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**
Academic Year	**: 2023/2024**
Date	**: 28.03.2024**
Time	**: 1.30 pm -3.30 pm**
Duration	**: Two hours only**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Six (06)** questions in **Seven (07)** 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. Draw fully labelled diagrams where necessary.
6. Any involvement in activities considered as exam offenses will result in punishment.
7. Use blue or black ink to answer the questions.
8. Clearly state your **index number** in your answer script.

Question No.1

1. Write down two steps you need to follow when selecting a suitable data structure.

(4 Marks)

2. Define an array data structure for the following situation.

   One dimensional array to store marks of 100 students. Array name should be **Marks** and marks does not contain any fractional part.

(3 Marks)

3. Mention an example for an Abstract Data Type (ADT). Specify three operations on that ADT.

(4 Marks)

4. In our everyday life we come across many situations where we have to wait in a queue to get some service done. The service is provided according to the order in which people joined the queue – **FIFO**. A queue is a special kind of list where people joined at one end known as **rear** end and removing from the other end known as **front** end. Queues can be implemented in a computer as either an array implementation or a pointer implementation.

   Write code in C programming language to implement a queue by answering the following questions.

   a. Create a suitable data structure to implement a **queue as an array implementation** (you need to define the array size as 15). The structure should contain members to store the **front** and **rear** positions of the **queue** and an **array** to hold numeric data items of type **int** in the queue.

   (2.5 Marks)

   b. Using the structure that you created in section(a) above, declare a queue with the name "**myqueue**".

   (1.5 Marks)

   c. Write a function in C to **insert** a data item into "**myqueue**". Use **void insertQueue(int x)** as the function header. (Check the queue overflow condition before you inserting a data item).

   (5 Marks)

   d. Write a function in C to **delete** a data item from "**myqueue**". Use **int deleteQueue()** as the function header (check queue underflow condition before you are deleting a data item.)

   (5 Marks)

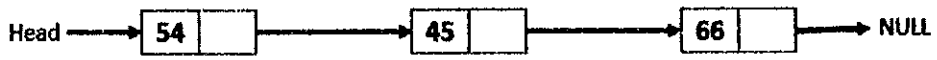
(Total 25 Marks)

Question No. 2

1. State two advantages of Circular Linked List over the Singly Linked List.

   (2 Marks)

2. The following diagram shows a singly linked list with 3 nodes.



   The following 1- 4 steps show how to insert the value 78 to the end of the singly linked list, given above.

   1st step: Allocate memory for the new node.
   2nd step: Assign the value to the data field of the new node.
   3rd step: Make the link field of the new node to point NULL.
   4th step: Then set the NULL pointer of the existing last node points to the (contains the address of the new node) new node.

   a) Write down the program segments for the above 1 to 4 steps. (4 Marks)

b) Draw an appropriate diagram for the above scenario. (2 Marks)

3. What will be the output of the following code if we input 5 for n?
(you need to write all output statements as it is)

(5 Marks)

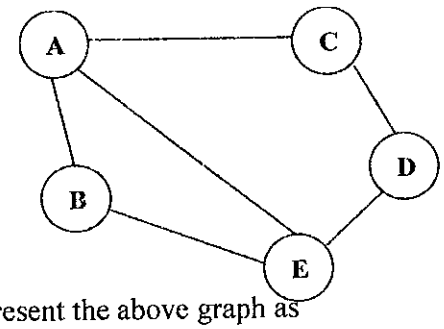
```
#include <stdio.h>
void display();

int n;        // global variable

int main()
{
   printf("Input value for n:");
   scanf("%d", &n);
   ++n;
   printf("In main n = %d\n", n);
   display ();
   return 0;
}

void display()
{
   ++n;
   printf("In display function n = %d", n);
}
```

4.



