

International Islamic University Chittagong

Department of Computer Science and Engineering

B. Sc. in CSE

Final Examination, Spring 2022

Course Code: CSE 2321

Course Title: Data Structures

Time: 2 Hours 30 Minutes

Total Marks: 50

[Answer all the following questions. Figures in the right hand margin indicate full marks. Use a Separate answer script for Group-A and Group-B.]

Group A

1. a) Let N be an integer and suppose G(N) is recursively defined by
- $$G(N) = \begin{cases} 3 * N & \text{if } N < 5 \\ 2 * G(N - 5) + X & \text{otherwise} \end{cases}$$
- i) Find the base criteria of G.
ii) Find G(2), G(8) and G(24).
[Here X is the last digit of your ID. For example, if ID is C191085, X will be 5].
- b) Consider the following *circular queue* where Queue is allocated six memory cells:
FRONT=2, REAR=5 QUEUE: _ , _ U, C, S, _
Illustrate the Queue, including **FRONT** and **REAR**, as the following sequences take place:
i) E is added iii) U, V, A are added
ii) Two items are deleted iv) Three items are deleted
- c) Write a procedure to insert an element into a circular queue and delete an element from a circular queue.

Or

Tower of Hanoi consists of three pegs or towers with n disks placed one over the other. The objective of the puzzle is to move the stack to another peg following these simple rules. Only one disk can be moved at a time. No disk can be placed on top of the smaller disk.

How many moves does it take to solve the Tower of Hanoi for 5 disks?

2. a) What is linked list? What are the advantages and disadvantages of linked list over the linear array.
- b) What is two way linked list? Form a two way linked list from the following one way list.
- | | | | | | | | | | | | | |
|-------|---|---|----|-----|---|---|-----|----|-----|-----|----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| INFO: | | | 41 | 129 | | 9 | 123 | 78 | 194 | 231 | 62 | 145 |
| LINK: | 2 | 5 | 11 | 12 | 0 | 3 | 4 | 7 | 10 | 0 | 8 | 9 |
- START : 6 AVAIL : 1
- c) Complete a procedure to store an array into a two ways link list.

Or

Let LIST be a linked list in memory. Each node of the list has a single character value. Write an algorithm to print all 'A' character in the LIST.

Group B

3. a) Illustrate the hash function.
- b) Research the following algorithms to compare their complexity:
- Linear Search Algorithm
 - Bubble Sort Algorithm
 - Binary Search Algorithm
 - Insertion Sort Algorithm
 - Selection Sort Algorithm
- c) Suppose the following characters are stored in an array A:
B, A, N, G, L, A, D, E, S, H
Apply *selection sort* algorithm to sort the array A and show each pass separately.

Or

Suppose the following characters are stored in an array A:

D, A, T, A, S, T, R, U, C, T, U, R, E, S

CLO3 C2 4

Apply **insertion sort** algorithm to sort the array A and show each pass separately.

4. a) Analyze the differences between Binary tree and Complete binary tree with figure. Construct an **expression tree T** for the following arithmetic expression: CLO1 C2 5

$(A + B * C) + ((D / E - F) * G)$

Traverse the tree T in **preorder, postorder and inorder**.

- b) Explain which data structure is most efficient to find the **top 10 largest items** out of **1 million items** stored in file? Why? CLO4 C4 1

i) Min heap ii) Max heap iii) BST iv) Sorted array

- c) What is a **binary search tree**? Suppose the following eight numbers are inserted in order into an empty binary search tree. CLO1 C2 4

49, 42, 19, 62, 37, 79, 44, 8

i) Draw the tree T.

ii) Find the inorder traversal of T.

Or

What do you mean by **max heap**? Build a max heap from the following list of numbers (Show each step): CLO1 C2 4

33, 29, 49, 21, 57, 62, 73, 54

5. a) Define **graph**? Draw a picture of the directed graph specified below: CLO1 C2 3

$G = (V, E)$

$V(G) = \{1, 2, 3, 4, 5, 6\}$

$E(G) = \{(1,2), (2,3), (3,4), (5,1), (5,6), (2,6), (1,6), (4,6), (2,4)\}$

Obtain the following for the above graph:

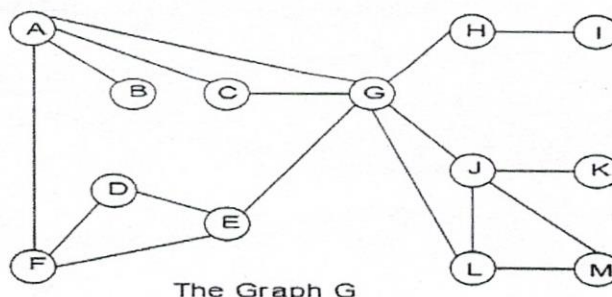
i) Find the **adjacency matrix A** of the graph G.

ii) Find the **adjacency list** of the graph G.

- b) For a set of vertexes V with n elements, how many possible edges there? CLO2 C2 2

- c) Give a comparison between **breadth first search** and **depth first search**. CLO1 C4 1

- d) Traverse the graph G shown below in **breadth first order, depth first order** and construct the **breadth first and depth first spanning trees**. Start from node C [if last digit of your ID is **odd**] / J [if last digit of your ID is **even**]. CLO1 C2 4



Or

Analyze the following graph G to

CO3 C4 4

i. Evaluate the adjacency matrix A of Graph G.

ii. Evaluate the path matrix P of Graph G.

