ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2022-2023
DURATION: 3 HOURS   FULL MARKS: 150

CSE 4107: Structured Programming I

Programmable calculators are not allowed. Do not write anything on the question paper.
Answer all 6 (six) questions. Figures in the right margin indicate full marks of questions whereas
corresponding CO and PO are written within parentheses.

1. a) In earlier days, applicants had to apply for admission in IUT using SMS. The format for the   10
   SMS was "IUT <First 3 letters of HSC education board> <HSC Roll> <HSC Passing Year>   (CO3)
   <First 3 letters of SSC education board> <SSC Roll> <SSC Passing Year>". Each part of the   (PO1)
   SMS will be separated by a space. A sample SMS is given below:

   IUT DHA 216754 2018 DHA 206543 2016

   Write a function named `validate()` which receives a string as an argument representing
   the whole SMS and returns 1, if the SMS is valid, otherwise it returns 0. The SMS will be
   valid if the word is "IUT", both SSC and HSC board is "DHA" (all must be capital letters),
   and the HSC passing year is at-least 2 years higher than SSC passing year.

   b) Assume a 2-dimensional array is used to store the applicant's ID and the total marks ob-   6 + 9
   tained in selected subjects (Physics, Chemistry, Mathematics, and English). Now, answer   (CO3)
   the following questions: (PO1)

   i. Write a function that receives an integer and a reference to a 2-dimensional array as ar-
   guments. The integer indicates the total number of applicants and each row of the array
   contains information of each candidate (applicant's ID and total marks). The function
   will sort the array based on the total marks for each applicant.

   ii. Write a function that identifies the list of applicants selected for the admission test. The
   function receives the sorted array, selects atleast first 8000 applicants, and stores their ID
   in another array. The first element of that array will be number of applicants selected.
   Note that all the applicants having same marks as 8000th applicant must be selected as
   well. For example: consider the following sorted array given in Table 1.

   Table 1: Sample Array for Question 1.b)

102	99
101	97
105	96
104	96
103	55

   Now, if you are asked to select top 3 students, in that case you have to select the 4th stu-
   dent as well, as his mark is same as 3rd student's mark. So the content of the resultant
   array will be: [4, 102, 101, 105, 104].
   The function will return the reference to the array used to store the selected applicants.

2. a) IUT auditorium is one of the several venues for the admission test. It can accommodate 600 applicants. The seats in the auditorium are arranged in 30 rows and 20 columns. Assume that you and your friend both got the seats in IUT auditorium. You want to calculate how far you are from each other. The distance is determined by summing the differences between their respective row and column positions.

   Write a user-defined function that receives the seat plan, your ID, and your friend's ID as arguments and returns the distance. (CO3) (PO1)

   b) The admission test consists of 100 Multiple-Choice Questions (MCQs) with four options for each (a, b, c, d). For each correct answer, one mark is awarded and for each incorrect answer, 0.25 marks are deducted. Unanswered questions receive no penalty. You need to write a function that takes two strings as arguments: one representing the applicant's answers (including 'x' for unanswered questions) and an other containing the correct answers. The function calculates and returns the marks obtained by the applicant based on the specified scoring system. (10) (CO3) (PO1)

   c) A unique student ID is assigned to each student when they register for a program. The digits of a student's ID represent various information. For example: first 2 digits indicate the batch number, the fourth and fifth digits combinedly indicate the department (01-MPE, 02-EEE, 03-CSE, 04-CSE, 05-CEE, 06-BTM), the third digit from the last indicates the section, etc. Given a student ID as an **integer** input, your task is to print the batch number, department, and section of that student. A sample input-output is given in Table 2. (6) (CO3) (PO1)

   Table 2: Sample input-output for Question 2.c)

Input	Output
220042112	Batch: 22, Department: CSE, Section: 1
210021213	Batch: 21, Department: EEE, Section: 2

3. a) Students submit digital pictures named with their student IDs (e.g., 220042112.jpg). An automated process is needed to generate 20 copies of each image to create backup, following the naming convention "id_backup1.jpg", "id_backup2.jpg", ..., "id_backup20.jpg" to create backups. (14) (CO3) (PO2)

   Write a function that takes a student ID as an argument and makes 20 copies of the picture of that particular student following the naming style mentioned earlier.

   b) Student's personal information is stored in a CSV file named "info.csv" with fields including Student ID (integer), Student name (string, up to 100 alphanumeric characters), Phone number (string, up to 20 characters), and CGPA (fractional value) separated by a comma. Answer the following questions: (3 + 4 + 4) (CO3) (PO2)

      i. Declare a structure that can store the information of a student and create an array of that structure to store the information of 2000 students.

      ii. Write a function named `load()` that reads the information of 2000 students from the "info.csv" file and stores it into the structure array passed as its argument.

      iii. Write a function named `save()` that overwrites the current content of the "info.csv" file with the information of 2000 students which are passed as an argument to the function.