Represent the above graph as

1. Adjacency Matrix
2. Adjacency List

(12 Marks)

(Total 25 Marks)

Question No. 3

1. Briefly explain what 'Algorithm' means.

(2 Marks)

2. How can we compare two algorithms written for the same problem and select the better one?

(4 Marks)

3. Following is a function in C programming language for some operation.

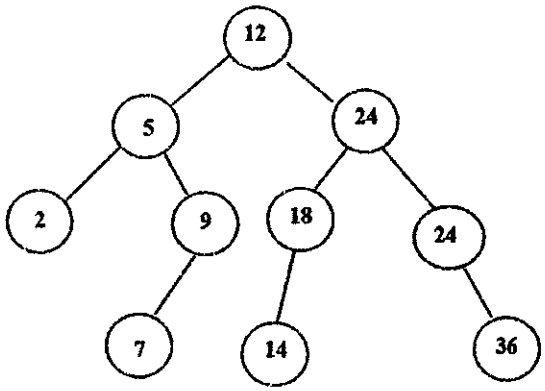
```
int push(int x)
{
        if (mystk.top == stksize - 1)
        {
                printf("stack is full\n");
                return(1);
        }
        else
        {
        mystk.top = mystk.top +1;
        mystk.data[mystk.top] =x;
        }
}
```

By analyzing the above function answer the following questions.

a) What is the data structure that this function belongs to? (2 Marks)

b) What type of implementation method is used to create the data structure? (2 Marks)

c) Which type of operation can be performed using the above function? (4 Marks)



4. Considering the following Tree, answer the below questions.

a) Is this tree a Strictly Binary Tree? (1 Mark)

b) What is the Root Node of the tree? (1 Mark)

c) Mention the leaf nodes in the tree. (2 Marks)

d) Write down the siblings of node 18 and node 5. (2 Marks)

e) Is this Tree a Binary Search Tree? (1 Mark)

f) Explain the reason for your answer in previous question (Part e). (4 Marks)

(Total 25 Marks)

Question No. 4

1. What are the two types of sorting methods? (2 Marks)

2. What is the main difference between the two methods mentioned above? (4 Marks)

3. Sort the following list of unsorted numbers using Quick sort algorithm by showing each step clearly. Assume the pivot value (node) is always the one on the left-hand side of the list.

   Circle all pivot values (nodes) and underline all numbers that have been changed to place in their correct respective positions.

44	75	23	43	55	12	64	77	33

(15 Marks)

4. Mention two types of Recursions. (4 Marks)

(Total 25 Marks)

Question No. 5

1. Use the following node definition to answer the below questions.

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

(a) What are the data structures you can implement using the above **node** definition? (4 Marks)

(b) What type of implementation method can be used in data structures mentioned in part (a) of this question? (2 Marks)

(c) Declare a variable named **'Lnode'** using the above definition. (3 Marks)

(d) Write a function named **'getnode'** to allocate memory dynamically to a new node. (You can use above structure definition and variable declaration in your function).

(6 Marks)

2. State three Algorithm design methods.

(3 Marks)

3. Construct the Binary trees of following mathematical expressions.
   (a) A + B * C (2 Marks)
   (b) (A + B) * C (2 Marks)
   (c) (A + B) $ ((X + Y) * Z) (3 Marks)

(Total 25 Marks)

Question No. 6

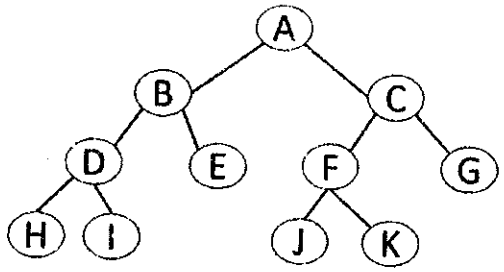
1. Explain what is known as a "***Binary Search Tree (BST)***"?

(2 marks)

2. List down three (03) traversal methods of trees.

(3 marks)

3. Use the below tree structure and write down the three traversal methods.



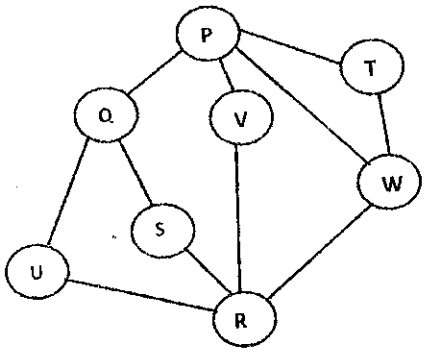
(9 marks)

4. Draw the **binary search tree** that is created when the following numbers are inserted into the tree in the given order.

10	15	3	30	21	42	12

(5 marks)

5. Write down the order of the vertices if visited in **"Depth First"** and **"Breadth First"** traversals in the graph below. Select 'A' as the starting vertex and state the two methods clearly.



(6 Marks)

(Total 25 marks)

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