ASSIGNMENT NO:9 **DATE:13/03/2015**

PROGRAM STATEMENT: **Solve the system of equations, by Gauss-elimination method,**

$$2x_1 + 3x_2 + x_3 = 9$$
$$x_1 + 2x_2 + 3x_3 = 6$$
$$3x_1 + x_2 + 2x_3 = 8$$

Correct upto 3-significant figures.

THEORY: It is a direct method for finding the solution or the values of unknown of a system of linear equations based on the principle of elimination of unknowns in successive steps .

Consider the following system of linear equations

$$\begin{aligned} 3x_1 + 6x_2 - 2x_3 + 2x_4 &= -22 \\ -3x_1 - 4x_2 + 6x_3 - 4x_4 &= 34 \\ 6x_1 + 16x_2 + x_3 + x_4 &= -33 \\ -6x_1 - 18x_2 - 2x_3 - 2x_4 &= 36 \end{aligned}$$

Writing a_{ij} for the coefficient of x_j in the ith equation and b_i for the right-hand side of the ith equation, this system can be written as

$$\sum_{j=1}^{n} a_{ij}x_j = b_i \qquad (1 \le i \le n) \tag{1}$$

with $n = 4$. To solve this system of equation, we write $m_{i1} = a_{i1}/a_{11}$, and subtract m_{i1} times the first equation from the ith equation for $i = 2, 3$, and 4. We have $m_{21} = -1$, $m_{31} = 2$, and $m_{41} = -2$. The following equations will result (the first equation is written down unchanged):

$$\begin{aligned} 3x_1 + 6x_2 - 2x_3 + 2x_4 &= -22 \\ 2x_2 + 4x_3 - 2x_4 &= 12 \\ 4x_2 + 5x_3 - 3x_4 &= 11 \\ -6x_2 - 6x_3 + 2x_4 &= -8 \end{aligned}$$

Write $a_{ij}^{(2)}$ for the coefficient of x_j in the ith equation. We will continue the above process: writing $m_{i2} = a_{i2}^{(2)}/a_{22}^{(2)}$ and subtract m_{i2} times the second equation from the ith equation for $i = 3$ and $i = 4$. We have $m_{32} = 2$ and $m_{42} = -3$. We obtain the equations

$$\begin{aligned} 3x_1 + 6x_2 - 2x_3 + 2x_4 &= -22 \\ 2x_2 + 4x_3 - 2x_4 &= 12 \\ -3x_3 + x_4 &= -13 \\ 6x_3 - 4x_4 &= 28 \end{aligned}$$

Write a_{ij}^{3} for the coefficient of x_j in the ith equation. Write $m_{43} = a_{43}^{(3)}/a_{33}^{(3)}$, and subtract m_{43} times the third equation from the fourth equation. We have $m_{43} = -2$, and the following equations result:

$$\begin{aligned} 3x_1 + 6x_2 - 2x_3 + 2x_4 &= -22 \\ 2x_2 + 4x_3 - 2x_4 &= 12 \\ -3x_3 + x_4 &= -13 \\ -2x_4 &= 2 \end{aligned}$$

This is the Gauss elimination and now we shall solve it to obtain the result.

PROGRAM CODE:

```
//C Program to Solve a System of equations by Gauss Elimination Method
#include <stdio.h>
#include <math.h>
int main()
{
      int n,i,j,k;
      printf("Enter the number of Equations and the number of variables::");
      scanf("%d",&n);
      printf("Enter the coefficients of the equations\n");
      double a[n][n+3],s;
      for(i=0;i<n;i++)
      {
            printf("Equation %d\n",i+1);
            for(j=0;j<=n;j++)
            {
                  scanf("%lf",&a[i][j]);
            }
      }
      for(i=1;i<=n;i++)
            printf("x%d\t",i);
      printf("b\tm\n");
      for(i=0;i<n-1;i++)
      {
            printf("Step %d\n",i+2);
            for(j=i+1;j<n;j++)
            {
```

```
                a[j][n+1]=-a[j][i]/a[i][i];
                for(k=0;k<=i;k++)
                      printf("\t");
                for(k=i+1;k<=n;k++)
                {
                      a[j][k]=a[j][k]+(a[j][n+1]*a[i][k]);
                      printf("%.3lf\t",a[j][k]);
                }
                printf("%.3lf\n",a[j][n+1]);
          }
     }
     printf("The Solutions are::\n");
     for(i=n-1;i>=0;i--)
     {
          s=0;
          for(j=i;j<=n;j++)
          {
                s=s+a[i][j]*a[j][n+2];
          }
          a[i][n+2]=(a[i][n]-s)/a[i][i];
          printf("x%d=%.3lf\n",i+1,a[i][n+2]);
     }
     return 0;
}
```

OUTPUT:

```
Enter the number of Equations and the number of variables::3
Enter the coefficients of the equations
Equation 1
2 3 1 9
Equation 2
1 2 3 6
Equation 3
3 1 2 8
x1    x2    x3    b     m
Step 2
      0.500 2.500 1.500 -0.500
      -3.500      0.500 -5.500      -1.500
Step 3
            18.000      5.000 7.000
The Solutions are::
x3=0.278
x2=1.611
x1=1.944
```