00364

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	**: CSU 3302 - Data Structures and Algorithms**
Academic Year	**: 2020/2021**
Date	**: 22.03.2022**
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 **(06)** questions in **(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. Involvement in any activity that is considered as an exam offense will lead to punishment
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script

Question No. 01

A) i) What is ADT (Abstract Data Type)?

ii) What are the two basic requirements you should consider, when selecting a suitable data structure?

(4 Marks)

B) i) What do you mean by an Algorithm?

ii) What are the two main factors that should consider when analyzing an Algorithm?

iii) Asymptotic Analysis evaluates the performance of an Algorithm in terms of input size. It commonly uses three notations. Name those three notations with the names used to measure the running time.

(Hint: consider the search problem -search a given item in a sorted array)

(7 Marks)

C) A **Circular Linked List** is just a Singly Linked List in which the link field of the last node contains the address of the first node of the list. A Circular List does not have a natural first or last node and it has to be done separately.

i) Create a Data structure to implement a **Circular Linked List**. The structure should contain a variable to store the **next position** of the Circular List as well as a variable to store information of type **char** in the list. Declare a list with the name '**CircList**'.

ii) Write a function to get a new node by allocating memory dynamically. Use **CircList getnode()** as the function header.

iii) Write a function to inset a new element at the beginning of an existing Circular List. Use **CircList insetfirst (char name)** as the function header.

(10 Marks)

D) What will be the output of the following functions if we pass "6" as the value for n.

i)
```
int sum (int n)
{
        if (n != 0 )
                return n + sum (n-1);
        else
                return n;
}
```

ii)
```
int fact (int n)
{
        if (n <= 1)
                return 1;
        else
                return n * fact (n - 1);
}
```

(4 Marks)

Question No. 02

A) Describe the unique features of a list.

(3 Marks)

B) **STACK** is an Abstract Data Type which can be implemented using arrays or pointers. Consider the following code segment in C language, which is written to implement STACK.

```
#define STACKSIZE 100

struct MyStack

{

    int top;

    int items[STACKSIZE];

};
```

i) Identify the implementation method.

ii) Declare a STACK with the name '**NewStack**'.

iii) Write functions in C language to perform the following tasks.

a) Insert an element to the stack you declared as '**NewStack**'. Use **void PushElement (int x)** as the function header. Before insert an element you should check whether the Stack is full or not.

b) Delete the top element of Stack. Use **void DelTop()** as the function header. Before delete you should check whether the Stack is empty or not.

(14 Marks)

C) i) Explain how LIFO Data structure differs from FIFO Data structure.

ii) Give an example for each Data structure mentioned above.

(6 Marks)

D) What are the two basic operations of Queue data structure?

(2 Marks)

Question No. 3

A) Define the following terms.

i) Binary tree

ii) Strictly Binary tree

iii) Binary search tree (Ordered Binary tree)

(6 Marks)

B) i) Construct a Binary Search tree for the following set of integers.

65	20	80	10	50	7	68	55	17	70	22	92	80	8	69

iii) Is the tree you previously constructed a complete binary tree or not?

iv) Tree traversal refers to the process of visiting each node in a tree data structure, exactly once in a systematic way. What will be the output when traversing the above constructed binary search tree in the following orders?

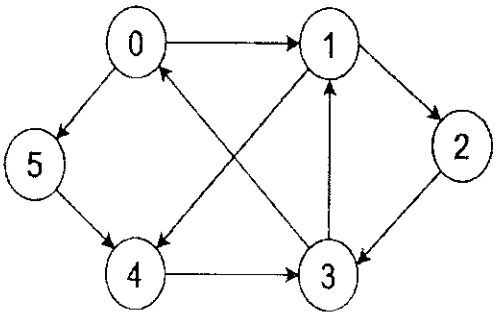
a) Pre-order

b) In-order

c) Post-order

(14 Marks)

C) Is the following di-graph is strongly connected? Give the reasons for your answer?



