The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

Department	: Computer Science
Level	: 03
Name of the Examination	: Final Examination (2nd Semester)
Course Title and - Code	: Data structures and Algorithm - CSU3302/CPU1142
Academic Year	: 2024/2025
Date	: 11.05.2025
Time	: 9.30 am -11.30 am
Duration	: Two hours only

General Instructions

1. Read all instructions carefully before answering the questions.

2. This question paper consists of (06) questions in (06) pages.

3. Answer any **four (04)** questions only. All questions carry equal marks.

4. Answer for each question should commence from a new page.

5. **Involvement in any activity that is considered as an exam offense will lead to punishment**

6. Use blue or black ink to answer the questions.

7. Clearly state your index number in your answer script.

8. If answer more than four (4) questions, the last answer/s will cut off without marking.

Answer Four (4) questions only.

Question No. 01

1. A. What is a Data Structure? (3 Marks)
   B. What are the two requirements that need to be considered when selecting a suitable data structure? (2 Marks)
   C. Give a simple example of a Data Structure. (1 Mark)

2. What are the two types of Heap structure? (2 Marks)

3. What will be the output of the following programs?

A. ```c
#include <stdio.h>
void display();
int n = 5; // global variable
int main()
{
    ++n;
    printf("In main function n = %d\n",n);
    display();
    return 0;
}
void display()
{
    ++n;
    printf("In display function n = %d", n);
}
```
(4 Marks)

B. ```c
#include <stdio.h>
int main() {
int x = 10;
int *ptr;
ptr = &x;

printf("Value of x = %d\n", x);
printf("Value of *ptr = %d\n", *ptr);
*ptr = 20;
printf("Value of x = %d\n", x);
printf("Value of *ptr = %d\n", *ptr);
return 0;
}
```
(4 Marks)

4. A **Doubly linked list** is a linked list that allows bi-directional traversal. In a doubly linked list, each node has three fields, namely the information-holding field, and the left and right fields that contain pointers to nodes in either side.

   A. Write the structure definition for a node in a Doubly linked list.
   B. Declare a Doubly linked list with the name 'Dnode' using the previously defined structure.
   C. Allocate memory for a node named 'newnode' in the list dynamically.

(9 Marks)

Question No. 2

1. **Stack** is an Abstract Data Type that can be considered as a special kind of list. It can be implemented using Arrays or Pointers. When implementing a STACK using an array, it needs to define the size of the array first. Consider the following code segment in C language.

```
#define STACKSIZE 100
struct myStack
{
        int top;
        int items[STACKSIZE];
}
struct myStack MySTACK;
```

Write functions in C language to perform the following tasks:

A.   PUSH an element to the STACK: MySTACK . (When you insert an element, it needs to check whether the stack is full)   (6 Marks)

B.   POP an element from the MySTACK. (When you delete an element, it needs to check whether the stack is empty).   (6 Marks)

2. A. Construct a Strictly Binary tree to represent the following expression

$$(a + (b * c) + d * (e + f))$$

(7 Marks)

B. Write down three different forms of expressions (prefix, infix, postfix) by traversing the tree constructed above in a pre-order, in-order, and post-order manner.

(6 Marks)

Question No. 3.

1. Using **Big O** notation in Asymptotic Analysis, determine the running time of the following C program segments. State any assumptions you make.

A.   sum = 0;
for(i = 0; i < n; i++)
sum++;

(2 Marks)

B. scanf("%d", &n);
    for (i=o; i<n; i++)
        for (j=0; j<n; j++)
            printf("%d %d \n", i, j);   (4 Marks)

2. A. What is the difference between Internal sorting and External sorting   (2 Marks)

B. State the three types of Internal Sorting Algorithms.   (3 Marks)

C. Sort the following numbers using the **Bubble Sort Algorithm**.
        53, 88,24, 63, 39, 82, 35,74, 25   (9 marks)

3. A. What are the two types of recursions?   (2 Marks)
   B. What do you mean by 'Base case' in Recursive Algorithms?   (3 Marks)

Question No. 4

1. Create a **Singly Linked List** by performing the following steps.
    A. Define a structure for a node in a Singly Linked List.
    B. Declare a List using the previously defined data structure.
    C. Allocate memory (dynamically) for a node in the list.
    D. Create the list with the value 135 as the first value.   (13 Marks)

2.In a **GRAPH** Data structure. what do you mean by
    A. Directed Graph
    B. Weighted Graph
    C. Complete Graph
    D. State two Graph representation methods, most commonly used.
                                                        (12 Marks)

Question No. 5.

1. A Circular Linked List is useful in applications where the end of the list naturally reconnects to the beginning.

    A. What is the difference between a **Singly Linked List** and a **Circular Linked List**?

4

B. Use the following structure definition in the C language for a node in a **Circular Linked List.**

```
struct node
{
        int info;
        struct node *next;
};
typedef struct node circnode;
```

Write a function named 'createCList' to create a Circular linked list. (It needs to allocate memory for a node dynamically and check for the availability of memory).

(15 Marks)

2. There are many different methods to design algorithms. State three of them.

(3 Marks)

3. What do you mean by Hashing?

(2 Marks)

4. Define a complete binary tree. Is the following tree a complete binary tree? Give reasons.
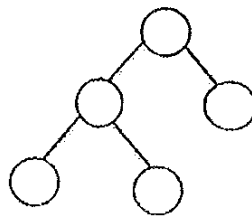
(5 Marks)

Question No. 6

1. Consider the following structure definition and answer the questions below.

```
#define SIZE 15
struct mystruct
{
        int front;
        int rear ;
        int info[SIZE];
```

5

/6·3