To develop a C-program to solve simultaneous system of Equations.

Gauss Elimination method: (Direct method).

Here n-Unknowns, by combining n-Equations in such a way that it reduced to an upper triangular system.

$$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + \cdots + a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \cdots + a_{2n}x_n = b_2$$
$$\vdots$$
$$a_{n1}x_1 + a_{n2}x_2 + a_{n3}x_3 + \cdots + a_{nn}x_n = b_n$$

a_{ij} & b_i are constants $x_1, x_2, \ldots x_n$ are the variables whose solution to be determined.

$$AX = B$$

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & & & \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix} \quad X = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix} \quad B = \begin{pmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{pmatrix}$$

Augmented matrix $[A, B]$

$$[A, B] = \left[\begin{array}{cccc|c} a_{11} & a_{12} & \cdots & a_{1n} & b_1 \\ a_{21} & a_{22} & \cdots & a_{2n} & b_2 \\ \vdots & & & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} & b_n \end{array}\right]$$

If $a_{11} \neq 0$ i.e. first column first row is non zero then multiply the first row by $-\frac{a_{i1}}{a_{11}}$ and add, it ith row of $[A, B]$

Except $\boxed{a_{11}}$, made the element below the first row in the first column ~~to~~ be zero.

Next come to 2nd row second column. Now consider the new a_{22} as b_{22} as the pivot element. We make all the elements below 2nd row, second column to be zero. Continue this process until you find all the elements below this leading diagonal to be zero.

i.e., After the elementary operations we will get the matrix of the form

$[A|B]$
$$\left[\begin{array}{ccccc|c} a_{11} & a_{12} & \cdots & & a_{1n} & b_1 \\ 0 & a_{22} & \cdots & & a_{2n} & b_2 \\ 0 & 0 & a_{33} & \cdots & a_{3n} & \vdots \\ 0 & \cdots & & 0 & a_{nn} & b_n \end{array}\right]$$

$x_1, x_2 \ldots x_n$ are Variables.

$AX = b$ $\quad a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n.$

$a_{21}x_1 + a_{22}x_2 + 0 \cdots + a_{2n}x_n.$

$\vdots$

$a_{nn}x_n = b_n$

$$x_n = \frac{b_n}{a_{nn}}.$$

code for gauss Elimination method :

```
1. Start
2. Input the augmented coefficient matrix - A.
   for i := 1 to n.
      for j = 1 to n+1.
    Read A_ij
   next j
   next i -
/* Apply gauss Elimination method */
   for ( i = 1 to n-1)
   {   if (a[i][i] = 0
       print (mathematical Error
        else
         exit(0)}
```

```
for (j = i+1 to n)
{ ratio = a[j, i] / a[i, i] ;
  for ( k = 1 ~~to~~ n+1 )
  { a[j, k] = a[j k] - ratio * a[i, k]
  }
}
```

4) Finding the solution by back substitution.

```
    x[n] = a[n, n+1] / a[n, n] ;
    for ( i = n-1 to 1 )
    { for ( j = i+1 to n )
```

```
  { x[i] = x[i] - a[i,j] * x[j];
    }
  }
5. Display the solution.
   for (j = 1 to n)
     { printf (x-values upto 3 decimal places
      }
6) End.
```

C - Program code:

```
# include <stdio.h>
# include <math.h>
# include <conio.h>
# define size [10]
int main ( )
{ float    a [size][size], x [size], ratio ;
   int    i, j, k, n ;
/* Reading the number of unknowns */
printf ("Enter the number of unknowns");
scanf ("%d", &n);
/* Read the augmented matrix */
   printf (" The elements of the augmented matrix ");
```

```
for (i = 1; i <=n ; i++)
{  for (j =1 ; j<=n; j++)
{ printf ("a[%d][%d] = ", i, j);
  scanf ("%f", &a[i][j]);
  }
}
/* Apply the Gauss elimination method */

for ( i = 1 ;  i <= n-1;  i++)
{    if (a[i][i] == 0)
   printf ("Mathematical Error");
  exit (0);
}   for( j = 1;j<= n j++)
```

```
{ ratio = a[j][i]/ a[i][i] ;
  for ( k=1; k<= n+1; k++)
  {      a[j][k]= a[j][k]— ratio *
                                  a[i][k]
  }
 }
}
}
/* Obtain the solution by back substitution
    x[n] = a[n][n+1]/ a[n][n];
      for ( i = n-1; i>=1; i-- )
```

```
{   x[i]= a[i][n+1];
    for(j=i+1;j<=n-1;j++)
    {   x[i]=  x[i]- a[i][j]
    }
/* Display the solution */
for(i=1; i<=n;  i++)
{ printf   ("x[%d]"=0.3f \n",
              i, x[i]);
}
  getch ();
  return(0);
              }
```

① $4x + y + 3z = 11$

$3x + 4y + 2z = 11$

$2y - 3y + z = 7$

$(1, 1, 2)$

② $4.12x - 9.68y + 2.01z = 4.93$

$1.86x - 4.62y + 5.50z = 3.11$

$1.10x - 0.96y + 2.72z = 4.92$

$(4.2075, 1.3327, 0.2466$