed results as soon as they are available,

$$x_i^{(k)} = \frac{b_i - \sum_{j<i} a_{i\,j}\, x_j^{(k)} - \sum_{j>i} a_{i\,j}\, x_j^{(k-1)}}{a_{i\,i}}.$$

There are two important characteristics of the Gauss-Seidel method should be noted. Firstly, the computations appear to be serial. Since each component of the new iterate depends upon all previously computed components, the updates cannot be done simultaneously as in the Jacobi method. Secondly, the new iterate $x^{(k)}$ depends upon the order in which the equations are examined. If this ordering is changed, the *components* of the new iterates (and not just their order) will also change.

In terms of matrices, the definition of the Gauss-Seidel method can be expressed as

$$\mathbf{x}^{(k)} = (\mathsf{D} - \mathsf{L})^{-1}\left(\mathsf{U}\,\mathbf{x}^{(k-1)} + \mathbf{b}\right),$$

where the matrices D, $-\mathsf{L}$, and $-\mathsf{U}$ represent the diagonal, strictly lower triangular, and strictly upper triangular parts of A, respectively.

The Gauss-Seidel method is applicable to strictly diagonally dominant, or symmetric positive definite matrices A.

SOURCE CODE

```
%gauss seidel method
clear all;
close all;


%the function
%20x + y - 2z = 17
%3x + 20y - z = -18
%2x - 3y + 20z = 25
disp("The equations:")
disp("20x + y - 2z = 17")
disp("3x + 20y - z = -18")
disp("2x - 3y + 20z = 25")
```

```
%the matrix
A=[20,1,-2;3,20,-1;2,-3,20];


%check variable initialized
check=1;


%checking for diagonally dominant matrix
for i=1:3
    sum=0;
    for j=1:3
        if(i~=j)
            sum=sum+abs(A(i,j));
        end
        if(abs(A(i,i))<sum)
            check=0;
            break;
        end
    end
end
%if matrix is diagonally dominant
if(check==1)
    disp("The matrix is diagonally dominant")
    %substitution for x y and z
    syms x y z;
    fx(y,z)=(17 - y + 2*z)/20;
    fy(x,z)=(-18-3*x+z)/20;
    fz(x,y)=(25-2*x+3*y)/20;


    %initial values
    x0=0;
    y0=0;
    z0=0;

    %applying the iteration 6 times
    for i=1:6
        x1=fx(y0,z0);
        y1=fy(x1,z0);
        z1=fz(x1,y1);
        x0=x1;
        y0=y1;
        z0=z1;
    end


    %rounding of the numbers
    X=round([x1;y1;z1]);
```

```
    disp('The column matrix X=[x;y;z] ')
disp(X)


else
disp("The matrix is not diagonally dominant")
end
```

OUTPUT

Case 1: Matrix is Diagonally Dominant

```
>> gauss_seidel
The equations:
20x + y - 2z = 17
3x + 20y - z = -18
2x - 3y + 20z = 25
The matrix is diagonally dominant
The column matrix X=[x;y;z]
 1
-1
 1
```

Case 2: Matrix is NOT Diagonally Dominant

```
>> gauss_seidel
The equations:
x + y - 2z = 17
3x + y - z = -18
2x - 3y + z = 25
The matrix is not diagonally dominant
```