4. a) Consider the Code Snippet 1, written by a novice programmer as an attempt to display 5
   "hello_world" to console. (CO2)
   (PO2)

```
1  #include <stdio.h>
2  int main()
3  {
4       hello_world("printf()");
5       return 0;
6  }
```

Code Snippet 1: A C program for Question 4.a)

Your task is to add necessary codes in this program without adding, removing, or modifying anything inside the main() function, so that the program displays "hello_world" to the console.

b) In C programming, variable names must follow specific rules. Beginners sometimes write 10
   invalid variable names. Your task is to create a function that takes a variable name (poten- (CO2)
   tially invalid) as an argument. The function removes invalid characters without altering (PO2)
   the character sequence in given string and prints the passed valid variable name.
   Some sample input-output is given in Table 3.

Table 3: Sample input-output for Question 4.c)

Input	Output
variable#1	variable1
12v@riaBle_2	vriaBle_2

c) In a lab task, students are required to write a program featuring a recursive function that 10
   calculates the sum of the digits of an integer. Code Snippet 2 attempts to provide a solution, (CO2)
   but the lines of the program are not arranged in the correct order. Rearrange them to produce (PO2)
   the desired output.

```
1  #include<stdio.h>
2  int f1(int num);
3  int f1(int num);
4  int main(){
5  int x, num;
6  int x;
7  scanf("%d",&num);
8  num /= 10;
9  x += f1(num);
10 x = f1(num);
11 x = num%10;
12 x = 0;
13 if(!num)
14 if(num){
15 printf("%d",x);
16 return x;
17 return 0;
18 }
19 }
20 }
```

Code Snippet 2: A C program with incorrect line order for Question 4.c)

5. a) The CSE department has chosen to host a picnic and Mr. Khan is responsible for recording the first names, while Mr. Ahmed records the last names of the participants. Mr. Khan's keyboard does not allow the typing of vowels and Mr. Ahmed's keyboard is stuck in uppercase. Develop a user-defined function that, when given a participant's first and last name as arguments, displays the stored name, accounting for the specific keyboard limitations. Sample behavior of the function is given in Table 4. *(10, CO2, PO2)*

Table 4: Sample behavior of the user-defined function for Question 5.a)

Input		Output
First Name	Last Name	
Kamal	Khan	Kml KHAN
Omi	Azad	m AZAD

b) In response to ongoing strike and road blockade issues, the CSE department is considering postponing the picnic. To assist in the decision-making, write a function to analyze a given news string for the occurrences of the words "strike" and "blockade". If the combined count of these words exceeds one hundred, the function returns 1, indicating the picnic should be cancelled; otherwise, it returns 0. *(10, CO3, PO1)*

c) The organizer for the picnic will be the person whose name comes first in the lexicographically sorted list of participants. Write a function that takes the list of all participants as an argument and prints the name of the organizer. *(5, CO3, PO1)*

6. a) Students final grade in a course is determined from four quizzes, a mid-term exam, and a semester final exam. The marks for each student are stored using a structure. As new students may enroll throughout the semester, rather than using a fixed-size array, the course teacher has chosen dynamic memory allocation for storing the marks for the students. Now, answer the following questions: *(5 + 5, CO3, PO2)*
   i. Write a program that dynamically allocates the memory to store 100 student's marks.
   ii. Extend the previously allocated memory so that 5 additional students' information can be stored.

b) The final grade is calculated by adding the marks of mid-term, final, attendance, and the marks of best of 3 quizzes. Consider the simplified grading policy given below: *(10, CO3, PO2)*
   - 80-100 percents is: A+
   - 70-79 percent is: A
   - 60-69 percent is: B
   - 50-59 percent is: C
   - 40-49 percent is: D
   - below 40 percent is: F

   Write a function that takes all the marks (including all 4 quiz marks) of a student as an argument and prints the final grade.

c) The course teacher of the Structured Programming course has given an encrypted message to all the students. Each character of the message is encrypted by reversing the rightmost bit of the binary representation of each character. The message is given below: *(5, CO3, PO2)*
   CDRU!NG1MTBJ!@OE!RNSSX!GNS!UID!DYUS@!BM@RR
   Your task is to write a program that reads the encrypted message and decrypts it to print the original message.