Assignment 2

1. Assume any 4 X 4 matrix such that the diagonal is dominant. Let the coefficients in each equation be widely differing (e.g. 100 x1+40 x2+10 x3 + x4). Assume any vector say {1,1,1,1} and generate the right hand vector. Now write a Gauss elimination algorithm without partial pivoting and solve the above problem. Now take the same matrix and rearrange the rows such that the diagonal dominance is destroyed. Resolve the problem and obtain the solution, and compare the obtained solution with that of the actual answer. Now also add partial pivoting to your algorithm and re-solve the problem. Comment on your results. (Note that the last part is only to automate pivoting whose solution would be same as part 1. In case of time constraints, this part can be skipped)

2. Write an algorithm to solve Problem 1 using Crout's method.

3. Write a tri-diagonal-matrix-algorithm(TDMA). Solve the following problem

$$\begin{bmatrix} -2 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & -2 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & -2 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & -2 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -2 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & -2 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & -2 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -2 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -2 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \\ x_8 \\ x_9 \end{Bmatrix} = \begin{Bmatrix} -1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -1 \end{Bmatrix}$$

Note that the value of each unknown in the above equation is 1

4. Solve the following system using the program developed in 1

$$\begin{bmatrix} 1 & 1/2 & 1/3 & 1/4 & 1/5 \\ 1/2 & 1/3 & 1/4 & 1/5 & 1/6 \\ 1/3 & 1/4 & 1/5 & 1/6 & 1/7 \\ 1/4 & 1/5 & 1/6 & 1/7 & 1/8 \\ 1/5 & 1/6 & 1/7 & 1/8 & 1/9 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{Bmatrix} = \begin{Bmatrix} 1+1/2+1/3+1/4+1/5 \\ 1/2+1/3+1/4+1/5+1/6 \\ 1/3+1/4+1/5+1/6+1/7 \\ 1/4+1/5+1/6+1/7+1/8 \\ 1/5+1/6+1/7+1/8+1/9 \end{Bmatrix}$$

Note that the exact answer is 1,1,1,1,1. Run the problem with both single and double precision. Comment on the results.