Assignment - 2

Course: *Engineering Computing Laboratory, ME*-502

Problem 1

Write a program to solve the following systems of linear equations using simple Gauss elimination. Program must print the following:
(i) The final augmented matrix after forward elimination (upper triangular form).
(ii) Whether a system has unique solution, multiple solutions, or no solutions.
(iii) If a unique solution exists, print the solution.

(a)
$$x - 2y + z = 3$$
$$-4x + 7y - 2z = 2$$
$$-3x + 5y - z = -4$$

(b)
$$x - 2y + z = 3$$
$$-4x + 7y - 2z = 2$$
$$2x - 3y + z = -4$$

(c)
$$x - 2y + z = 3$$
$$-4x + 7y - 2z = 2$$
$$-3x + 5y - z = 5$$

(d)
$$2x + 3y + z - 11w = 1$$
$$2x - 2y + 6z - 6w = 6$$
$$3x + 4y - 7z + 2w = -7$$
$$5x - 2y + 5z - 4w = 5$$

(e)
$$5x + 2y - z = 7$$
$$-15x + y - 2z - 3w = 0$$
$$x + y + w = 6$$
$$-5x + 5y - 10z + 8w = 26$$

Instructions: The code has to be written such that the coefficients of augmented matrix of each system are read from each input text file, and the required outputs are printed in corresponding output text file. The names of input text files for each sub-question of problem-1 should be '**input_1a.txt**', '**input_1b.txt**', '**input_1c.txt**' , '**input_1d.txt**' and '**input_1e.txt**'. Correspondingly the names of the output text files should be '**output_1a.txt**', '**output_1b.txt**', '**output_1c.txt**', '**output_1d.txt**' and '**output_1e.txt**'. There should be a single C program file for problem-1. The name of the C program file should be '**problem_1.c**'.

marks: 25

Problem 2

Write a program to solve the following system of linear equations using Gauss elimination with zero diagonal element situation. The program should be able to handle the situation where a zero pivot element is encountered. The program must print the following:
(i) The final augmented matrix after forward elimination (upper triangular form).
(ii) The solution.

$$4x + 2y + 6z = 19$$
$$2x + y - 7z = -1$$
$$10x - 3y + 7z = 15$$

Instructions: The code has to be written such that the coefficients of augmented matrix of the above system are read from an input text file, and the required outputs are printed in an output text file. The name of input text file for problem-2 should be '**input_2.txt**', and the name of the output text file should be '**output_2.txt**'. The name of the C code file should be '**problem_2.c**'.

marks: 15

Problem 3

Write a program to solve the following system of linear equations using Gauss elimination incorporating partial pivoting. The program must print the following:
(i) The final augmented matrix after forward elimination (upper triangular form).
(ii) The solution.

$$25x + 5y + z = 106.8$$
$$64x + 8y + z = 177.2$$
$$144x + 12y + z = 279.1$$

Hint for partial pivoting:

- Incorporate two nested loops

- First loop is to compare the pivot element with the elements below it in that column, to find the largest element.

- If a largest element is found, the second loop interchanges the pivot row with the one containing this largest element.

Instructions: The code has to be written such that the coefficients of augmented matrix of the above system are read from an input text file, and the required outputs are printed in an output text file. The name of input text file for problem-3 should be '**input_3.txt**', and the name of the output text file should be '**output_3.txt**'. The name of the C code file should be '**problem_3.c**'.

marks: 20