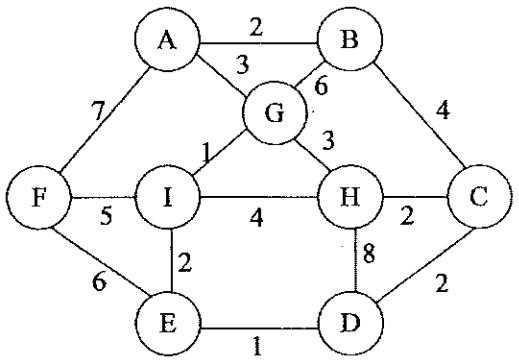
(2 Marks)

D) There are many different methods to design algorithms. Mention three methods used to design an algorithm.

(3 Marks)

Question No. 04

A) Consider the following graph to answer the questions below.



i) Write down the V, vertices and E, edges in the graph
ii) Represent the above graph as an adjacency matrix
iii) Write the order of the vertices visited as '**Depth first traversal**' and '**Breadth first traversal**' of the graph given above, starting from vertex A.

(13 Marks)

B) Explain the following terms with regard to a graph
   a) Directed graph
   b) In-degree of a vertex
   c) Connected graph

(6 Marks)

C) What are the two sorting methods? Briefly explain them.

(6 Marks)

Question No. 05

A) Write down the steps clearly that you used to sort the following set of numbers using the selection sort algorithm.

12	**24**	**6**	**56**	**32**	**19**	**45**	**63**

(6 Marks)

B) i) What do you mean by a heap?
ii) There are two types of heap structures. Briefly explain those two.
iii) Construct a heap from the array given below and convert it into a max heap.

(12 Marks)

81	89	9	11	14	76	54	22

C) Consider the steps of running times O(f(n)) and O(g(n)), where

$f(n) = n^4$ if n is even
$= n^2$ if n is odd

$G(n) = n^2$ if n is even
$= n^3$ if n is odd

Consider that f(n) and g(n) placed sequentially. Calculate the time complexity for both odd and even n separately.

(2 Marks)

D) Circular queue can be thought as an array in a circle, where the first position (Front) follows the last (Rear). Following are two conditions that use with the circular queues. What are the conditions you check with these conditions?

i) Rear = (Rear + 1) % Maxsize
ii) Front = Rear

(2 Marks)

E) Write the three types of internal sorting algorithms?

(3 Marks)

Question No. 06

A) Convert the following infix expression to postfix expression. Clearly show the steps required for conversion.

((A – (B + C)) * D) / (E + F)

(5 Marks)

B) Following is a function in C Programming language for some operation.

```
void func_name (int item)
{
        nodeptr *ptr;
        ptr = getnode();
        ptr -> info = item;
        if (head == NULL)
        {
                ptr -> prev = ptr -> next = NULL;
```

```
            head = tail = ptr;
        }
        else
        {
            ptr -> prev = NULL;
            ptr -> next = head;
            head -> prev = ptrr;
            head = ptr;
        }
}
```

By analyzing the above function, answer the following questions.

i) What is the data structure that this function belongs to?

ii) What type of implementation method is used to create the above data structure?

iii) What type of operation can perform using the above function?

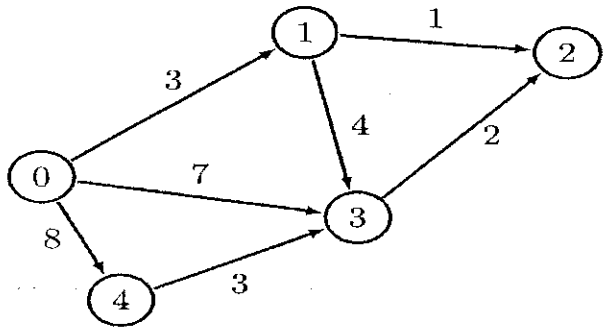
(7 Marks)

C) Sort the following numbers using the Radix sort method. Use both two types – LSD Radix sort and MSD Radix sort.

379	**229**	**293**	**83**	**329**	**457**	**62**	**739**	**258**	**223**

(6 Marks)

D) Given below is a weighted directed graph



i) Write an adjacency list representation of the above graph.

ii) Write all the possible paths from vertex 0 to vertex 2 and find the shortest path.

(7 Marks)